State of Roads

Public Works as Research, India circa 1960

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Submitted to the Department of Architecture,
in Partial Fulfillment of the requirements
for the Degree of Master of Science in Architecture Studies
at the
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Abstract

That the road is a symbol of the prowess of the nation-state seems tautological, a unified phenomenon of political symbolism that manifests as an infrastructural network. When subjected to a close historical examination, the texture of this tautology begins to disintegrate; the road emerges as a nuanced geographical object created by the state. On one hand, the newly independent India of 1947 attempted to presence itself within its jurisdiction through the road, laying administrative claim to any territory that it could pave. On the other, the state, through the road, had to contend with the topography of its land, its ancient and tenuous geological formations, the stretching and creeping of its mountains, and other vagaries of nature. This had to be done within the framework of a nation violently birthed from two hundred years of colonial rule, its limited economic resources, cement shortages, lack of technical expertise, and contingencies of available infrastructural networks.

The state's attempt at being modern, doing modernity, emerged in the details of road making. In the 1960s research projects investigating rigid and flexible pavements were funded, street-paint and signage was experimented with, traffic studies and parking geometry was produced, and new mixes of concrete were developed; the state's modernity manifested as a central research institute whose task it was to rationalize existing knowledge, and produce new knowledge about roads and road building. The studies, reports, and handbooks produced by their research institutes represent the state's desired discourse of rational modernity. Yet, in reading this material against the grain, reading it textually, a counter discourse of the difficulty of deploying modernity in a country like India. I argue that the road can be read as an archive, a repository of 1960s India's governmental desire.

+ Acknowledgements

I would like to express my appreciation for my advisor, Arindam Dutta, whose work has inspired this thesis and helped situate it in a discursive frame much larger than what this small project was. I also want to express my appreciation for Mark Jarzombek and Ijlal Muzaffar, their critical feedback has strengthened its premise, pointing it in a direction that I hope to pursue as I move on to larger projects. Conversations and classes with them have been invaluable and I really appreciate the attention read that they have given this project.

I would also like to thank all the people who helped me out in my research, MISTI, India for funding my travel, the librarian at the CRRI, Delhi, Dr. Ashok Kumar, DG D.P. Gupta, who spoke with me at length about the history of legislation regarding roads, Pema Wangchuk Dorji, editor of Sikkim Now! who's generosity with his newspaper's material and conversations about Sikkim have helped me contextualize my work. Conversations with Awadhendra Sharan at Sarai, Gopal Pradhan from Siachen, and Mr. Chopra, engineer at the MMRDA, who built border roads in Arunachal Pradesh, have all been invaluable in helping me understand the intellectual and political landscape of infrastructure in India.

I want to thank my friends at KRVIA, without whom none of this would have been possible, Kausik, Rohan, and Prasad. I am very grateful to my colleagues, whose conversations about my work have helped me clarify and remake my arguments, Catherine, Nori, Nida, Haseeb, and Alia (who also travelled with me, keeping me sane in the North East), and finally, my family, my father, who drove me across the country before I knew what that meant, in every car that the market made, my sister, who battled Indian bureaucracy so that I could get photocopies from recalcitrant archives, the other one, whose struggle with ridiculous exams reminded me of how far I had come, and most of all my mother who, amongst everything else, rushed out to get photographs for my thesis, because I am so far away from what I study, and more than anything, for their constant inter-continental support, they have kept me cheerful through the coldest ice storms.

| Contents

| Introduction | Institutions and the Indian State

Roads are symbols of the prowess of the nation state. The claim seems so obvious that to say that roads are symbols of the nation is almost tautological. If there is anything I learnt from Marx it is that the tautological is precisely the space where ideology conceals a more nuanced relationship. It was this claim that led me to look at roads more closely, and subject them to a closer historical analysis. When subjected to a close historical examination, the texture of the tautology begins to disintegrate and the road emerges as a nuanced geographical object of governmental desire. The relationship between the road and the state is historically constituted one, where both create the other: the state does not make the road, the state and the road re-make each other. It was with this idea that I began to work on this thesis and keeping this premise in mind, approached the material I read. In the following parts I introduce the institutional framework within which roads were built and the discursive framework within which this thesis is set.

+ Administering Roads in the 20th Century

The institutional framework through which roads have been conceptualized and administered in India did not suffer a radical break with the stroke of midnight in 1947. Conversely, the story of roads is the story of a slow accretion of administrative control over territory that the roads enter into and go through. The slow acquisition of administrative power through the taking of responsibility to develop a set of roads also meant that road development occurred in a piecemeal and fragmented fashion. The story of centrally administered roads can be begun with the point of legislative intervention into an already functional network. Although roads like the Grand Trunk

Road had existed beyond precisely known beginnings (since time immemorial), this slice of history starts when the British Government of India decided to take charge of the development of roads in the country. In lieu of criticism levied against the British that too much attention had been paid to the rail network at the expense of the road networks, the Jayakar Committee of 1927 was formed. The committee recommended two things, the creation of a 'Road Fund,' and that National Highways be identified and placed under the charge of the central government who would then take up the responsibility of developing them.[1] Regardless of the material ramifications of the committee, an institutional terrain was being laid out that would have a direct result in how roads were legislated for in post-independent India.

In 1934, as a direct result of the Jayakar Committee report, seventy three chief engineers gathered together to discuss the formulation of standards for planning, design, construction and maintenance. This semi-official technical body then came to be known as the Indian Roads Congress (IRC)[2]. These standards are till date followed by all states, (although there are some deviations and exceptions.) The IRC, formulated of representatives from each state, members from the private sector, with the minister of the Shipping and Road Transport at its helm it set the long term

1. Consequently, in 1929 the Central Road Fund was created through a levy on petrol at the rate of 2 annas a gallon (2 annas a gallon is equivalent to 6.25 paise a liter of petrol). In 1931 this tax was raised to 2.5 annas a gallon (at the rate of 10 annas a gallon of petrol this tax amounted to a tax of 25%) and from the March of 1931 up until the March of 1998, across different regimes, different governments, petrol price hikes and increasing consumption quantities, the levy on a gallon of petrol remained 2.5 annas in absolute terms. As of 1998, while the central government earned 25 crores from this fund, their expenses on road development were in the region of 10,000 crores. This asymmetry between income and expenditure was to drastically shift in 1998, it was balanced by the decision to tax diesel, but that I tackle this in the conclusion of this thesis. What is of import is that it was always petrol, the luxury fuel for cars, not diesel, the more ubiquitous fuel, used by busses, trucks, and also in gas stoves, generators and in rural houses, that was taxed.

2. Engineers from the ETH Zurich were part of this conference and went on to have a long relationship with the Indian State. The first director of the 1954 created Central Road Research Institute was Dr. E. Zipkes of the ETH.

goals for road research and development for the state. The more specific 20 year plans however, happened through the Nagpur Road Congress of 1943, the Bombay Road Congress of 1961, and the Lucknow Road Congress of 1984.

The Nagpur Plan, one of the country's central documents, defined the different kinds of roads, National Highways, Provincial (or State) Highways, District Roads (major roads and other roads), and Village Roads.[3] This plan can be seen as a lexical exercise that defined roads, their sizes, and laid out am administrative framework for them that still forms the base for the categories of roads and their jurisdiction today. The term 'National Highway' has less to do with the physical and geographical specificity of the road and more to do with the administration of the road. It is this administrative framework that I attempt to untangle in this thesis looking for the modernity that was hidden within the process of re-appropriation and accretion through which the Indian state worked.

+ Modernity and the Post Colonial Indian Polity

Movement and speed were fundamental to the theorizing of the experience of the modern subject, and in turn, the design of the parkway. Gideon, in his magisterial work, "Space, Time and Architecture"[4] assigns a special place to the experience of movement on the parkway. He says,

> "The engineer has been nearer to the spirit of the age than the town planner who has been too frequently concerned with the reorganization of the body of the city itself. The American parkways as they developed in the early nineteen twenties and thirties -....- revealed in their whole treatment the fact that they were one of the elements of the contemporary town, one of those born out of our vision of the period."

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3. Post-War Road Development in India; Proceedings of The Conference of Chief Engineers of Provinces and States, Held at Nagpur from the 15th to 18th December, 1943

4. Giedion, Siegfried. 1967. Space, Time and Architecture: The Growth of a New Tradition, Fifth Revised and Enlarged Edition. 5th ed. Harvard University Press, January 1.

The parkway for Gideon (as he redefines it), is the symbol of everything modern, its separation of the pedestrian from traffic, restored the rights of them both and harmonized their functions.

> "Out of this separation came the fundamental law of the parkway -- that there must be unobstructed freedom of movement, a flow of traffic maintained evenly at all points without interruption or interference."

Gideon defines the road through the experience of driving on it and places this experience as the fundamental tenet of modernity. He explains why the parkway was different from all roads that preceded it,

> "The road was laid into the countryside, grooved into it between gentle green slopes blending so naturally into the contiguous land that the eye cannot distinguish between what is nature and what is the contribution of the landscape architect."

In my thesis I attempt to background the experience of being modern that emerged in the cannon of architectural theory to foreground instead clunky, anxious, and experimental way in which modern subjectivity was crafted through the careful crafting of the road in India. On one hand, the newly independent India of 1947 attempted to presence itself within its jurisdiction through the road, laying administrative claim to any territory that it could pave. In my thesis I attempt to look at this process of using infrastructure as a mechanism of presencing the state and making its fringes legible.

On the other, the state, through the road, had to contend with the topography of its land, its ancient and tenuous geological formations, the stretching and creeping of its mountains, and other vagaries of nature that it had both, no precise knowledge of and no control over. This had to be done within the framework of a nation violently birthed from two hundred years of colonial rule. The post colonial nation state formed itself through a negotiation with its geography mediated by its limited economic and technical resources and mandate towards self sufficiency. In this

thesis I look at the production of research through an appendage of the state that can then reveal the state itself.

India's claim to being modern, and the emerging Indian modern subjectivity, I argue can be traced in, or are rather formed by, the experiments that the state engaged in, in the building of infrastructure.

| Roads

The Border Roads Organisation

The town of Siliguri on the Mahananda river is all about traveling on National Highway 31 (NH31). On the long strip of road called Hill Cart, you will find transport terminals for buses both public and private, whiskey shops, lunch homes for drivers, share taxis, private taxis and many more forms of transport and their accoutrements, whose owners will battle over the privilege of housing you or taking you out of West Bengal and into the North East at 'fixed rates.' Surprisingly, one taxi-stand on this transport axis even caters to exactly my demographic - young female students going up to Darjeeling or Gangtok or the Sikim Maniphal Institute of Technology, who are loathe to take the bus.

This abundance of options emerges in part, from Siliguri's odd geographical location, which brings it to the fore of transport activity. It is the point in the metaphorical hour-glass where the border roads organization takes over from the Public Works Department and NH31 funnels through the chicken neck of India (fig 1) into the North East. It is the point where the distance between the international boundaries of India, at Nepal to the North and Bangladesh to the South, are a mere 24 kilometers apart. The Siliguri corridor connects the rhomboidal shape of the country with its land-locked North East. This political and territorial isthmus of land was created in 1947 when East Pakistan was carved out of the sub-continent by British cartographers demarcating territory based on population concentration.[5] This sliver of territory, regardless of its demogra-

5. It was from the British empire's project of drawing boundaries, making maps, and demarcating territory, that the North East had emerged as a landlocked vestige, an accretion of territory produced over time through a prolonged process of war and treaty making. It was the remaining territory after Nepal was demarcated through the Treaty of

phy, was given to India to provide it road access to the North East, consequently, all traffic moving between the North East and the rest of the country must move through here either by the National Highway 31 or by a broad gauge and metre gauge railway line. Siliguri's provision of road access dissembles its other essential function: the maintenance of territorial contiguity of the nation-state.

Road infrastructure functions through dissemblance, concealed in the materiality of the road, is another function, one that is not so obvious, a claim to territory, a strategic alliance, a normalizing function. Consequently, the road operates as a site for the occurrence of many simultaneous meanings. The material connectivity provided by the road is operationalised to alter the geography in different ways: all roads are not the same, different roads do different things.

The Border Roads Organization (BRO), a military- engineering body, was created by Prime Minister Pandit Jawaharlal Nehru in 1960 to build roads to take armies to the vulnerable Sino-Indian borders. Since then, over the past five decades, the BRO has functioned in many avatars of road building. Not only has this organization performed a territorial function, building roads to help armies reach borders, it has also built roads across international borders into Bhutan and Myanmar and in a wholly different register of responses to regional tensions that threatened India's position in the global geo-political arena becoming a tool of strategic alliance making. Most recently, the BRO has built roads in the dense forest areas of central India, in areas where the country has faced internal militancy problems. Here the road becomes a tool of creating legibility.

Sugauli in1816, and Bhutan through the Treaty of Sinchula in 1865. Myanmar was designated as a separately administered colony in 1937, and finally East Pakistan, was cut out beneath the region 1947.

Each extension of the state via infrastructure, into illegible territory, each attempt at connecting, providing access to, and thereby, transforming a region into national territory, occurred as different iterations of national concerns dissembled as infrastructural responses: a technological solution to a political problem.

The act of dissemblance was central to the formation of the institution. The BRO as, says their own propaganda,

> "[was a] unique... force... conceived as an unarmed civilian Organisation, but uniformly modelled and trained on a military pattern and manned by a healthy mix of officers and men from the [General Reserve Engineering Force] GREF, as the permanent establishment and from the Army deputation."[6]

Initiated by the Prime Minister after China entered the Aksai Chin region at the Ladakh border of Jammu and Kashmir(fig 2), the creation of the BRO was a direct manifestation of Prime Minister Nehru's acknowledgement of the official Chinese position on India's inherited borders: China would, and still does, lay claim to certain territories that it believed were lost in unjust British imperial wars. On one hand, Nehru's creation of a road building organisation in lieu of Chinese incursions, points to the overlap between infrastructure and territoriality. On the other hand, in the institution of the BRO itself is a dissembling of its form and function: it is staffed by military personnel and it acts as an appendage to the Ministry of Defence, yet in a conscious attempt at obfuscating India's official military expenses, it is funded by the Ministry of Surface Transport. This rather blatant dissembling opens a schism through which we can think of infrastructure's allegorical nature. The material road is decoupled from both the meaning and function it actually performs. Infrastructure, the underlying framework, the invisible non-object that allows for every-

6. Suri, P, The Border Roads Organisation: A Perspective, Indian Highways June 2003

thing else to function, is then malleable in meaning. It becomes a site that can be manifest several meanings.

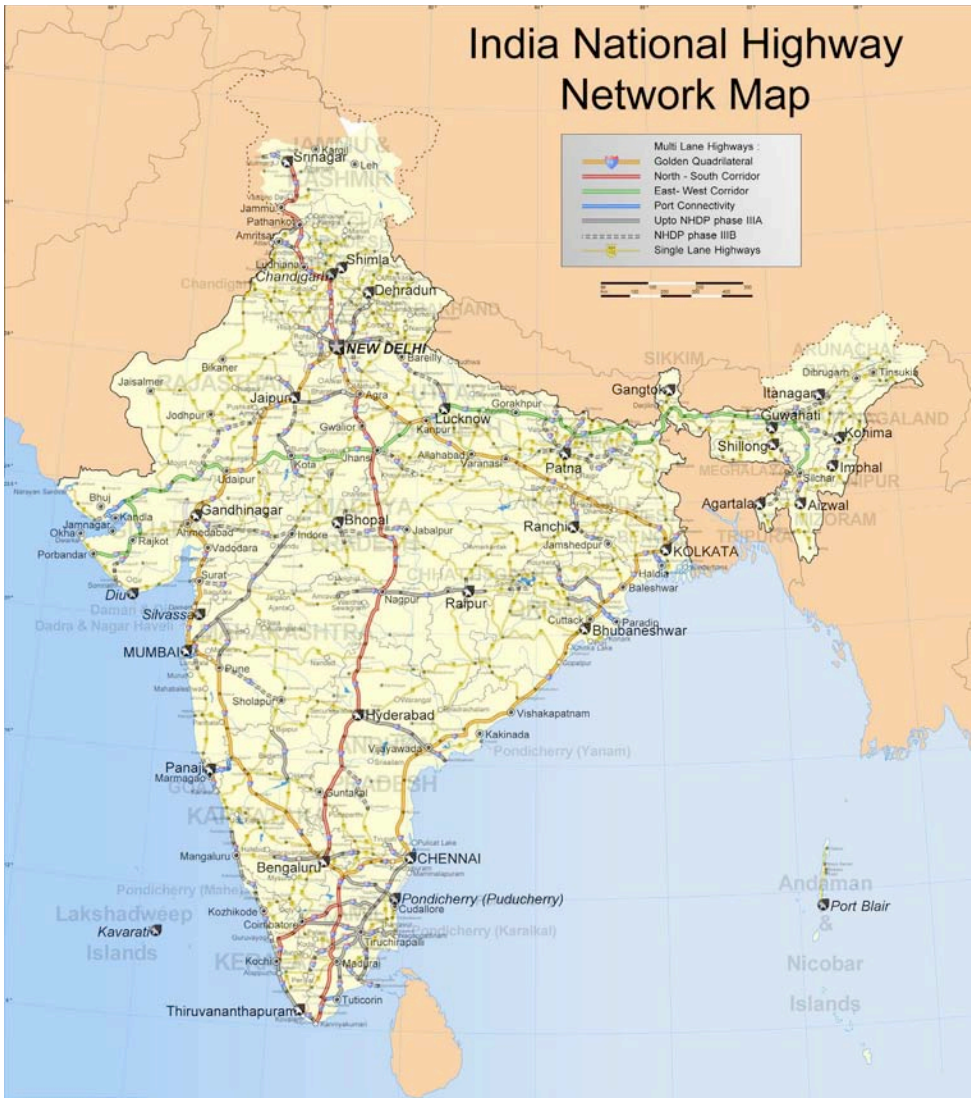

Figure 1: Map of India from the National Highways Authority of India showing the Siliguri Corridor and landlocked North East

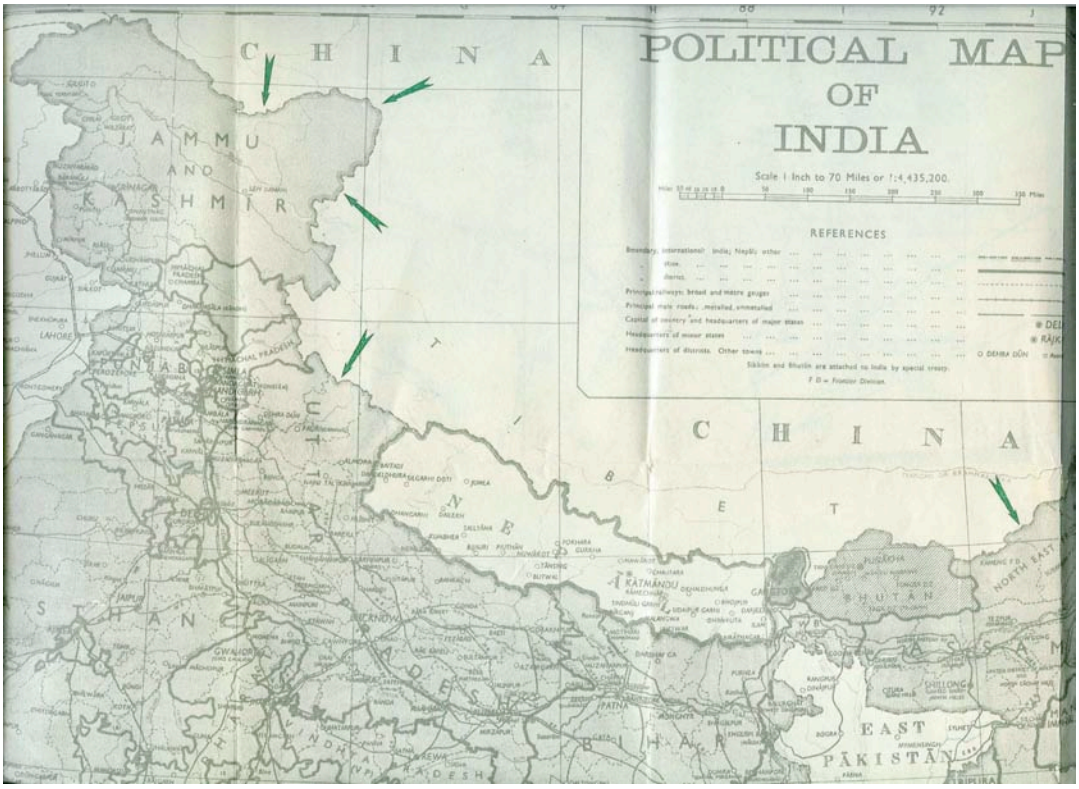

Figure 2: The vulnerable points on the Indian Border on a 1950s map drawn before the Chinese aggression

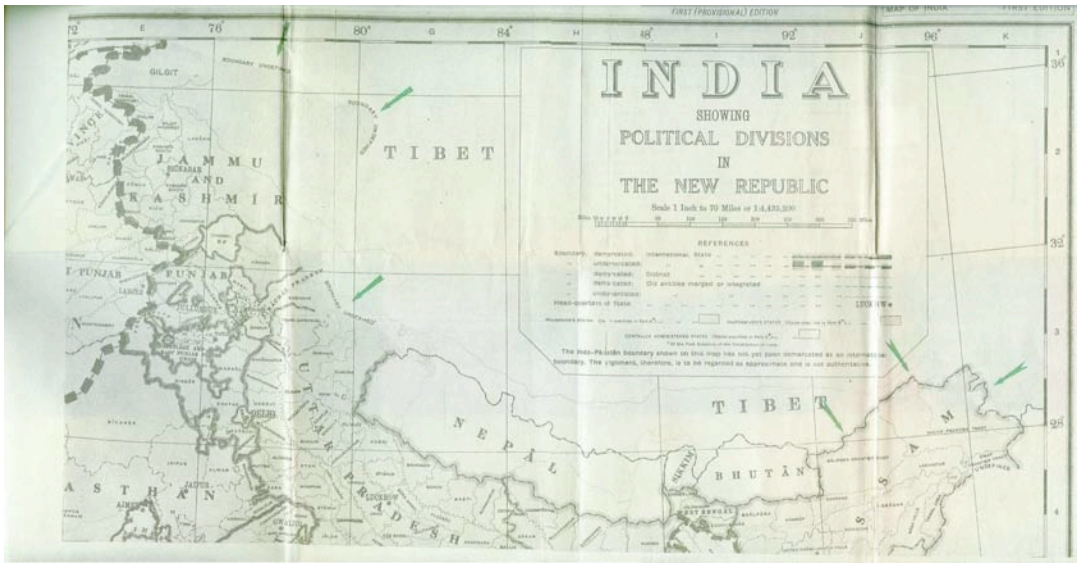

Figure 3: The same map drawn after the aggression with the Aksai Chin region of Ladakh re-drawn as disputed.

Territorial Roads

In its first iteration, the task of the BRO was to provide infrastructural access to take armies and military paraphernalia to vulnerable borders where the lack of them meant that India would not be able to protect its territory against Chinese incursions. The question here is, why were these borders between the Indian subcontinent and her centuries old neighbors suddenly problematic, and the question that follows is what role did infrastructure play in the negotiation of this edge?

Along the northern edge of this region (the North East), is the McMahon Line (fig. 6), a line that was part of the palimpsest of border conditions that had emerged over the past two hundred years of strategic alliances and treaty making. (Fig 4 & 5), drawn at the Simla Conference of 1914, in a meeting between Britain and Tibet. China countered this line arguing that Tibet's ability to decide the location of a boundary is invalid as a region that was not an autonomous one, had no right to make decisions regarding its boundaries.[7] It was in China's rejection of 'imperialist treaties' and India's acceptance of them, both acts being claims to the territory around the McMahon Line, that India began building roads in its North East.

Dissembled by the rhetoric of connectivity and security, the BRO performed another very crucial function. Within the first two decades of independence, the administratively homogenous North East disintegrated internally into a number of states based on ethnic and linguistic groupings.[8] The complete reconfiguration occurred through a process of the turmoil of identity

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7. p.25 2004. The India-China Relationship: What the United States Needs to Know. New York: Columbia University Press. Ed. Francine Frankel and Harry Harding

8. The reconstitution of what the Union of India now thinks of as the North East occurred in the following way.

politics that led to secessionist movements, violent militant insurgencies and finally, repressive counter insurgencies. It was in this quickly disintegrating fabric, on which India had an increasingly tenuous grasp, that the BRO had taken on innocuous sounding projects described as such,

> 'Project Vartak was raised with the aim of provision and maintenance of vital strategic road communication in Arunachal Pradesh for efficient management of India-China border and socio-economic development of remote areas.'[9]

The innocuousness of the words 'socio-economic development of remote areas' conceals the role played by the BRO in stitching together the fragmented and fractured North East of India forcing it to be 'Indian.'

Along this endless Indo-Chinese border, India was not alone in building roads to lay claim to contested territory. In 1958, the government of India discovered that the Chinese military engineers had constructed a road from China to Tibet that went through the Aksai Chin, a region of Ladakh that according to the earliest border between British India and China, belonged to India. India had always laid claim to this line, and Nehru wrote to Zhou En Lai stating that he had trans-

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Nagaland was, in 1947, known as the Naga Hills Tuensang Area but there was unrest surrounding its status, which in 1957 was administered by the Governor of Assam. In 1961 it was renamed Nagaland in the hope to quell uprisings against the state and given the status of a state in the Indian Union. The North Eastern Frontier Area (NEFA) was never part of Assam, in 1962 it was renamed Arunachal Pradesh, a sanskrit name that was a semantic attempt at appropriating what the Chinese considered as China into India. In 1950 Manipur was granted Part C statehood as a part of Assam, It was governed by a territorial assembly after the 1963 Government of union territories Act and 1972 it achieved full statehood. In 1970 Meghalaya was carved out as an autonomous part of Assam. In 1972 the North Eastern Region Re-Organisation Act was passed and at this point Meghalaya, Manipur and the erstwhile autonomous kingdom of Tripura were named full fledged states. Mizoram and Arunachal Pradesh were named Union Territories. In 1984 Arunachal Pradesh was given the status of statehood and in 1987, Mizoram. (Data gathered from India Yearbook 2008-09, published by the Government of India.)

9. Brig KT Gajria, Border Roads Organisation Connecting People, http://demotemp92.nic.in/writereaddata/2007/english/may01-07/h3.htm

gressed into Indian territory and violated their agreements. Zhou En Lai replied the Aksai Chin, on which the Tibet Xinjiang highway had been built was Chinese territory.[10] (Fig 7)

At this point, India lost territorial hold over the Aksai Chin, the loss had to be dealt with, and maps had to be redrawn (fig 2 & 3 in the previous chapter). It was at this point that through Prime Minister Nehru that Project Beacon was deployed to build, amongst other roads, a road that began at the western side of India at Manali in the state of Himachal Pradesh and ended finally in the region of Ladakh, where the state of Jammu and Kashmir meets the disputed zone of the Aksai Chin between China and India at India's western border.

The battle over the Aksai Chin, a region barren of, vegetation, resources and anything of value to a nation state and also barren of people, therefore historical, cultural, and anthropological markers through which its 'rightful' owner could be identified, was waged through the building of infrastructure: the Tibet-Xinjiang Highway on the Tibetan side and the Ladakh road on the Indian side. -both fabulous engineering feats, and logistical enterprises that in turn dictated the form of road execution agencies. (Fig 8)

Simultaneously, the road allowed the state access into its fringes, gave its armies access to Kashmir and the North East, which is now a militarized zone It allows these illegible regions access to the discursive mechanisms of the state including them in census data, trade circuits, and GDP calculations. The road allowed for the collection of repositories of governmental knowledge.

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10. p.112 Ganguly, Sumit. 2004. in Frankel, Harding ed. The India-China Relationship: What the United States Needs to Know. New York: Columbia University Press.

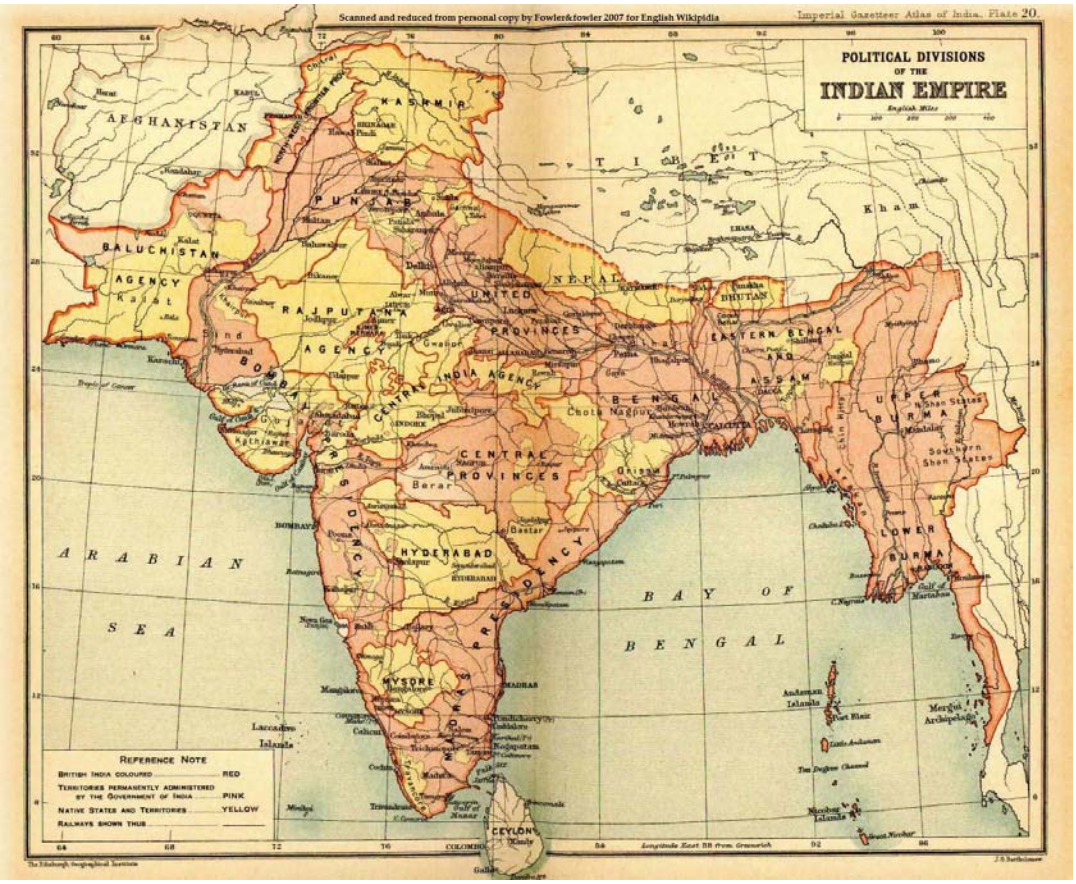

Figure 4 Showing the different relationships of the British with different princely kingdoms in 1909

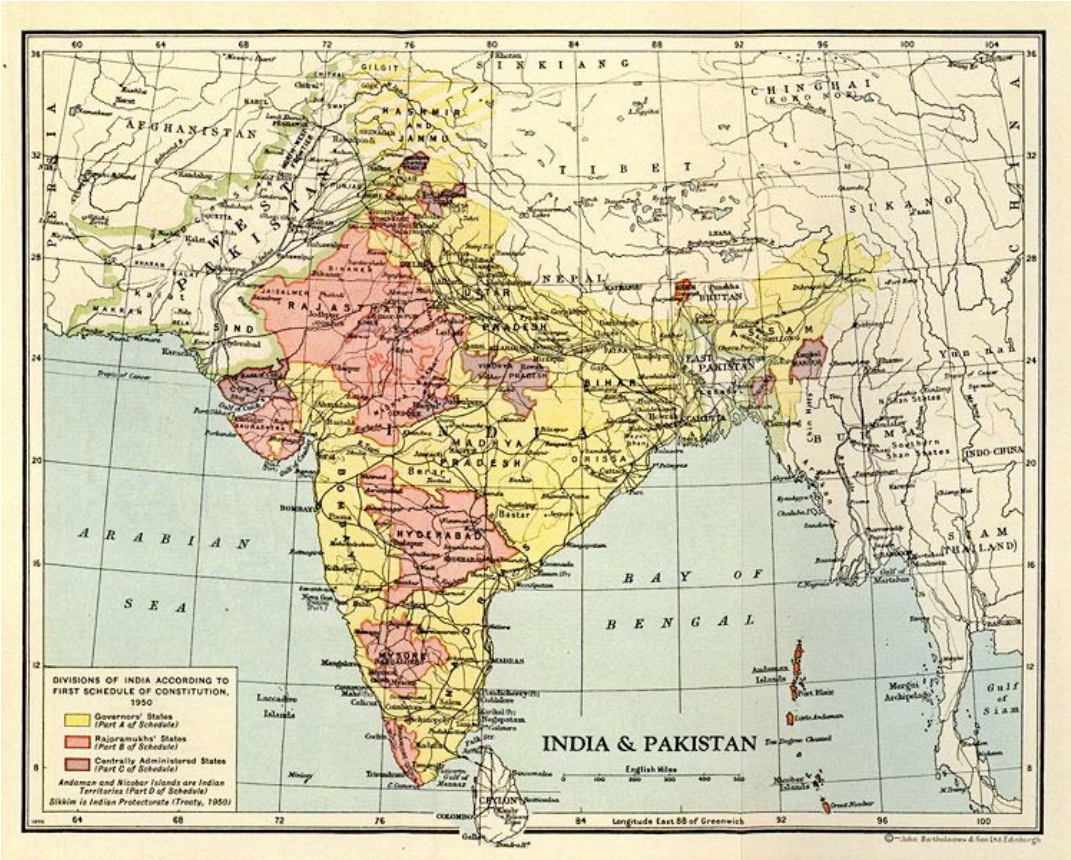

Figure 6: The new divisions of India in 1950

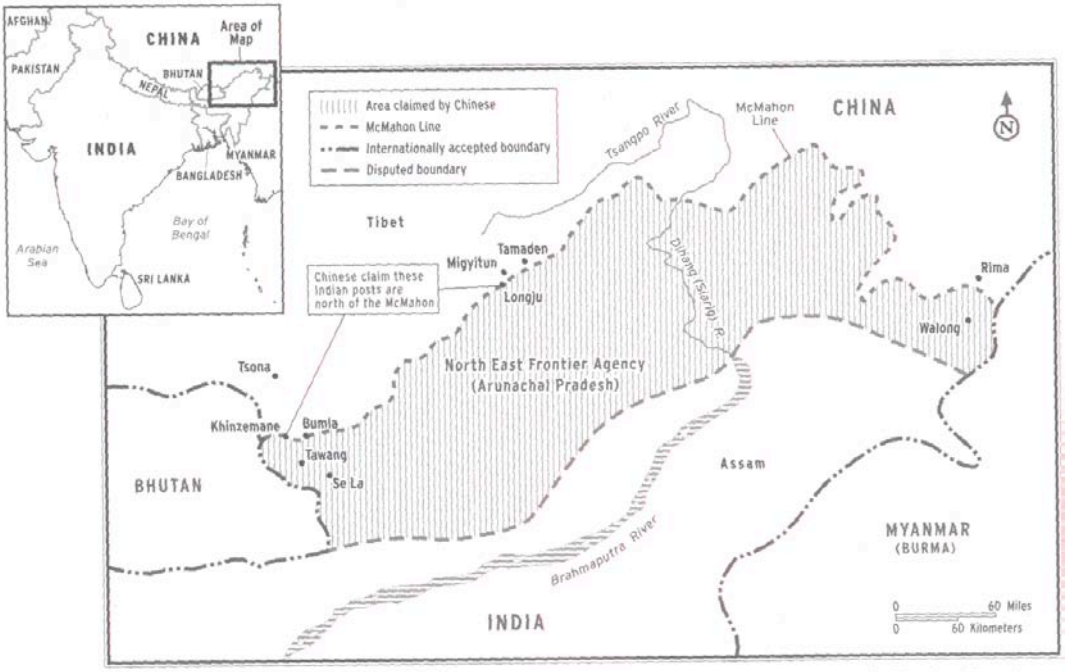

Figure 4.2 *Boundary dispute in the eastern sector, 1959. (From Alastair Lamb,* The China-India Border *[London: Oxford University Press for the Royal Institute of International Affairs, 1964]. Reprinted by permission of the Royal Institute of International Affairs.)*

Figure 6; A Diagram of the McMahon line and the area in the North East laid claim to by the Chinese. 2004. The India-China Relationship: What the United States Needs to Know. New York: Columbia University Press. Ed. Francine Frankel and Harry Harding

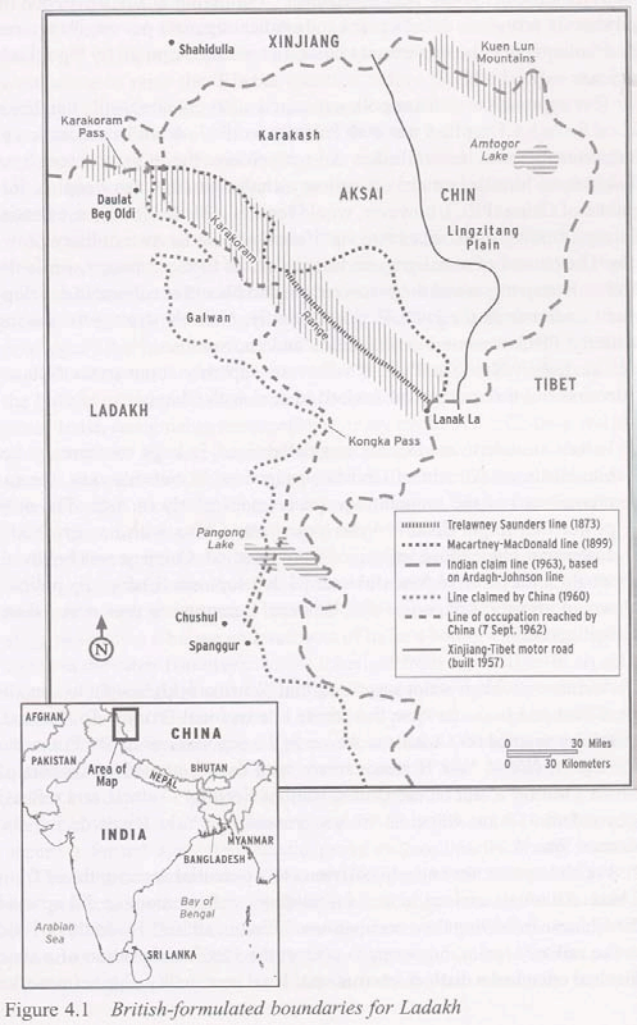

Figure 4.1 *British-formulated boundaries for Ladakh*

Figure 6: Showing the multiple borders at the Aksai Chin region of India and the Tibet Xinjiang Highway running through what India considered Indian territory, 2004. The India-China Relationship: What the United States Needs to Know. New York: Columbia University Press. Ed. Francine Frankel and Harry Harding

Figure 8: An image of the Road to Ladakh

Strategic Roads

In 1962 the Chinese attacked India - a betrayal of agreements of peaceful co-existence by Premiere Zhou En Lai that was reputed to have broken Prime Minister Nerhu's heart. Until then, Nehru's policy with respect to China had been one of conciliation and appeasement, a policy that found its materialization in *Panch Shila*, the five principles of peaceful coexistence,[11] that, for example, in accepting China's sovereignty in Tibet, aimed at strategizing a diplomatic relationship with China within the continent. After the 1962 attack, facing the ridicule of his country, Nehru abandoned "Hindi-Chini bhai bhai" (Indians and Chinese are brothers) and his ideal five principles of peaceful co-existence and taking another tack, began infrastructural projects in an attempt to create strategic alliances within the subcontinent.

The first strategic road that the state embarked on was a road to Bhutan that was funded by largely Indian aid. Bhutan's cultural and trade ties had mainly been with Tibet and the occupation of Tibet by China in 1951-52 cut Tibet-Bhutan trade almost overnight. The King of Bhutan made clear to India the Chinese incursions on Bhutanese territory and the massive military buildup and expansion of roads in Tibet across the Border. As the Economic and Political Weekly , an Indian journal reports in 1971,

> "On the one hand, China is mounting pressure along the entire length of the Tibet-Bhutan border by constructing wide roads, cantonments, military posts and gun positions. There have also been numerous intrusions into Bhutan, if what King Jigme Dorji revealed to Indian journalists during President Gir's visit to Thimphu is true."[12]

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11. 1. Mutual respect for each other's territorial integrity and sovereignty, 2. Mutual non-aggression, 3. Mutual non-interference in each other's internal affairs, 4. Equality and mutual benefit, 5. Peaceful co-existence

12. Anon, Only the Mountains Are Serene Source: Economic and Political Weekly, Vol. 6, No. 1 (Jan. 2, 1971), p. 13

The anecdote here is that Nehru immediately rushed off to Bhutan, which he had to do on a mule, because there was no motorable road from the south into Bhutan, which at that point was one of the most isolated countries in the world. He went through Sikkim and the beautiful Chumbi valley in Tibet, where he met with Bhutan's 28 year old King to whom his recommended solution to the Chinese incursions was that Bhutan modernize. - most likely a sincere recommendation.[13]

Also, a book "published in 1954 by the Foreign Languages Bureau, Peking, maps were included which clearly laid claims to Sikkim, Bhutan and Nepal,"[14] forced Bhutan to recognize its geo-political sensitivity within the subcontinent. In 1959 the Bhutanese government asked the Indian Government to build a road (a task that was given to the BRO) from their isolated capital, Thimphu, to the Indian border, facilitating trade and development. In 1961 the Indian Government sent over a research team that prepared a report based on which a five year plan was drawn up and aid was provided for the building of the road that was delegated to the BRO. Over the next 3 plans, the first two aided completely by the Indian government, the last partially funded by the Bhutanese government, the BRO built and maintained the road between Sikkim and Thimphu.[15] And so infrastructure played out its role in being a strategic object.[16] The building of roads on either side of the border of Bhutan reveals roads to be material iterations of the state's attempt to

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http://www.jstor.org/stable/4381477 Accessed: 06/02/2009 09:33

13. ibid

14. ibid

15. ibid

16. What I cannot figure out is the role of the British built Coronation bridge crossing the river to take you to Bhutan: what territories was that meant to connect? What was the British role there. I do have a fascinating photo of it being built.

hold territorial control over regions and maintain their image of military prowess in the global arena.

The other road that the BRO built across a border was the Tamu - Kalemyo road into Myanmar. In the 1990s aside from being Myanmar's largest export market, India provided assistance to them through the 170km long Indo-Myanmar Friendship Road. The project was inaugurated in 2001 and built in an attempt at reorganizing the hierarchies of power in the region. The political game that India played with Myanmar was very careful in that Myanmar had ties with both of India's political adversaries, Pakistan and China, and to enter into a relationship with Myanmar required careful calculation on the part of the Indian state. What complicated matters more is that Myanmar's oppressive junta is highly unpopular and problematic and the act of entering into material ties with them legitimizes their rule in the country.[17]

17. Rajeshwar, Courting the Burmese Junta, Economic and Political Weekly, Vol. 35, No. 38 (Sep. 16-22, 2000), pp. 3393-3394 http://www.jstor.org/stable/4409743

Building Internal Roads: New Iterations of Security

In its most aggressive avatar the BRO, a military force, was sent in to forcibly insert technology as a solution to, or rather a method of bypassing, an irresolvable political problem. The Black Diamond units of Project Hirak were deployed in the 'red' areas of the country, (Fig 9) the "hard core Naxal belt,"[18] of Maharashtra, Andhra Pradesh, and Chattisgarh. The Naxalites are an underground, rebel, Maoist faction of the communists in India who have mobilized the rural and forest areas in an insurgency against the state.

The BRO's road construction was halted due to militant attacks and the Bombay High Court, taking suo moto (on its own motion) interest in the matter, ordered police protection for the engineers and workers of the BRO building roads in the remote areas of Gadchiroli and Gondia, throwing the weight of the state, by engaging many of its appendages, behind the building of infrastructure. (Fig. 10)

A project that takes on the problem of internal security, explains what roads and infrastructure is capable of doing. The road makes less autonomous the regions that tribals / naxals have taken over and have formed quasi governmental systems in. These systems resist the state's control in territories whose geography is unknown to and unmappable by the state's institutional framework: the police, para-military organizations like the Central Reserve Police Force, and the Assam Rifles. The road is one of the first mechanisms allowing the creation of legibility for the nation state in the forested areas that house tribals.

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18. Brig KT Gajria, Border Roads Organisation Connecting People, http://demotemp92.nic.in/writereaddata/2007/english/may01-07/h3.htm

The question is, how does the road create this legibility? What dissembled function does it serve in this case? Anthropologist Christoph von Furer Haimendorf working on the lives of Tribals around National Highway 17 in Andhra Pradesh, marked the change that the area underwent between the 1950s and 1976, a change that he had predicted with the insertion of the Utnur Asifabad road along NH17 that allowed the influx of trading community migrants from Maharashtra. Access to forest land and the illegal acquisition of tribal land by migrants changed the fabric that Haimendorf encountered upon his revisit. The problem is not so much with a rearranged fabric as much as with the fact that in rearranging, in bringing infrastructure into the region, a fundamental asymmetry was coded into what development meant and for whom it was instituted.

The incessant building of roads reveals infrastructure to be material iterations of the different anxieties of the state. This anxiety plays out in historically, politically, culturally contested terrains making them legible as national. The economy of infrastructure allows disparate territories purchase within the discursive realm of the national. Cutting roads into the mountains becomes then a way of inserting those mountainous fringes into national discourse, and infrastructure becomes the site for that discursive act and the road becomes a repository of governmental knowledge. In the materiality of the road is a dissembling of the political, of the state, and in this way the road becomes an allegory, a sign obfuscated from its meaning, and therefore a powerful tool of the state. The various functions performed by the road are all complicit in the forming of the state, a relationship that is historically constituted.

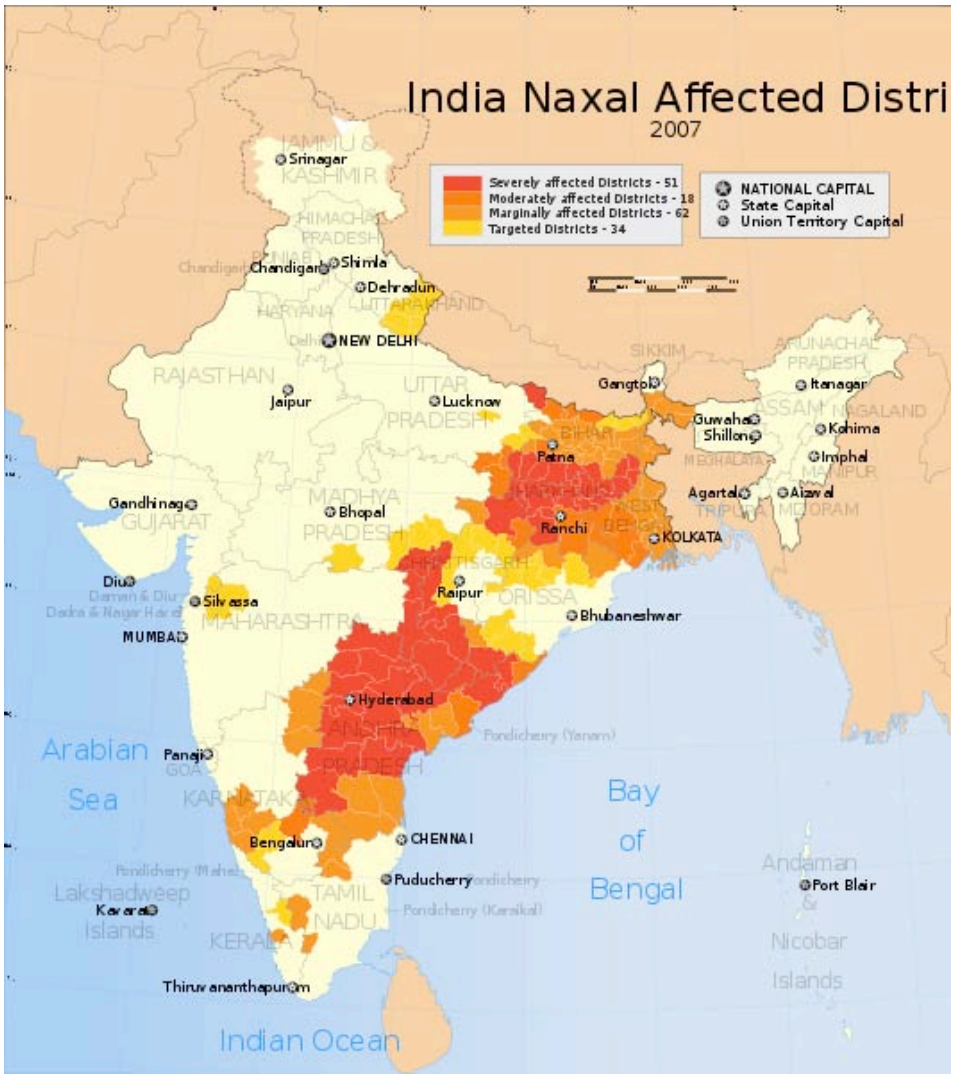

Figure 9: Map showing the Naxal affected areas

Figure 10: Image from the Border Roads Organisation website showing the road at the border of Naxal territory. The sign reads, "We welcome you to the earth / ground of Bastar"

Researching Roads: The Institution of a National Laboratory

In 1952, a young Indian government, acutely cognizant of its shortcomings in the field of scientific and industrial research, budgeted 5 crore 38 lakh (a mere 53 million rupees) for the construction and the purchase of equipment for a Central Road Research Institute (CRRI), an institute that was one of India's eleven national laboratories.[19] These laboratories, built in different cities across India, were started so the state could foster industrial research because at that point in time 'industry depended on foreign techniques and had no research programmes of its own.'[20] The Central Road Research Institute (CRRI), was conceptualized as one of these "national laboratories" by the Industrial Research Planning Committee which felt 'adequate facilities for road research were practically non existent'[21] in the country at that point.

The Industrial Research Planning Committee (IRPC) identified the problems faced by the the transport sector in India with especial reference to roads as follows: firstly, there were not

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19. The **National Chemical Laboratory** at Poona**,** the **National Physical Laboratory** at New Delhi, the **Fuel Research Institute** at Dhanbad, the **Central Glass and Ceramic Research Institute** at, Calcutta, the **Central Food Technological Institute** at Mysore and the **National Metallurgical Laboratory** at Jamshedpur were opened before the end of 1950. Then followed the **Central Drug Research Institute** at Lucknow in January 1951 and the **Central Road Research Institute** at New Delhi in June 1952, the **Central Electro-chemical Research Institute** at Karaikudi and the **Central Leather Research Institute** at Madras, both in January 1953 and the **Central Building Research Institute** at Roorkee in April 1953.

The National Physical Laboratory and the National Chemical Laboratory are concerned with fundamental research in general and the development of the industry as a whole, while the remaining nine laboratories are specialized institutions dealing with the problems of specific industries. The main function of all these institutes is to seek new knowledge in fundamental and applied research.

20. India's National Laboratories, The Publications Division; Ministry Of Information And Broadcasting Government Of India. April 1954.

21. ibid

enough roads; India had only three quarters a mile of road for every thousand people, whereas the UK had 3.6 miles and the United States had 21.[22] Secondly, the methods of road construction were ubiquitous rather than specific and road conditions were poor. Finally, while some 'experimental field work' had been done in different parts of India by different agencies, it remained largely 'uncoordinated.'

Although vague in terms of what it meant by 'road conditions' and 'experimental fieldwork', the challenge to construct a robust and profuse system of roads, as outlined by the IRPC, was laid down in the realm of knowledge; the methods were ubiquitous, instead, specific responses to geographic conditions were needed, experimentation with different techniques needed to be co-ordinated so the nation as a whole could learn. What seemed to be implied in the IRPC's conceptualization of the CRRI was that a centralized system was needed that would consolidate knowledge that was already present and produce new knowledge on roads, thereby creating expertise that could be operationalized for industrial purposes. The IRPC did not conceive of roads as a problem of execution, or, for that matter, as a problem of producing a viable business model (as it would be re-conceived in the 1990s with the National Highways Authority of India[23]). Instead, as a problem of knowing, roads were conceptualized as the rational union of technology and geography; by 'problem of knowing' I mean that theoretical and technical expertise was needed. By 'rational union,' I mean that a scientifically and experimentally verified knowledge was to be applied to

22. This fact should here be read keeping in mind that India also had a lot of people. (reference for future research: Paul Ehrlich The Population Bomb)

23. I tackle the form and purpose of the NHAI in my conclusion.

the various geographies of India, rational in that they could be measured and planned for crisis and contingency: technology would be made to respond to the specificities of the geography.

Concordantly, the road itself, the object of this state's affectionate research, stands an allegory of the state that built it. Any cross-section of road can be read as an archeological slice of soil, stone, asphalt, bitumen, cement, and lime, compressed into a ribbon of materials sourced from across the nation, through national industrial processes that transform them. The nation is a geography of materials, quite literally these materials came from different parts and processes in india. In this way, the section of the road becomes a metonymic representation of the nation-state in itself.

The road means different things, when interpreted through different disciplinary registers. What for the technocrat is a physical means of access and transport drawn on a master plan in the horizontal plane, is to the engineer a section of materials, stresses and strains whose techniques can be deployed anywhere in the country. To the state it is a means of providing legibility and securing territory, as I have argued in chapter 2. Perhaps to the historian, the road is an archive of these discourses that produced it. I argue that if we consider the road as an archive, we can read it to reconstruct the nature of the state that produced it.

The documentation in the annual reports of the CRRI form the site of accretion of experimental ideas that took place on the site along the Delhi-Mathura road.[24] The seemingly prosaic and repetitive terrain of knowledge that emerges in these documents, forms a historical archive that occupies the intersection of the Indian state's attempt at constructing itself as an industrially and

24. The site was donated by the Archbishop of Delhi-Simla, pointing to the extensive penetration into the imagination of the nation that it was everyone's duty to take India forward on the path of industrialization.

technologically competent one, but one without the resources to deploy this knowledge outside the space of the laboratory.

These texts need to be read in the context of their dedication to the two mandates set by the state. Firstly the state wanted to break reliance on foreign technical expertise, producing not only a body of relevant technologies but also a body of technical experts and expertise. Secondly, that these technologies were necessarily required be industrially operative. It was imperative that these new technologies could be manufactured within the infrastructural framework that was already in place in the country. Given these two objectives that existed as the framework within which the CRRI worked, their organization was subdivided into groups that would then work on specific problems. The sections of the annual reports represented these aspirations in a linear 'scale':

1.1	Soils Division	This division studied the detailed micro soil geography onto which the roads were laid.
1.2	Flexible pavements division : bitumen	This division studied the flexible materials with which roads were made, ie. bitumen.
1.3	Rigid pavements division: concrete	This division studied the rigid materials with which roads were made, ie. concrete.
1.4	roads division	This division designed those materials into the different physical sections that formed the technical road, thereby laying the materials onto the soil.
1.5	traffic engineering, economics and statistics division	This division made decisions at an anthropometric scale as to the patterns and shapes of the road. It actually worked out the ways in which people would move along the roads

The divisions can be seen to form a linear scale of growth from the detail of the soil to the design of material: the design of them together into a road and finally the design of these objects in the environment with regard to a human scale (statistics and planning).

In this arrangement of scaled up study, the Indian state attempted a rational mapping of the emerging modern subject, his body, the topography, and environment onto each other. The gaps between body and topography were stitched together through an epistemology of materiality, testing, experimentation, psychology and scientific study. But if this discourse emerged from the CRRI, capturing the projective desires of the emergent nation state through the rational use of geometry, science and technology, from within the textuality of this projected discourse of rationalized and standardized aspiration, erupts a simultaneous counter-discourse of the desire for and promise of modernity which is constantly negotiated by the difficulty of actually deploying it. This counter-discourse emerges from the textuality of the various publications that the CRRI produced. The text of their annual journals is substantiated with photograph after photograph of black and white images, taken by anonymous photographers, perhaps amateur, on a camera or a set of cameras that seem to have travelled across the country in a zealous attempt at documenting the work of engineers, planners, geologists, laborers, drivers and anyone else whose expertise was harnessed to develop road networks. Emerging from these photographs is a narrative of the (perhaps irrational[25]) ways in which the modern Indian subject did inhabit newly formed "national" space. Within these photographs one can see the ways in which new national space produced the

25. By irrational I mean a very specific thing. To say that something is irrational is to say that the factors that contributed to the making of that thing cannot necessarily be extricated from that thing in a rational and logical way. The parts come together as an irruducible whole that cannot be thought of as its component parts. Perhaps the irrational is best captured by Sol LeWitt's "Sentences on Conceptual Art," 1 and 3, "Conceptual artists are mystics rather than rationalists. They leap to conclusions that logic cannot reach" and "Irrational judgements lead to new experience."

emergent Indian subject and conversely, in a reversal, the ways in which the emerging subject complicitously played a significant role in the creation of this rational space, as we shall see in the next chapter.

Vignettes from Road Research Reports

+ Pedestrian Safety Studies

On page 26 of the 1961-62 annual report of the CRRI[26] is a short passage on pedestrian safety in the section by the division of Traffic Engineering, Economics and Statistics. The passage is presented as a documentary report,

> "Studies in pedestrian safety problems are in progress for the last few years. Pedestrian safety devices such as improved sidewalks, proper signal phasing, railings, cross walk markings at intersections, and enforcement of traffic rules have been studied."

Alongside this text is a largely illustrative and demonstrative photograph (Fig. 11) labeled 'Fig. 24 Pedestrians are crossing the road through cross walk.' The image at first sight seems innocuous, smooth gray road, sidewalk with neatly parallel parked Ambassador car, and trees a good city distance apart, and prominently, a checker board cross walk pattern receding in perspective that dominates the frame, echoing a cartesian grid, on which 5 men and 2 boys (with 2 men skirting the edge)[27] are obediently crossing the road. The image seems too perfect. Of Course the image is staged. The photograph documents the modern-Indian-road-crossing-rule-following subject, and in doing so, stages that subject. But somehow the photograph is more complicated then just the creation of the modern subject through the staging of him. Perhaps through a careful looking at the photograph, we can access the act of staging.

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26. p.26 1961-62 Central Road Research Institute, and Council of Scientific & Industrial Research (India). Annual Report. New Delhi: Council of Scientific & Industrial Research.

27. Thanks to Caroline Jones for pointing this out, perhaps 20% off is still within the bounds for the Indian state, as it is for the Chinese state, as Yung Ho Chang pointed out.

Perhaps the various layers of the image need to be further separated to get to the subtle way in which the image is staging a complicated and nuanced Indian modernity and subjectivity that needs to be untangled here. The image is set within the framework of two simultaneous conditions of India, on one hand it stages the democratic industrializing nation state and on the other it stages the space of the colonial state. The image is set in Lutyens' Delhi, on Janpath, in the plan for the administrative capital through which the colonialist would administer the native, an architecture that the new administration seamlessly inhabited. On the other hand, the image erupts with symbols of Indian entrepreneurship that invoke the industrial nation in its attempt to undo economic colonialism. In the background on the left of the image is the store front of Lawrence and Mayo, an Indian optical store established in 1877, a store that produced and sold indigenous products and services. In front of the store is 1950s Ambassador, most likely Morris Minor, a model of manufactured by Hindustan in what would be a long partnership with Morris Motors of Great Britain.[28]

Prominent is this carefully constructed representation of the polity is the cross-walk. Occupying the entire lower half of the photo, it plays a palpable role in the organization of its space. It is through the image of this checker board receding in perspective that the modern Indian subject gets tied to the process of production of an indigenous paint. A complicated line is drawn between this Indian Polity that backdrops the cross walk and the subject, whose safety depended on the painting of these crosswalks that in turn depended on the will to develop a road marking material,

28. The Moris Minor was the first model of the series of Ambassador cars produced by Hindustan motors in 1952 from the British design.

an indigenous paint that would perform the task of remaining on the streets while the wheels of vehicles plied to and fro above. It is this relationship that is the subject of my inquiry.

Two trajectories of thought open up here. The first is as to how the site of the CRRI and the road outside its gates, Mathura road became the sites for heuristic experiments to test the viability of paint samples. The citizens that used the road and consequently the whole city became unknowing participants in the CRRI's project of the comparative testing of paint. Heuristic because the material engineers would then go outside, paint the road, and observe the fading paint month after month.

The second thread of thought goes to the Institute's obsession with the indigenous manufacture of the perfect 'road marking material.' In 1962, the flexible pavements division filed a patent for

> "a good marking paint which [they described] has a very good adhesion to any surface and which does not bleed [that was] developed in the institute."
>
> This paint, "dries out faster than generally used paints and has at the same time a satisfactory covering power. It is capable of taking any colour that is required. It is much cheaper and under service conditions compares very favourably with many of the road marking paints as can be seen from fig. 11." **(fig. 12)**

This frame that accompanied the quote becomes an oft repeated one in the process of developing an indigenous version of this material and determining if it fits the criteria of a good paint. Samples to be tested were laid out on Mathura road, outside the premises **(fig. 13a & b)**

> "Transverse lines of different materials have been marked (Fig. 25(a)) for study at two busy locations in Delhi. Out of these materials applied for test at the first site, six paints with code No. 1, 2, 5, 6, 7, and 11 are foreign. The reflective test lines No.s 6 and 7 are of indegenous base with foreign glass beads and the rest are local products.
>
> Based on 12 months of observation of field performance of these materials placed at this site carrying about 29000 average daily vehicular traffic, the tentative results have been drawn and given in table 5. **(fig. 13c)**

> The durability has been determined by visual inspection and also through photographs taken periodically as shown in Fig. 25(b).[29]

Here the assessment is through a "visual inspection." It was, of course, not rigorous enough to heuristically and visually determine the quality of fading paint. This took too long and did not achieve a quantifiable result. Instead, an expression of the rate of fading and an index rating of paint had to be developed to conclusively determine a way to choose road marking materials. (fig 14)

> "In order to compare the durability performance, service value of the test lines were rated by comparing with a rating index (fig. 22) which was prepared on the basis of general appearance measured by a photo reflection meter. Upto the rating value of 30, the test line was considered useful.
>
> This useful life was determined with the help of the rating index, and the cost of each line per 1000 feet length (4in. wide) per 10,000 tonnes of traffic load passing over it was calculated."[30]

Here aesthetic judgment of a surface of paint is rationalized and calculated in terms of usefulness and economy. But to what end is this obsession with paint directed?

It is the image of the pedestrians crossing the cross walk that brings together these obsessive studies on paint and the states concern for the safety of the pedestrian. (Fig. 15) The line between state and subject is drawn out in the realm of responsibility. The crosswalk brings together the pedestrian and the state through experiments, tests and paint. The state's responsibility towards the pedestrian manifests in the zebra-crossing - it is a symbolic space of responsibility. Through it, the state and the subject get tied in an intimate way, where the state invokes and stages the road crossing subject and the subject invokes the street painting state. Both are complicitous in

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29. p. 47-48 1963-64 ibid
30. p. 39 1965-66 ibid

the maintenance of this symbolic and representational space. There is a line being drawn between state and subject: safety would come if pedestrians followed street etiquette in crossing the road and pedestrians would follow etiquette, if they knew how, and they would know how, if it was represented on the intersection, on every intersection, on every road, in every town. In this seemingly rational chain of association, though, is a moment of irrationality. The break in the chain is the impossibility of performing the task of painting every road. This impossible task then slides into the task of developing the perfect paint: the solution is displaced.

Yet this irrational relationship between state and subject exists, and can perhaps only be reached at by a detour through fiction. In her book, The God of Small Things, Arundhati Roy's characters accord a special value to state services and specifically zebra crossings,

> "According to Estha, if they'd been born on the bus, they'd have got free bus rides for the rest of their lives. It wasn't clear where he'd got this information from, or how he knew these things, but for years the twins harbored a faint resentment against their parents for having diddled them out of a lifetime of free bus rides.
>
> They also believed that if they were killed on a zebra crossing, the Government would pay for their funerals. They had the definite impression that that was what zebra crossings were meant for. Free funerals. Of course, there were no zebra crossings to get killed on in Ayemenem, or, for that matter, even in Kottayam, which was the nearest town, but they'd seen some from the car window when they went to Cochin, which was a two-hour drive away."[31]

The street painting state lurks in the imagination of the road crossing subject. Even in Ayemenan where there were no zebra crossings to get killed on, that is, where even where the state did not have the resources to paint. The street paint was a contract of the responsibility between the state and the subject.

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31. p. 6 Roy, Arundhati. 1998. The god of small things.

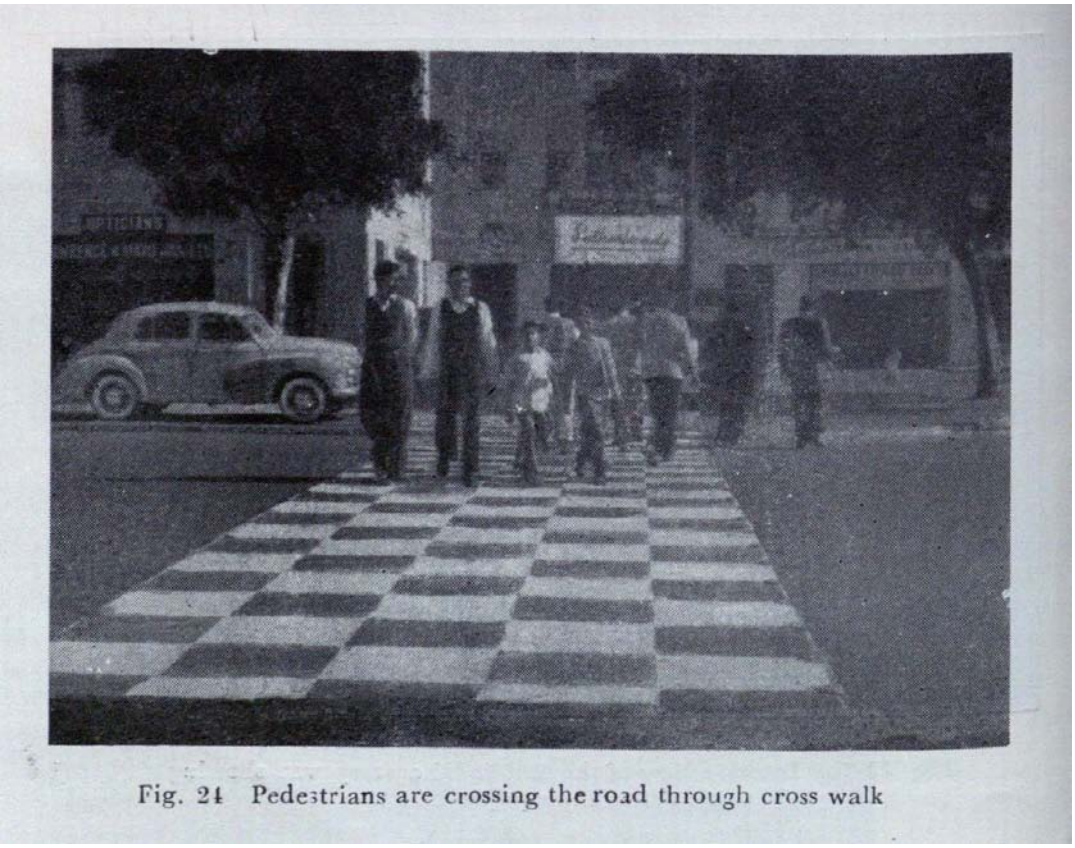

Fig 11: Pedestrians Crossing Road Using cross walk image p. 26 CRRI annual report 1961-62

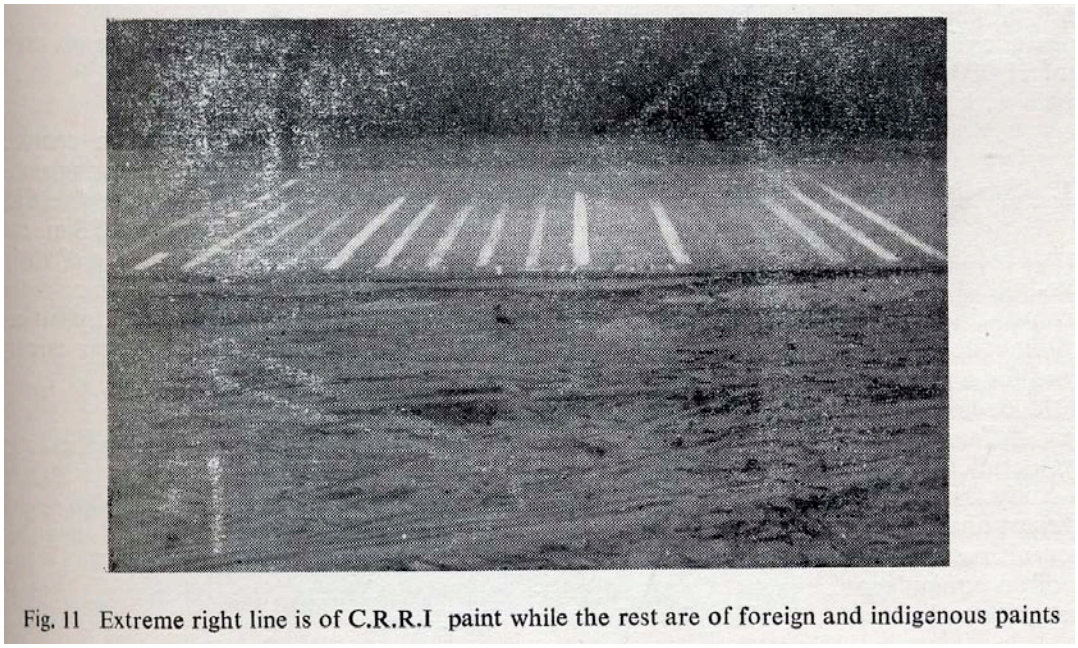

Fig. 11 Extreme right line is of C.R.R.I paint while the rest are of foreign and indigenous paints

Figure 12: Using a pitch as the base material, a good marking paint which has a very good adhesion to any surface and which does not bleed has been developed in the institute. It dries out faster than generally used paints and has at the same time a satisfactory covering power. It is capable of taking any colour that is required. It is much cheaper and under service conditions compares very favourably with many of the road marking paints as can be seen from fig. 11. A patent on this has been filed.

Annual Road Research Report, 1961-62

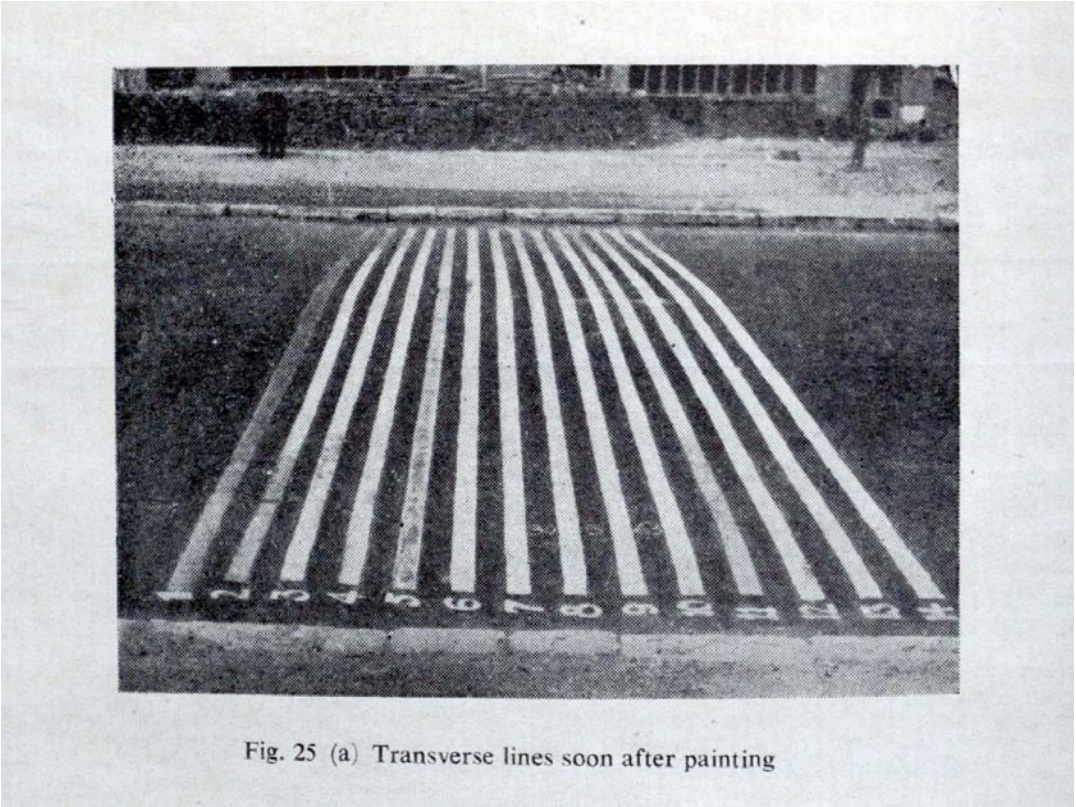

Fig. 25 (a) Transverse lines soon after painting

Figure 13a

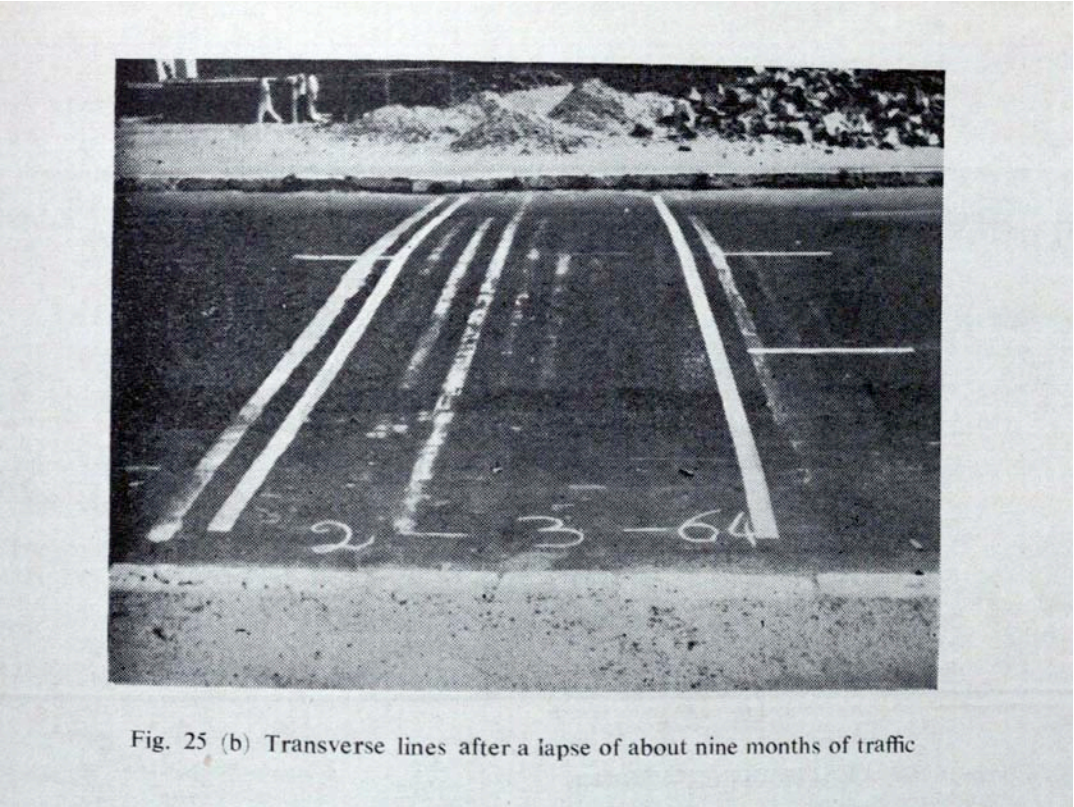

Fig. 25 (b) Transverse lines after a lapse of about nine months of traffic

Figure 13 b

TABLE 5

Field data on the Transverse lines Marked on Mathura Road

Test line No.	Age in months	Drying time	Covering capacity sq. ft./liter
3,8 & 9	2 months	5 mts. each	37,36 and 25 sq. ft. respectively
10,13 & 14	3 months	5,30 & 10 mts. respectively	20,50, & 52 sq. ft. respectively
4,6 & 7	5 months	9 mts. each	36 sq. ft. each
12	7 months	33 mts.	43 sq. ft.
5	11 months	60 mts.	30 sq. ft.
1,2 & 11	Continue to be good		

Figure 13c

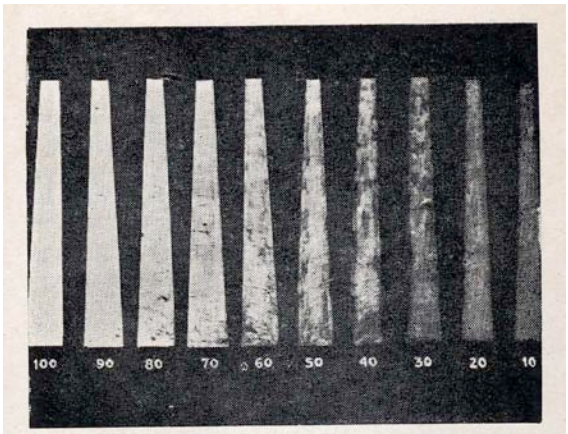

Fig. 22 Rating index prepared for study of comparative performance of road paints

Fig 14 rating chart

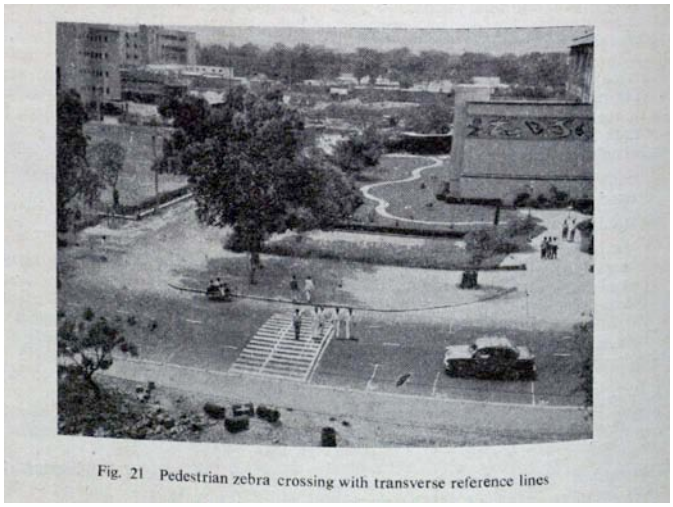

Fig. 21 Pedestrian zebra crossing with transverse reference lines

Fig. 22 Accident spot map of Delhi 1958-1962

Figure 15 Cross walk and accident map juxtaposed

+ Testing Drivers

The 1961-62 annual journal announces:

> "A study on the techniques of examination and licensing of drivers and checking their performance for improvement was carried out. The recommendations included scientific driving tests, physical and psychological tests, and an introduction of the checking of drivers' performance by 'Point System Control'.

Consequently, a drivers' Clinic was set up that used a series of tests and testing apparatuses for the purposes of understanding the psychological capacity of drivers on the Indian roads. Over the next 17 years drivers were administered certain 'psycho-physical' tests such as simple reaction time, complex reaction time, color blindness and so on.[32]

Before I discuss the ramifications of the use of 'psychology' on the design of space, I want to point out certain things about the nature of this research. Appearing in the section entitled, "Traffic Engineering," these tests were and continue to be standard methods used to gauge the physical and mental capacities of drivers using the road. Traffic engineering as a discipline, is one that exists in the elusive gap between technological engineering and human performance.[33] Both difficult to define and to locate within the scientific scheme of things, the discipline is one that

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32. A complete list of these tests: simple reaction time, complex reaction time, color blindness, depth perception, distance judgment, colour perception, visual acquity, side vision, speed judgement, night vision and glare recovery

33. p. 3 Mannering, Fred L., Walter P. Kilareski, and Scott S. Washburn. 2004. Principles of Highway Engineering and Traffic Analysis. 3rd ed. Wiley, July 26. This book doesn't really provide a definition of the field but explains in its introduction, "The mobility and opportunities that highway infrastructure provides also has a human cost. Although safety has always been a primary consideration in highway design and operation, highways continue to exact a terrible toll in terms of loss of life, injuries, property damage, and reduced productivity as a result of vehicle accidents. To be sure, the elements of highway safety are complex. They involve technical and behavioral components and the complexities of the human machine interface." (emphasis mine) I use this passage to point out the reliance of highway engineering on a psychological framework, which resulted in direct design decisions with regard to the road and the car.

attempts to apprehend psychology in its attempt at engineering (and controlling) human movement.

The problem that traffic engineering encountered was that the link between the human body/mind and the road are essentially at odds with one another; discontinuous, they cannot be mapped onto one another. We might even say that they exist "irrationally" in relation to one another. And yet, the project of road engineers was to produce a rational framework with which to bridge the gap between highways and the human beings that used them, through a logical and scientific process. It was to rationalize this irrational relationship. The body, for the designer of road systems is a conglomeration of various human functional parts. Roads, and the systems through which we use them, are meant to anthropometrically cater to these various functionalities within their scope. For example, the speed of movement on the road must respond to the speed with which vision can adapt, the movement of the spine, the turn of the neck, it must respond to a hand eye co-ordination possibility and so on. If the design of roads and the systems by which we use them are to be rational, they must necessarily emerge from a close study of the physical functioning of the human body/mind (psycho-physical).[34] To map the human body/mind onto the road is then to know all the possible functions of the body/mind, and manufacture and design precisely in response to this body. Since it is difficult, if not impossible, to fully know the body (there is only

34. p. 39 Mannering, Fred L., Walter P. Kilareski, and Scott S. Washburn. 2004. Principles of Highway Engineering and Traffic Analysis. 3rd ed. Wiley, July 26. Section 2.9.6 illustrates exactly what this attempt to design the road according to the function of the human body, "in providing sufficient sight distance for a driver to stop safely, it is also necessary to consider the distance travelled during the time the driver is perceiving and reacting to the need to stop. The distance travelled (dr)... is given by dr = V1 x tr ... where tr is the time required to perceive and react to the need to stop, in s (seconds). The perception/reaction time of the driver is a **function of a number of factors, including the driver's age, physical condition, and emotional state**... For highway design a conservative perception/reaction time has been determined to be 2.5 seconds." (emphasis mine)

the possibility of creating an approximate standard), there exists a gap in the design of the body/mind and the method in which is uses the road.

My thesis looks at exactly this problem of psychophysical ability as it was encountered by Indian road engineers and the measures that it took to deal with it in the 1960s. A paper written in 2007 helps provide a comparison in to this ongoing issue of safety.[35] The authors propose the creation of a set of sensors to help bridge the gap between the ability of the human body to drive and the skill required to do it. These sensors, placed on the body of the driver, constantly gauge her fluctuating 'psycho-physical ability,' one that is lowered if the driver is talking on the phone or is fatigued. The information collected by the sensors is then fed back to the driver and the car in an attempt at preventing accidents. Although this paper is written in a different context, I quote it to emphasize the different kinds of solutions possible for the same problem. This problem was conceived in a physical-technological realm, that of seat belts, airbags, and finally sensors.[36]

The Indian road engineers on the 1960s also took very seriously, the ability to drive on a road and the repercussions that that the lack of it would have on the safety of those involved. The denouement of this story is that for the Indian state, a state that lacked the resources to invest in serious technology and design, the question of lowered ability was dealt with in the 'psycho' part of psychophysical. It was the mind of the subject that needed to be gauged and monitored (perhaps redesigned) to use the road.

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35. C. Zocchi, Prof. Eng. A. Rovetta, Dr. F. Fanfulla, Physiological parameters variation during driving simulations, IEEE Xplore. Downloaded on April 6, 2009 at 23:53

36. It is also of note that this problem was conceived in a different framework, that of the market, where different options are possible.

In the reports by the CRRI, psychology was the primary discipline through which the driving subject could be quantifiably accounted for. Perhaps this tedious process of testing Indian drivers was a method for apprehending the emerging Indian subject, but in this process of testing, the state also established itself as a modern entity. For the state the use of psychology was a performative one,[37] as it produced the psychologizable entity, it produced itself as the modern psychologizing state. But as a result of this double process, the state designed a space through which roads rules could be imparted to its citizens. This space was, not only a space of lawfulness, but also one of etiquette. It is the design of the space that is the odd outcome of these psycho-physical tests.

Accompanying the reports of the psychophysical testing of drivers enrolled at a driver's clinic are photographs.[38] The 1963-64 report has two images in it (Fig. 16), each of an object by which to test a certain psycho-physical capability. Both photos are of these objects against monotone surfaces, bathed in uniform light and devoid of any reference to scale and size. The photograph 'Fig 28 (b) Portoglare' contains an object denied of any context, except a handle that betrays its approximate size. It is some sort of openable container on whose outer surface are two headlights and a screen. The lights blind the viewing subject, and the screen most likely displays some text that has to be read once you are able to read again, the recovery time having been documented. Our experience of the object through the photograph of it, however, is in no way as harsh an expe-

37. I worry that mentioning the word 'perfomative' opens a whole can of Butlerian worms, in this case what I mean is that just as Butler argues that gender is something one does, the modernity too, is something the state constantly does, in this case, the state by doing psychology, performs itself as a modern psychologizing entity. (h/t Alia Somani)

38. (Residual passage that I am not sure what to do with) (Fig 15) labeled 'Fig. 25 Reaction time test being conducted at the Driver's Clinic.' It is a photograph demonstrating the someone taking a reaction time test. It shows two men sitting on folding metal chairs, placed perpendicular to each other at a desk on which some sort of barely discernible equipment sits. The man on the left is administering the test to the man facing the machine.

rience as that which the person being tested is subjected to. As privileged viewers, we see this object in its dormant state, docile and on display.

'Fig 28 (a) Mirror drawing apparatus' seems to be about a foot long and consists of two parallel surfaces, 6 inches apart, the lower resembling a clipboard with a piece of paper with a six pointed star on it, the upper clearly a shield to prevent one from looking at it. Within this scheme it is the mirror as the backdrop of these objects that draw your attention to what exactly this apparatus is supposed to do. Warren's Dictionary of Psychology describes it as such:

> "A line drawing made by viewing a given design in a mirror while attempting to trace or reproduce it while the hand, pencil, and paper bearing the design are concealed from direct view."[39]

The apparatus is part of a standard psychological lexicon for testing the cognitive skills of people. When I first saw the apparatus, I imagined that it was linked to the act of apprehending objects when looking at them in a rear-view mirror, a commonplace situation when one is driving. This object, I discovered, had no real relationship with the act of driving, instead it was just a measure of everyday cognitive skill. In fact, it is hard to see what purpose this test served in the mandate that the CRRI set for themselves, which was to improve the performance of drivers. Instead the image seemed to serve a completely different purpose, which can perhaps be told by the nature of the photograph. The photograph of the object is taken from a privileged point of view. It does not photograph the object as the person taking the test would see it. Instead it allows the viewer of the photograph an alternate, privileged view. A view that the subject being administered the test is specifically denied. We see the star in its original form, not the mirror image of it that the

39. From the Archives of the History of American Psychology http://www3.uakron.edu/ahap/apparatus/apparatus.phtml?code_id=6&app_id=466 accessed April 6, 2009

subject would see. We see below the visual shield that blocks the subjects view. The object is on display and it has been completely revealed to the viewer.

Both objects displayed in this naked way, holding back very few of their own secrets, in some sense objectified by the CRRI's presentation of them, only reveal the institutes capability of owning them. Far from being an object that helps the institute gauge methods of making driving safer, through the owning of the object, the institute lays claim to the discipline of psychology.

On page 46 of the 1963-64 annual report is a pair of photos (Fig. 17) belonging to the same category of driver testing. Both images seem similar in their composition, they are closely cropped images of a young Sikh man sitting at a desk or a table in a room. He is wearing a shirt, sleeves rolled up above his elbows and is in deep concentration looking at and working on some objects in is hands. To the bottom left of both images is the left hand of a person cut off at the wrist, holding a stopwatch. The first image is labeled, 'Fig 24 (b) A driver being tested on Thematic Apperception Personality Test' (TAT). In his hand is an image of a man's face staring out of the sheet and behind him is a woman seemingly straining to tell him something.[40] The image is turned just slightly out of the plane of the tested subjects view and faces into the camera. The second image is cropped in a similar way, eliminating all excess and focussing on the object used for testing the driver. In this second image the 'passalong (intelligence) test' is being administered. He is showed an image and has to rearrange the mobile planes in the object in his had to match the pattern in the image. Both images use the same composition of the cropped body parts of the two people in the room to frame the object that is the test.

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40. How absurd is it to attempt to describe an image when the test states that through projection, one's description of the image reveals the describer's personality?

The test being administered in the first image, the TAT, was devised in 1935 by Morgan and Murray to subjectively gauge the personality of the subject being tested. The test shows up in many places, but the reference I cite is from a 2005 publication by Indian psychologist team Ram Nath Sharma and Rachana Sharma who, in their book Experimental Psychology, write,

> "The founder of this test, Murrey (sic) investigated the personality traits with the help of some pictures. These pictures are still considered to be standard. Observing the pictures, the subject, by projection, identifies himself with the characters in the picture. The pictures are presented one by one to the subject who has to compose a story on each of them within some fixed time period, say five minutes. Unknowingly, the subject expresses many of the peculiarities of his personality in these stories by projection. He does not get time to think. Therefore, the story expresses his natural desires, emotions, sentiments etc. On the basis of these stories, the psychologist analyses the personality of the subject and uncovers its traits.
>
> As in the Rorschach ink-blot test, there is some difficulty in Murrey's thematic apperception test, since the personality investigation done is by it is not numerical but qualitative with the possibility of mistakes. But there is no doubt that an experienced and skillful psychologist can use this method to uncover many hidden traits of the personality of the subject. This test helps in the discovery of many abnormalities of the personality as well."[41] (sic)

Apart from the problematic use of the categories of normal, natural, and abnormal in this passage, what is clear, is that the psychology that the state engaged in was fell very much in the realm of clinical psychology, the experiments conducted were designed with method and strict controls. The state, having laid claim to modernity through the discipline, the question then becomes, how did the discipline change the state in return.

To engage with the question of how psychology transformed the terrain that it was meant to objectively observe, I take recourse to Mark Jarzombek's book, 'The Psychologizing of Modernity.' In this book, Professor Jarzombek outlines the problem with the discipline of psychology, that it had the ability to, both, centre itself on anything, yet have no epistemological centre of its own.

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41. Sharma, Ram Nath, and Rachana Sharma. 2006. Experimental Psychology.

This remarkable ability of the discipline allowed it extreme flexibility in how it could be borrowed and deployed. To quote a passage from the book slightly out of context,

> "These authors realized that psychology could do more than describe reality. It could help transform it. And the revolution was sweeping. I fact one could argue that psychology's main field of operation was not in the controlled environments of scientific laboratories,... but in the more free-wheeling discursive practices of philosophers, historians, avante-garde artists, cultural reformers, and politicians."[42]

The argument here is that when non-psychologists deployed psychology, outside of its clinical context, it gained a certain currency to transform the nature of discourse itself. So then, operationalizing this idea of the transformational nature of the popular use of psychology, here is the strange denouement of the story. If it was not in the controlled spaces of the laboratories but in other discursive and non-discursive spaces that psychology really gained currency, then it was not the psychologists buying the instruments and testing the subjects that actually deployed psychology, it was the planners and the designers who attempted to, through design, create the perfect driving subject that intuitively followed road rules. In the most serious and non ironic passive voice, the 1963-64 annual report states,

> "it is well recognised that the best time to train road users in traffic rules and regulations is when they are young."

With a continued tone of chauvinism, it reports,

> "In traffic training parks, the children learn traffic rules while playing, and develop road sense."

Traffic training parks, as the name suggests, were spaces where children could be brought, where, while playing, they would imbibe the language of road rules. Road rules were a language,

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42. p. 16, Jarzombek, Mark, The Psychologizing of Modernity: Art Architecture and History

the signage, road paint and signals were its words and grammar. The language being taught young, the rules would come naturally to the children, that is the future, adult drivers.

These parks (figs 18a,b,c,&d) were constructed in Delhi, Mumbai and Calcutta, an experiment that there was no way to create a control for. Constructed by British owned m/s Burmah-Shell, India's largest oil storage and distributing company (soon to be overtaken by Indian Oil), the design of the parks are strange and fascinating.

The park in Calcutta (fig. 18a) consists of a scaled down and squashed together series of pathways painted to represent roads. The two-way streets are a scaled down size between 9 and 12 feet wide, with two cross-roads and one roundabout. what is embedded in abundance in both, the drawing of the proposed layout and in the park, is signage. In the plan of the proposed layout, every sign that is imagined necessary is drawn in elevation at the point at which it will be inserted. They include at least five signs that I personally have never seen on Indian city roads.

These signs are road rules abstracted into easily identifiable images, drawn into little squares. They litter the drawing forming a dense map of road etiquette. The park in Mumbai is similar in composition with miniaturized layouts of road systems densely filled with traffic rule signs. The park is filled with zebra crossings all reduced through some equation to child size.

Looking through photos of the currently deserted traffic park in Mumbai, (Fig 19) a lonely speed limit sign that reads '40' stands in the foreground of a stadium whose risers have been patterned with blue, yellow, and white squares that display different traffic signs, blue and yellow being the theme colors of the traffic police in Mumbai. The park makes road etiquette into pattern, almost claiming that if one is familiar with the language with which road rules are spoken at an

everyday level, one might be more like to recognize (and perhaps follow the rules) when encountered on the street.

This over-designed and miniaturized park becomes a place where the planner / designer plays out her ideal road fantasy, its unintended consequence being its transformational use of psychology and the inadvertent creation of a site for the production of the ideal modern citizen-subject.

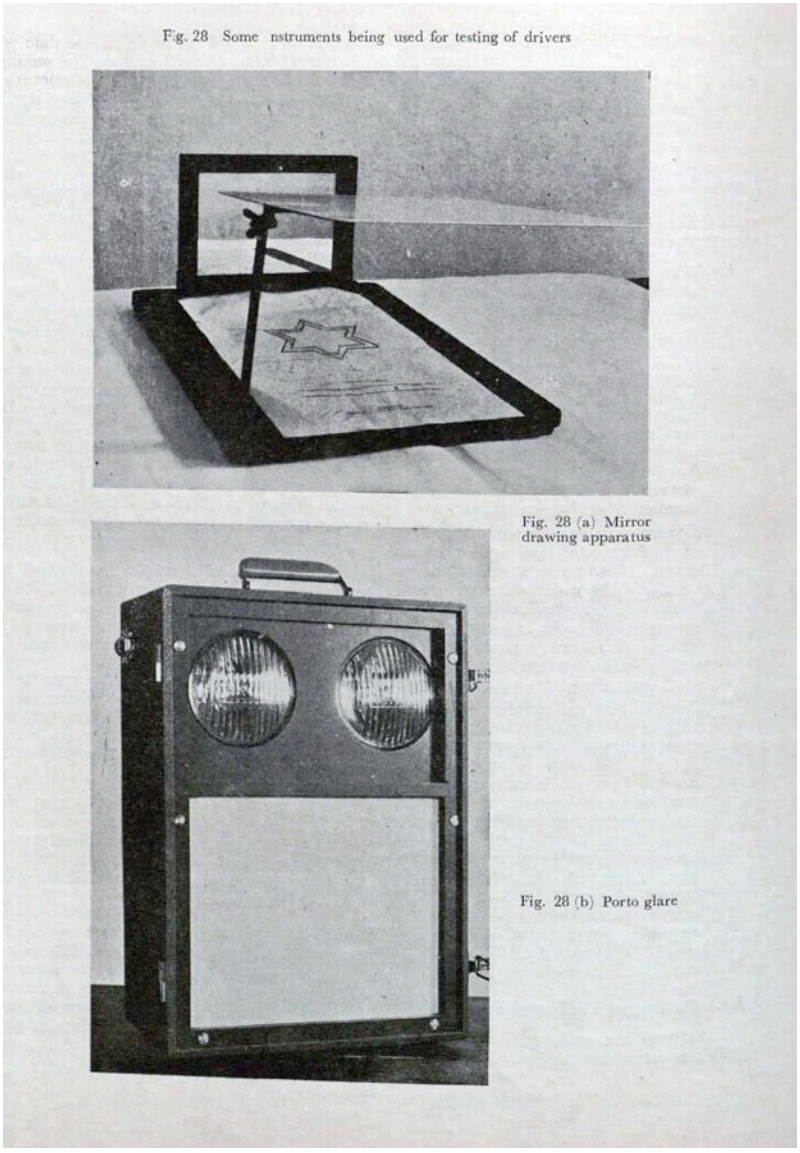

Figure 16 Mirror drawing apparatus and Porto glare

Fig. 24 Psychological tests on drivers

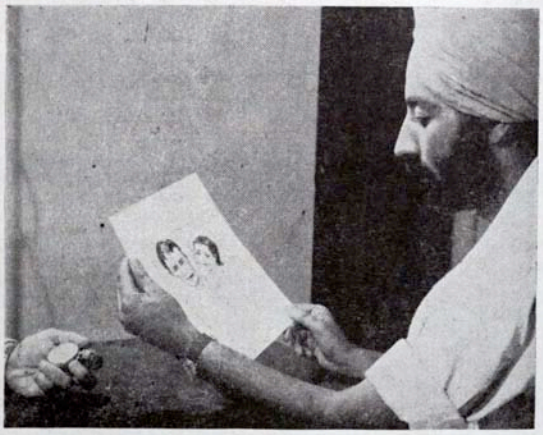

Fig. 24 (a) A driver being tested on Thematic Apperception Personality test

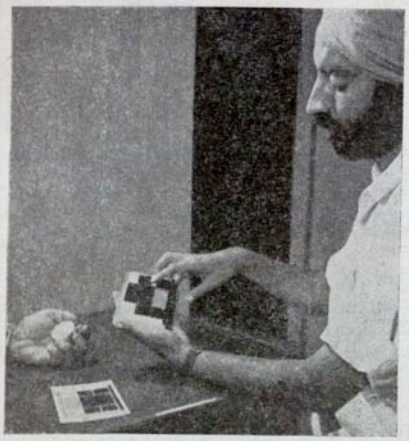

Fig. 24 (b) A driver being tested on passalong (intelligence) test

1.5.6. Road Markings

(i) Road marking Standards

A study to evolve standards of road marking suiting mixed traffic conditions has been undertaken. As a result of this study, a draft manual of road markings specifications covering all types of markings under the following categories, has been prepared for consideration by Indian Roads Congress.

TYPES OF ROAD MARKINGS

1. *Pavement markings*
   - (a) Longitudinal markings
   - (b) Transverse markings
   - (c) Other markings
2. *Curb markings*
   - (a) Curb markings for visibility
   - (b) Curb markings for parking prohibition
3. *Object markings*
   - (a) Object within the roadway
   - (b) Object adjacent to roadway

Figure 17 Psychophysical tests on drivers at the driver clinic

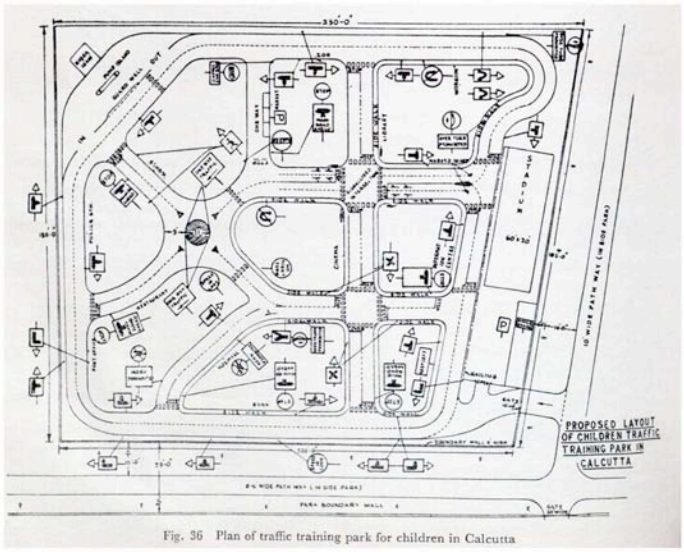

Fig. 36 Plan of traffic training park for children in Calcutta

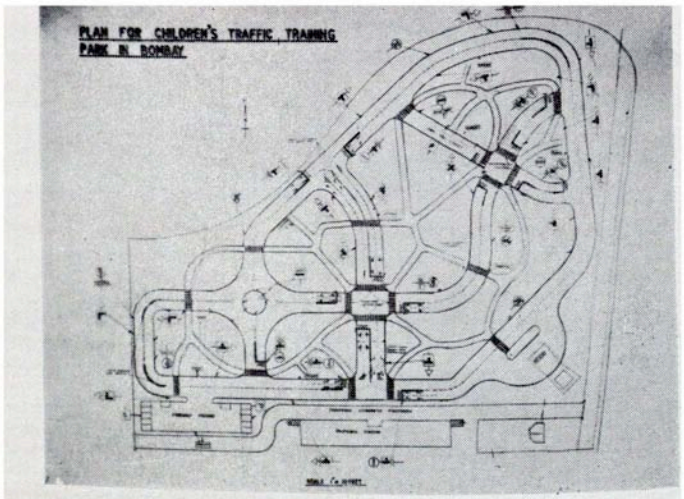

Fig. 32 Plan of childrens' traffic training park in Bombay

Figure 18a, b, Traffic Training Parks

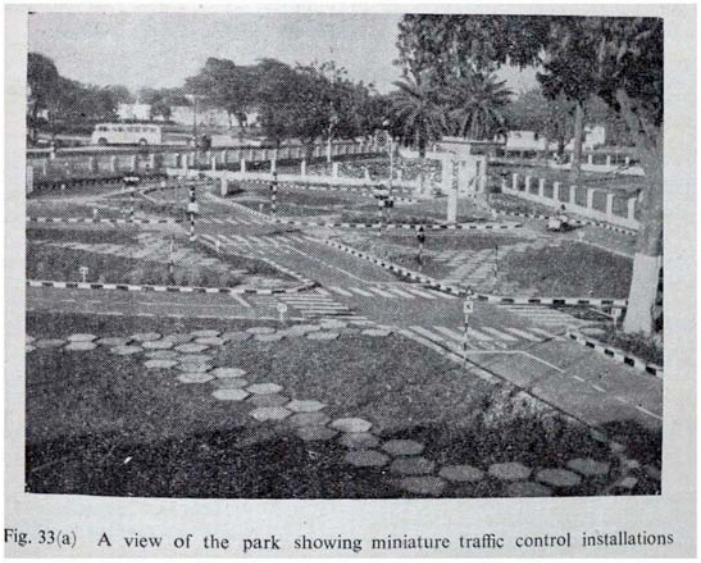

Fig. 33(a) A view of the park showing miniature traffic control installations

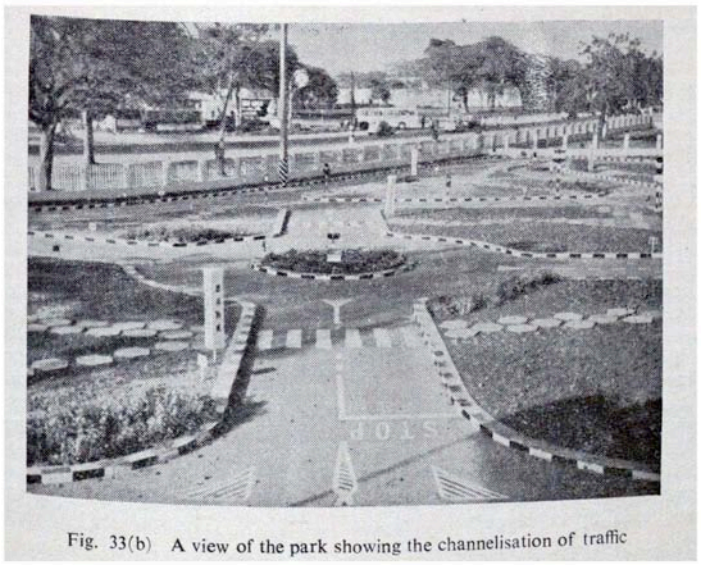

Fig. 33(b) A view of the park showing the channelisation of traffic

Figure 18 c,d, Traffic training parks

Figure 19 The traffic training park as it is in Mumbai today

Puzzolanic Clays and Surkhi

The story of the experimentation with, and the industrial production of Puzzolanic clays is a tale of the discursive re-appropriation of 'naturally occurring materials' for the purpose of the national project. Language and representation became the tools that the state used to reconcile the material's colonial and colloquial past, with its role in the new national narrative. The material's inherited narratives, both colonial and colloquial, had to be recast within a new national mould. This project of recasting is an aesthetic one, it is a project whereby representation (language and drawings), not content, is altered and manipulated. In this chapter I attempt to trace and foreground "the modernity that is disguised in this manipulation."[43]

In the first decade of India's independence, the construction industry felt the lack of cement supply in the country. The shortage of cement and its rationing by the government, a process of attrition that would find one eventual manifestation in the cement scam of Maharashtra Chief Minister A R Antulay[44], began after independence in the 1947. Apparently, the partition of India and Pakistan resulted in a disproportionate tonnage of cement manufacture falling into either side, causing Pakistan to face a glut of cement production and India, a shortage.[45] Whatever the causes, the effect was that India was looking for ways to substitute the material so it could maintain a ro-

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43. I borrow this phrase from Prof. Jarzombek, Mark, The Cunning of Architecture's Reason, Footprint Trans-disciplinary, Autumn 2007 because I like it so much.

44. Cement was a highly regulated commodity, one in constant shortage to be distributed to contractors equitably. AR Antulay was the chief minister of Maharashtra who used his political position to distribute cement to contractors in return for favors.

45. Das, Kumar Bar. 1987. Cement industry of India.

bust construction industry, without having to import cement at the expense of its foreign exchange.

Although the story of the cement industry in India is an interesting one, this chapter deals with a material whose importance emerged as a fallout of the shortage: *surkhi*. Surkhi is a kind of Puzzolana, a material, when mixed with lime, whose hydraulic properties resemble that of cement, that is, they harden without contact with the atmosphere. The name 'Puzzolana,' comes from the ash that had properties of a hydraulic cement and was found near the 529 BC Roman village of Puzzuoli, the essential building material of Rome at that point. Now, in its semantically recast form, it refers to any artificial preparation resembling this ash's mixture of silica, alumina, and lime.

In the 1960s the CRRI conducted research to locate and manufacture a 'good puzzolanic surkhi.' Their research indicated that this material could replace up to 20% of cement in concrete mixtures without a reduction in the strength of the concrete, thereby augmenting the supply of binding material available in the country considerably. The creation of puzzolanic surkhi became one of the most important events in the history of the CRRI, symposiums about it were held, papers were written, feasibility studies conducted and finally, in 1964 they published a road research special report titled 'Puzzolanic clays of India their Industrial Exploitation and use in Engineering Works.' (Fig. 20)

The research conducted on locating, experimenting with, and manufacturing puzzolanic surkhi was part of a larger discourse of the recasting colonial knowledge as national knowledge. Clay, through this discursive mechanism, became an object whose knowledge belonged to the national, the centre then in turn, mediated knowledge about this material at the local industrial level. The process of making maps and representations of this resource was simultaneously a process of

creating an administrative and bureaucratic structure to both collect and disseminate technological information for the creation of small and medium scale clay related industries at the local level, with the centre as their knowledge base. The maps of clay that were produced by this project were not simply geological maps, they encoded within their representation, a structure of governance; the maps represented the way the state conceived of itself. (fig 22, 23)

+ Colonial

This geological knowledge that the CRRI was recasting was colonial data that had been procured from the Geological Survey of India (GSI),

> "Information connected with the occurrence of major deposits of these materials was collected from the various publications of the Geological Survey of India, Council of Scientific and Industrial Research, the geological publications of various states."[46]

One of the oldest of such institutions in the world, the GSI founded in 1851, had its beginnings in the first half of the 19th century as miscellaneous descriptions of landscapes by traveling colonists. It was not until 1856, when Lord Canning, infamous for his governor-generalship of the East India Company during the 1857 mutiny, took an interest in geology that Dr. Thomas Oldham began his concerted effort at mapping the minerals of the sub-continent. Filled with maps, sketches, and sections, (Fig 21a,b,&c) Oldham's memoirs contain categorical descriptions of the various topographical mineral formations that he encountered across the region which were the first in a long series of mappings, mostly in search of coal, that occurred over the next hundred years. This exercise of representing the mineral resources of the colony used the picturesque as the aesthetic mode of its representation.

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46. Central Road Research Institute. 1964. Puzzolanic clays of India: their industrial exploitation and use in engineering works. Road Research special reports, no. 1. Delhi.

The geological project to locate and map minerals, was simultaneously a territorial one and at many points geological expeditions were folded into military ones. Colonel McMahon[47] of the McMahon line of ch2 makes a re-appearance here in ch7 in the avatar of a geologist looking for coal mines in the Assam Provinces. For colonialists, military missions and geological surveys necessarily happened simultaneously, the search was largely for coal, but the abundance of documentation that emerged from this search is overwhelming. I argue that the process of staking claim to territory was also an aesthetic project of representing landscapes.[48] The aesthetic mode through which the terrain was represented was the picturesque.

> "As a whole the rocks are much twisted and contorted, the bands of of quartzose grits generally form the high peaky and precipitous hills which are dotted over this area, the blue slates and traps occurring in the lower grounds and valley's between them."[49]
>
> "Interfoliated with the gneiss there are found in one or two places bands of chloritic rock approaching serpentine in texture and quarried to a considerable extent by the natives"
>
> (Descriptions of some of the pictureque images by Oldham in his book *Geological Survey of India*)

The images that accompany these descriptions are drawings that frame the land in the mode of the picturesque: the abundant landscapes extending into the horizon, engulfed by foggy clouds, the native in the foreground, staring into the distance. As Guha argues, this was a style that had an established artistic history.[50] In its mediation of the gaze of the viewer (which is how

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47. :)

48. This is reflected in Oldham's narration of how at the farthest reaches of the Afghan-Russia border that were not yet colonized, it was impossible to do surveys while remaining 'unmolested' by the natives - they had to train natives to the surveys for them.

49. p.259 Geological Survey of India. 1859. Memoirs of the Geological Survey of India. Thomas Oldham

50. Guha-Thakurta, Tapati, "The compulsions of visual representation in colonial India" in Pelizzari, M. A. (ed.) Traces of India: Photography, Architecture and the Politics of Representation 1850-1900. Yale University Press, 2003.

William Gilpin described the picturesque) was a naturalization of the colony as represented through the mediated gaze of the viewer, it is a tool of political mediation between the colony and the colonizer.[51] In the 'Memoirs of the Geological Survey of India, this picturesque became the frame through which other discursive practices like geology deployed themselves.

Within the 'picturesque' aesthetic mode of representing the topography of the Indian colony, was embedded a deeply political and territorial gesture. Representational techniques became that through which, on one hand, the colony as a discursive site was produced, and on the other, simultaneously, the colonizer was created.[52] I argue that the independent Indian state's remaking of the representational techniques of geology was a way of severing aesthetic ties with the picturesque, so that the discipline with its new representational strategies of industrial cartographies could now do work outside the colonial paradigm and within a national one.[53]

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51. Michasiw, Kim Ian. "Nine Revisionist Theses on the Picturesque." Representations, no. 38 (Spring 1992): 76-100.

52. h/t Catherine McMahon for helping me articulate this point.

53. I would like to quote the preface of D. N. Wadia, who is rewriting Indian Geology, and his project exists exactly within the framework of reworking British material: "As a lecturer in Geology to students preparing for the Punjab University Examinations I have constantly experienced great difficulty in the teaching of the Geology of India, because of the absence of any adequate modern book on the subject. *The only work that exists is the one published by the Geological Survey of India in 1887, by H. B. Medlicott and W. T. Blanford, revised and largely rewritten by R. D. Oldham in 1893—a quarter of a century ago.* Although an excellent official record of the progress of the Survey up to that time, this publication has naturally become largely out of date (now also out of print) and is, besides, in its voluminous size and method of treatment, not altogether suitable as a manual for students preparing for the University Examinations. .... It would not be too much to say that this lack of a handy volume is in the main responsible for the almost total neglect of the Geology of India as a subject of study in the colleges of India and as one of independent scientific inquiry.

The *object of the present volume is to remedy this deficiency by providing a manual in the form of a modern textbook, which summarises all the main facts of the subject within a moderate compass.* It is principally a compilation, for the use of the students of Indian Geology, of all that has been published on the subject, *especially incorporating the later researches and conclusions of the Geological Survey of India since Oldham's excellent edition of 1893.* (emphasis mine)

+ Colloquial

The material 'surkhi,' born from the cement crisis, referred more to a process than an object. The signifier 'surkhi' was a word from the argot of masonry and construction workers that referred to coarsely ground brick-bats,

> 'a surkhi prepared in this manner does not show any high puzzolanic reactivity with lime.'[54]

This word, borrowed from construction vocabulary had to be remade through the process of research from meaning burnt brick bats into a word that referred to a clay that was a precise mix of chemicals, that had specific reactive properties. The report continues,

> 'On the other hand, carefully selected clays, could, however undergo thermal changes conducive to good reactivity on being calcined at their optimum temperatures.'[55]

Now surkhi no longer referred to burnt brick-bats, it was the name for something completely different, it referred to,

> 'a burnt and ground clay, that when mixed with lime, showed high reactivity as a binding material.'[56]

The higher the reactivity, the better the suited the surkhi would be as an additive to cement. The introduction to the essay on Surkhi begins with the statement that

> "surkhi, as understood till recently, was taken to be powdered brick bats usually ground coarse."[57]

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54. p1 Central Road Research Institute. 1964. Puzzolanic clays of India: their industrial exploitation and use in engineering works. Road Research special reports, no. 1. Delhi.

55. ibid

56. ibid

57. ibid

Experiments had revealed that brick bat surkhi, although constituted of burnt clay, did not show high reactivity with lime, as it had too many inert materials. The clays that made bricks were different from the ones that the CRRI was on the lookout for. What was essential then, was to locate the correct clays that showed sufficient puzzolanic qualities and map their quantities and qualities in the various regions of the sub-continent, that would make a good surkhi. The semantic prefacing of the study is a harbinger of what is to come, an announcement that through the study, the word 'surkhi' will be re-appropriated from its context in a construction vocabulary and given a new technical meaning as a chemical object; this re-appropriation of language being a technique of deploying modernity.

The task for the CRRI to create this 'surkhi' was to not only locate the puzzolanic clay deposits and their sizes, but to also locate them in relation to roads, railways, cement factories, lime kilns, and other support infrastructure surrounding them; their task was to create a cartography of an industrial geology (Fig. 22). On one hand, this creation of an industrial cartography of India folds into the nation's desire for economic independence through industrialization and the CRRI's search for puzzolanic deposits can be read as one iteration of the India's manifold industrial desires. On the other hand, the act of creating a representation can be seen as an aesthetic technique that was employed to represent a new political and administrative system. This new representation brought into conversation three different systems. The first was the geological material map that located the deposits. The second was the system of infrastructure, the maps located irrigation, and power plants and roads that would support affiliated industries that wanted to use the clay as a raw material. The third system that was brought into conversation with the other two systems was that of cities and states. The maps located these industrial networks within the administrative framework of the states and in relation to the cities that would become the trade nodes for this trans-

formed and operationalized material. (Fig. 23) In this way the aesthetic project of making a map became a tool by which a geological knowledge that the state had inherited from its colonizers was operationalized in another sphere: the industrial one. The remaking of the aesthetics of a clay emerges as a particularly political gesture, a gesture that drastically changed the signification of what clay meant.

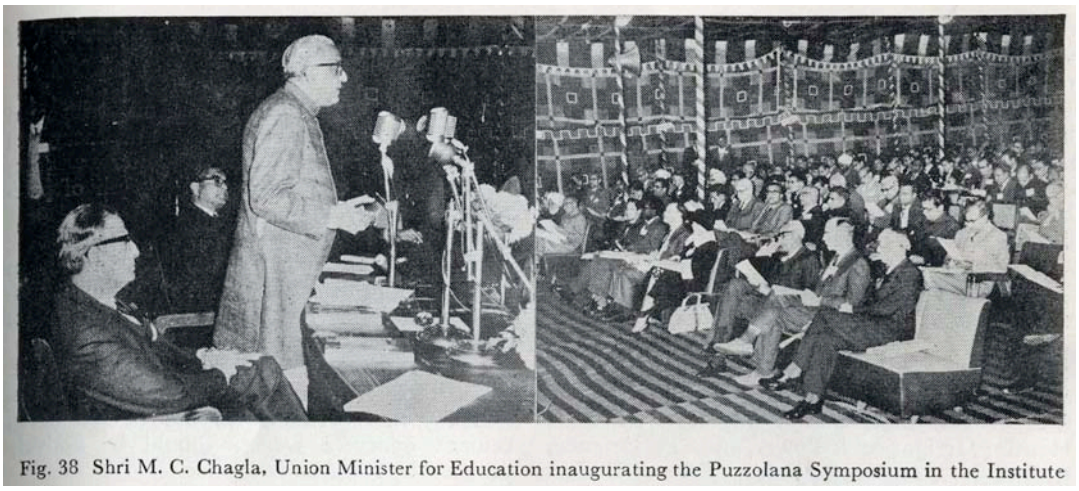

Fig. 38 Shri M. C. Chagla, Union Minister for Education inaugurating the Puzzolana Symposium in the Institute

Figure 20 Dr. SR Mehra (left) and MC Chagla at a Puzzolana symposium

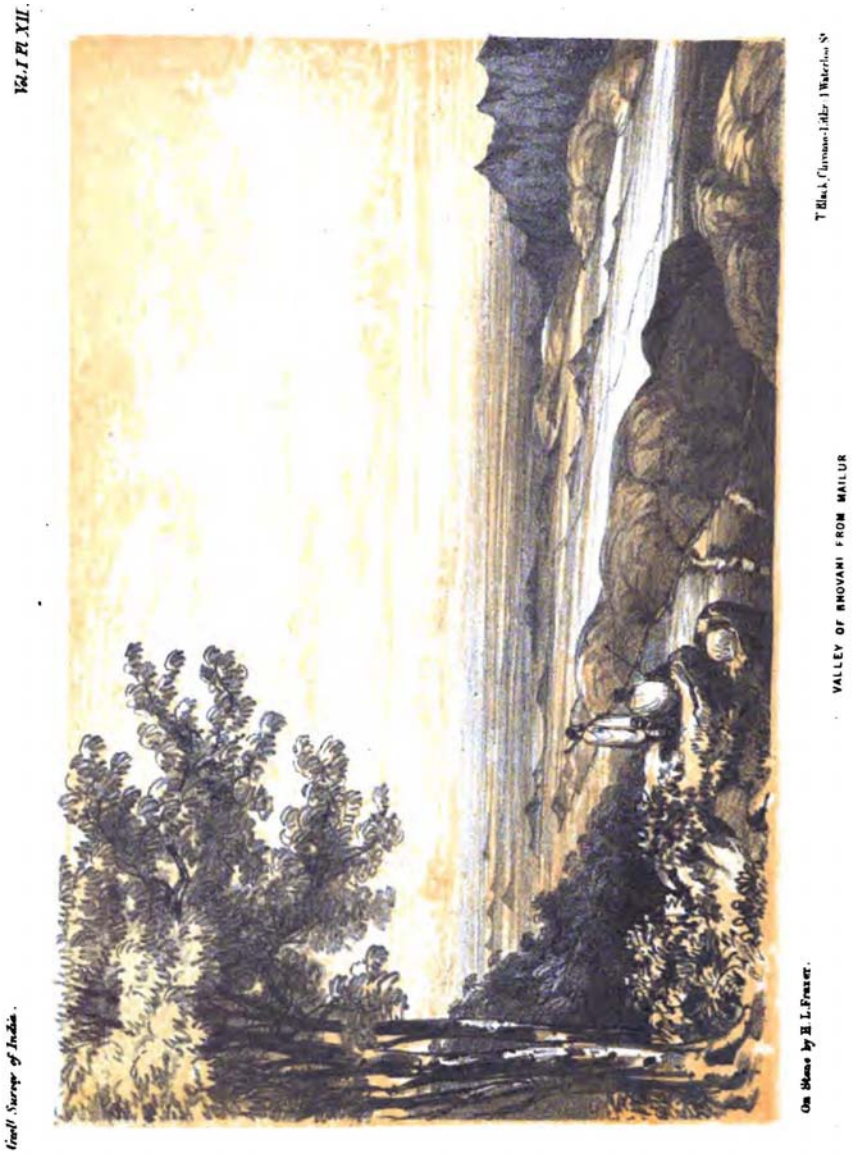

Figure 21a Memoirs of the Geological Survey of India by Thomas Oldham

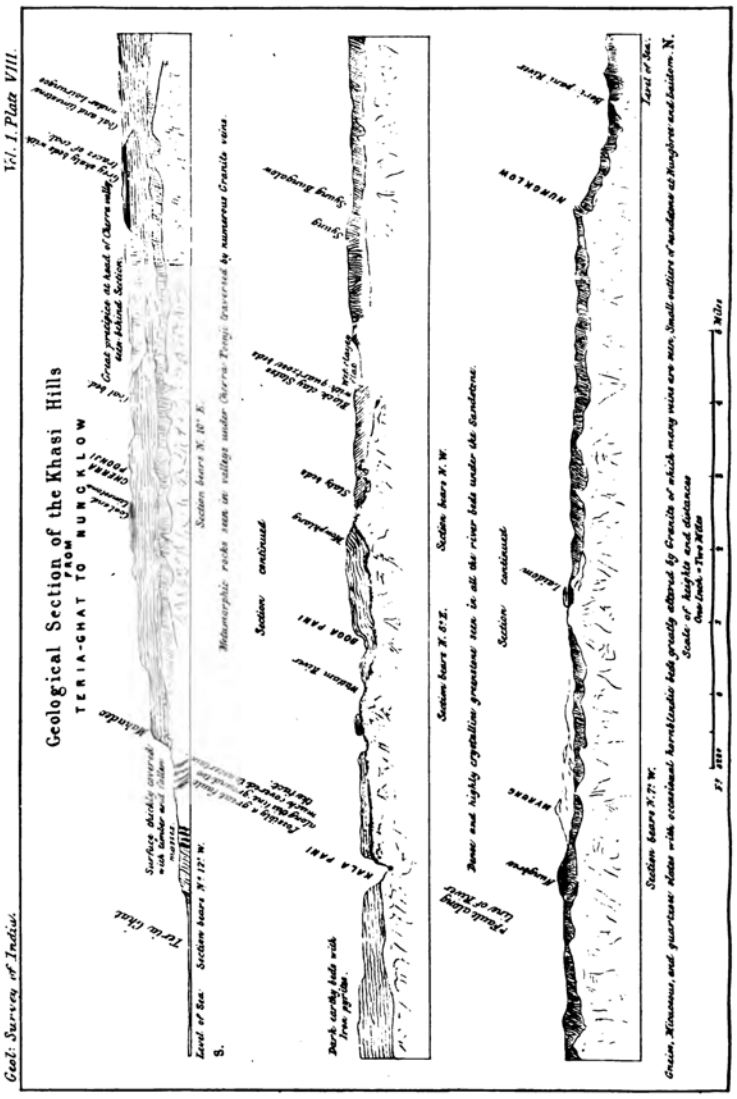

Figure 21b Memoirs of the Geological Survey of India by Thomas Oldham

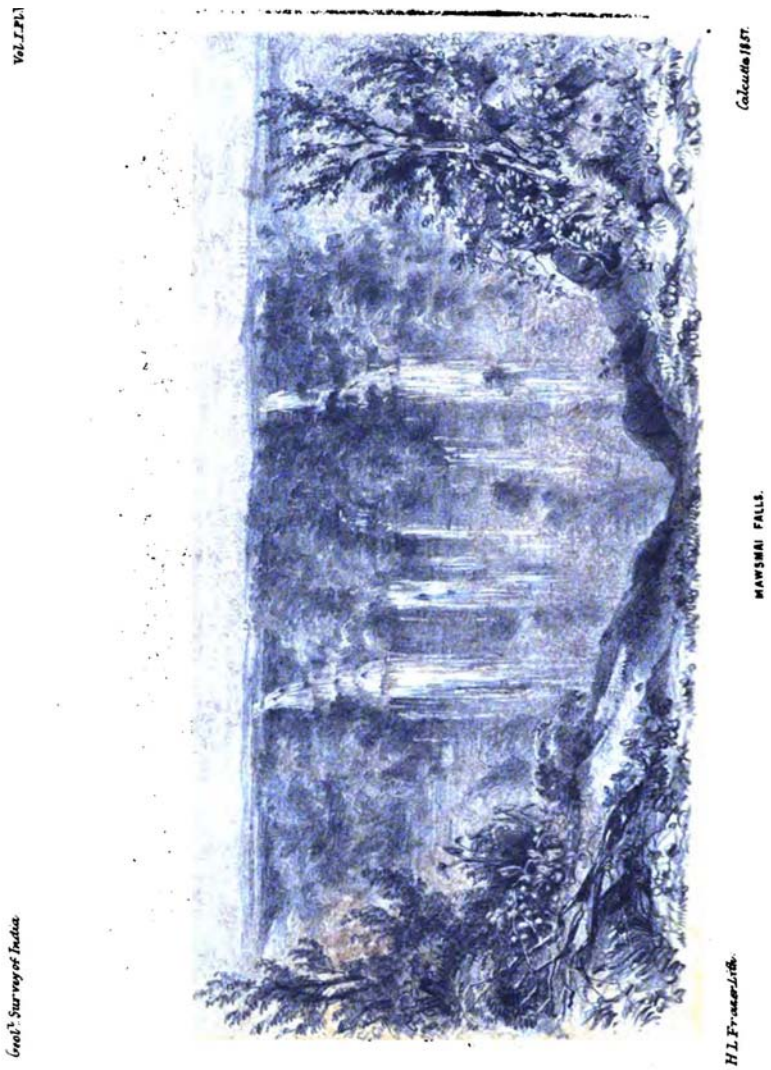

Figure 21c Memoirs of the Geological Survey of India by Thomas Oldham

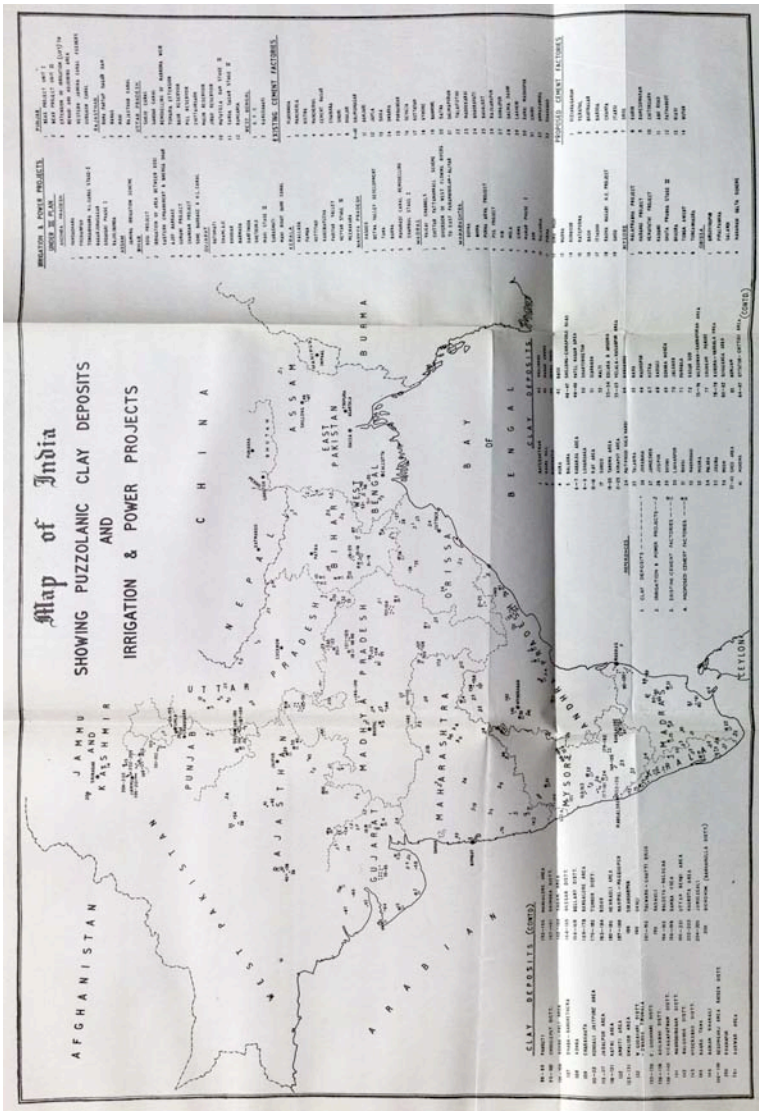

Figure 22 Industrial Cartography locating deposits in relation to power plants, coal and road networks

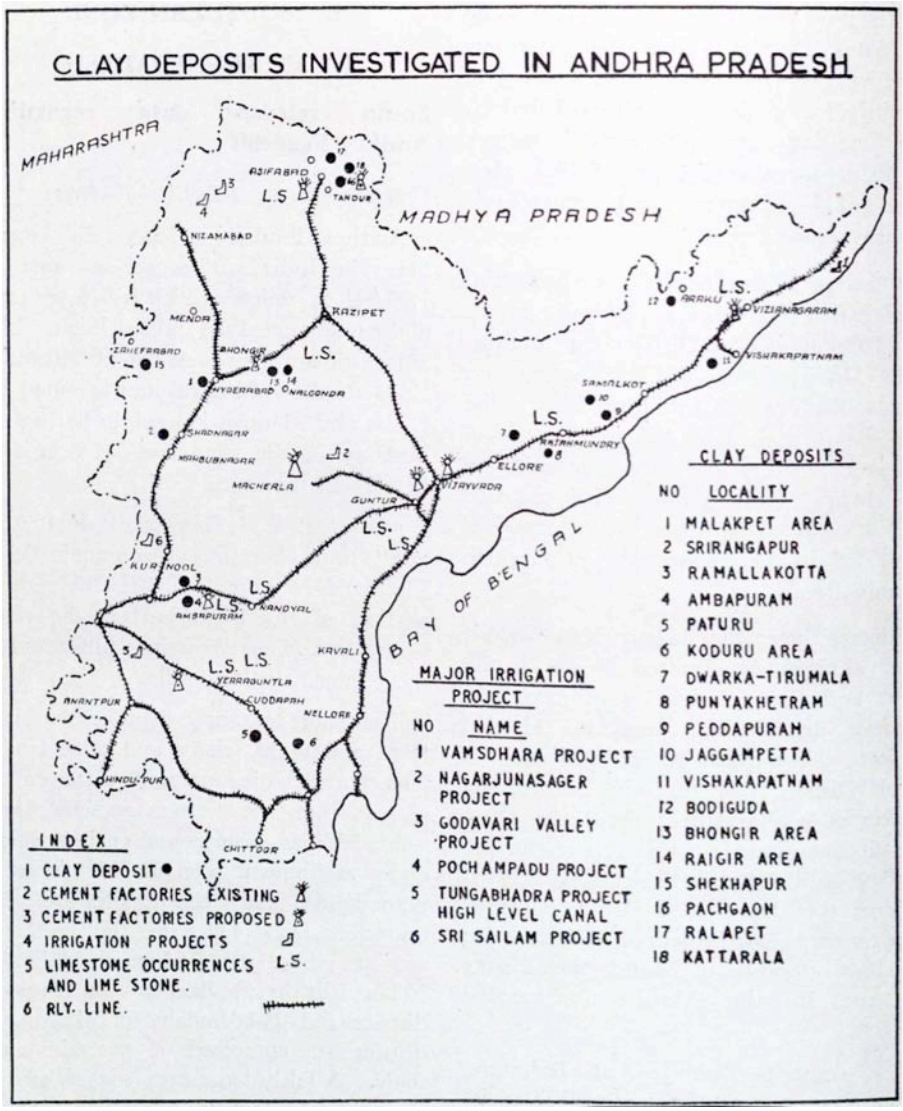

Figure 23 Industrial Cartography locating deposits in relation to power plants, coal and road networks

Studying Landslides

Natural disasters, the failing of the earth, foregrounds knotty and contorted problems for the state. Perhaps infrastructure must necessarily collapse, perhaps it is in the failure of a mountain to maintain its internal stability, that the state finds itself in a position of responsibility towards the subject. In the constant annual degradation of the road, the state finds itself to be necessarily perpetual. Or perhaps this is just how the state constructed itself: as an alibi for reconstruction of the perpetual degradation of the physical network that fell within its territorial boundaries. In both cases, the modern democratic polity that was India, took up the responsibility to manage failure. It is in the economy of failure that the state maintains intimate purchase in the lives of its subjects, coding itself into their routine imagination. In the moment of failing, the state is invoked as responsible and managerial.

While traveling on NH31a in Sikkim,[58] failure of the highway was coded into the routine of plying up and down it. Landslides, road sinks, fog and rain were some of the contingencies that were managed by local transport vendors who would quote inflated driving times and advise early departures so that airplanes and trains at the other end could be reached on time. The routine failure of the transport network whose management was the responsibility of the state, made ubiquitous the state into the lives of the road plying subject, and landslide and road article appeared frequently in the local newspaper Sikkim Now! (fig. 24).

Even though it was in the management of failure that the state found itself ubiquitous, its purchase on perpetuating itself emerged contrarily, in the imagination of the possibility of a failure

58. July 2008, with thanks to MISTI India Travel grant for supporting my research.

free future. Alongside articles of highway collapse was an article that planned a 'dream highway,' a four lane road with a railway alongside "as the crow flies"[59] (fig. 25). In the constant gap between the road that barely functions and the 'air conditioned, lighted, fire proof' 'dream highway,' is the state, tenuously hung. The state finds itself perpetually in this in between, between immortal infrastructure (the realm of responsibility) and everyday collapse (the realm of management).

Responsibility is a difficult word, that, on invoking 'duty,' takes on a moral tenor. Here I borrow from Thomas Keenan's Fables of Responsibility[60] where he, for the purpose of analysis, posits one extreme of responsibility, where the response offered has no grounds on which it can be based. If this extreme form of responsibility invokes a purely ethical space of no grounds, no alibis, then this space becomes the site where one can parse out the relationship (through the process of being responsible) between the state and the subject. The landslide, the sliding of land, a moment that in its slipperiness is so inherently inscrutable to the engineer (and therefore the state), is the perfect site to investigate the state's nature through its claim to responsibility. In the case of the landslide, the state invokes itself as a poltical entity, political because it is involved in the management of routine failure, but as also a responsible one, because it has no claim to having caused the problem of the failing mountain, nor does it understand it.

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59. I am greatly indebted to editor of Sikkim Now! Pema Wangchuk Dorji, conversation with him has helped me understand what is at stake in the state of Sikkim and the harsh reality of being connected to the state through the singular artery of NH31a. I am grateful for his generosity in sharing his archives with me, which is the source for all my images.

60. Keenan, Thomas. 1997. Fables of Responsibility: Aberrations and Predicaments in Ethics and Politics (Meridian. Stanford University Press, October.)

Landslides are peculiar and particular forms of failures. Within the moment of the collapse of earth, "the rapid displacement of a mass of rock," is embedded the depth and breadth of geological time and space, alongside the contingencies of immediate events. This mass of moving debris is a result of, both, the history of the earths plate movements, and the exigencies of current rock cuttings. When the mountain collapses, the debris through its documentation, becomes a repository of information as to the causes of failure. The pile of debris waits to be taken apart and reassembled through photographs, reports, maps and soil analysis. Through the process of documentation, it gets reconstructed as an epistemological object that can then be systematically analyzed to undo the knotty and contorted mysteries of long past geological events.

In 1966 the CRRI published a 'Handbook on Landslide Analysis and Correction'[61] that sought to create a reference for any engineer dealing with mountainous conditions prone to shifting. A photograph (Fig 26) in the handbook captures the sense of difficulty that the engineer would face in apprehending what a landslide is. The image, labeled 'Fig. 4 Debris Fall' is one of a set of images that illustrate what a few of the different kinds of landslides might *look* like. The photograph is taken from a distance, perhaps the next bend in the highway skirting the mountain, so that the lens, can capture the height of the rock fall. At the bottom of the frame is a washed out sliver of road resting on random rubble retaining wall. The debris in the image funnels through the centre of the frame in the concave between the between the rockier bulges of the mountain, spilling over, weighing into the centre of the image, covering the pavement of the road, reducing it to the sliver we now see. Right at the fulcrum of this image, at the conceptual centre of the photograph, (what in Barthesian terminology would be the punctum), in the moment of meeting of

61. Mehra, S. 1966. Handbook on landslide analysis and correction, New Delhi: Central Road Research Institute.

earth and rock and road, is one aberration, a geometrical and compositional aberration: the engineer. Standing upright in his contrasting black pants, back to the camera, body staring into the debris, he surveys the damage caused by this arterial blockage. With weight shifted onto left leg, he seems to be looking down into his hands, perhaps filling out the landslide questionnaire at the end of the handbook that he has become an illustration for.

Once the land has collapsed, it must reemerge through the engineer as a knowledge object. Its internal stability having been compromised, it must gain coherence again through disciplinary registers; the engineers task is to now recreate the inscrutable landslide into a known object, classified into its correct geological and technical category. The state, invoking its techno-political self, presences itself in the photograph, through the body of the engineer.

To know is to be able to classify and the classification of a landslide is no easy task, Dr. SR Mehra's technical handbook opens with precisely this problem of classification. The first chapter, 'Landslide Types and their Classification,' says of classification that,

> 'From the point of view of highway engineering there is not much point in classifying earth movement in too great detail... Actually, each failure deserves to be considered individually and classification should be used only for purposes of general description. Very often it has been expressed "Landslides are individuals" and as such, generalisations have perforce to be limited."[62]

This passage is ironical in that it points to the endless ink that has probably been spilt in attempts at classifying landslides, even though they are unclassifiable. Although this passasge is ironical, it is not paradoxical, in fact, it precisely maps the problem of state responsibility towards failure. If the state is to be responsible for the management of failure, yet not culpable for the col-

62. p. 4 ibid

lapse of the mountain, it requires its representative, the engineer, to claim the mountain as inherently inscrutable. In some ways the engineer is a representation of the state.

In order to deal with this inscrutable mountain, the engineer uses two strategies. First, she tries to create a table that is not a definite grid but rather a kit of parts which by different combinations can be conjoined to understand 'complex landslides.'[63] (Fig 27 & 28) Both tables are attempts to re create the mountain in its complexity. The first table tabulates the different ways in which rock falls, different movements and the different materials that move, and then at the bottom leaves a sort of blank space to be filled intuitively, that is labeled, 'combination of materials or types of movement,' a space that relies on the expertise of the engineer, and not on any form of theoretically verified method. The second table details the same table in terms of what different landslides look like, creating an aesthetic terrain for the engineer to learn from, to be able to read the topography.

The second thing that the engineer does is define experientially what cannot be pinned down technically,

> 'The term landslide refers to the rapid displacement of a mass of rock, residual soil or sediment adjoining a slope in which the centre of gravity of the moving mass advances in a downward and outward direction.'[64]

Here, the landslide is explained by its movement down and out from the mountain onto the road. It is a definition that explains the movement of the earth from the point of view of the experience of the user of the road. It conveys the severity of the problem of the unexplainable and unpredictable shifting of lose earth in terms of its coming 'downward and outward' into the road,

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63. complex is a technical term for landslides that have more than one kind of earth movement in them

64. p. 1 ibid

the space of the subject. Here the engineer crafts herself as the expert that can provide testimony regarding the inscrutability of geological phenomena for the state that would otherwise be culpable for the failure of the mountain. The impossibility to know the landslide as an epistemological object is simultaneous to the creation of the a field of expertise surrounding it, that depends on an aesthetic reading of the mountain.

Reading this experiential definition, I was reminded of my conversation with Pema Wangchuk Dorji, the editor of the daily Sikkim Now! Sitting in his Gangtok office, he related to me stories of the repeated annual collapse of culverts and caving in of sections of road, along NH31a, the singular artery into Gangtok. Why could they just not throw a bridge over these failure prone segments, he wondered, visibly irate at the annual problems that emerged from the states inability to produce permanence (or at least something that would last beyond one rainfall). With this again we are back in the space of responsibility. The decisions that the state makes with regard to dealing with the problem of shifting earth are dependent, not on the vagaries of geology, but on the contingencies of economy and technological ability. What has to be acknowledged (by the historian) is this constant asymmetry that the post colonial state was subjected to between cognition of the movements in the earth and the action taken by the state to mitigate the problem (as we experience it), because of constraints of economy.

In the case of the landslide, this gap, interruption, asymmetry between cognition and action was bridged by the expertise of the engineer and the geologist, who, through the aesthetic reading of the earth's surface and the resolution of the physical forces at play inside the earth through geometry created a scientific (and therefore modern) solution for this problem, which I explore in the next chapter.

Saturday, 23 February, 2008 — Vol 1A No 107 — Gangtok ☐ Rs. 3

SIKKIM NOW! FIRST WITH THE NEWS

Farmers' Club reps groomed for adopting technology

a NOW REPORT

GANGTOK, 22 Feb: About 20 representatives of various farmers' clubs of Sikkim completed a capacity building initiative aimed at encouraging them to "adopt technology". The 2-day affair was jointly organized by NABARD and the Sikkim unit of the G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) here at the latter's campus at Pangthang.

The programme focused on medicinal plant cultivation, multipurpose plant propagation (conventional and tissue culture) and related nursery practices, bio-globules, bamboo propagation, improved kiln for large cardamom, low cost polyhouse and poly-pits, bio-composting (conventional and vermi based), water harvesting structure, etc.

turn to pg2

Scientific enquiry will help protect Sikkim's environment better: CM

LUBHANA RAI

GANGTOK, 22 Feb: "Imagination is greater than knowledge." Quoting Albert Einstein, Chief Minister Pawan Chamling today lent a fitting flavor to the inaugural ceremony of the State's first Science Centre at Marchak, East Sikkim as he expounded on his government's endeavors "to bring maximum benefit and joy to our people through thousand acts of imagination".

"Today, we have succeeded once again and the establishment of this Centre, I am sure, will help in igniting the minds of thousands of our countrymen to make our society, state and nation stronger and more confident through scientific quest and technological invention," the Chief Minister said in his inaugural address.

In view of the abundance of natural resources here and the need for protecting their sanctity, he emphasized that more scientific studies and exploration were required for the identification, protection and promotion of environmental wealth of the Himalayas.

The Chief Minister elaborated the various initiatives undertaken by his government for the safeguard of the environment. Mentioning the institution of the country's first Commission for glacial study, initiated and constituted by the State Government last year, Mr. Chamling today informed that the Commission had already evoked positive response from glaciologist from Iceland who have offered their unconditional support to the endeavor.

He also shared the Union Ministry of Environment & Forests' decision to relocate the Regional Museum of Natural History [RMNH] for the North East Region to Gangtok.

He also informed of a Biotechnology Mission programme launched by the government for sustainable development and utilization of the rich biological resources using biotechnological intervention for employment generation and economic upliftment of weaker section of the society.

Mention was also made of the joint venture between the state government and the Regional Remote Sensing Centre, Department of Space, for development of digital database on the natural resources of Sikkim under the National [Natural] Resources Information System [NRIS].

Pointing out Sikkim's susceptibility to earth-

turn to pg2

Namok Khola bottleneck chokes Dikchu-Mangan traffic, everyday

WANGCHUK BHUTIA

DIKCHU, 22 Feb: Traffic disruptions over the Namok Khola stretch, 35 kms from Singtam on the Mangan-Dikchu highway has become a persistent nuisance for commuters and travelers here who are forced to wait for at hours end for the bottleneck to clear every time a truck gets stuck on the slippery incline, which is very often.

With work beginning on hydel projects further up in North Sikkim, the volume of this truck traffic supplying the project sites is expected to rise even higher and the excruciatingly slow progress of repair works on the stretch has hardly commuters worried.

And the problem is not limited to the commuters alone. The trucks and other bigger vehicles have to overcome the stretch at the expense of sustaining possible

turn to pg2

Fig 24 Landslide article

Wednesday, 14 May, 2008 RNI Regd. No: SIKENG/2008/23069; Vol 1A No 172 Gangtok ❑ Rs. 3

SIKKIM NOW!

FIRST WITH THE NEWS

BRILLIANT COACHING
"Success is Our Motto"
Direct Admission for Medical, Engineering& different professional course
Under Management Quota/ NRI is going on!
Enrollement for ICSE & ISC
WINTER CRASH COURSE
is going on!
Beside Nepali Sahitya Parishad Bhawan, Dev. Area, Gangtok

MASTERS EDUCATION POINT [MEP]
[Established- 2003]
CRASH COURSE [LAST BATCH] FOR ACCOUNTS CLERK & ACCOUNTANTS
STARTING FROM 5TH MAY 2008
SUBJECTS:
i. Arithmatic
ii. English and G.K.
BESIDE IPR OFFICE, TIBET ROAD, GANGTOK

18,000 still buried at heart of China earthquake

The official death toll in the Chinese earthquake rose to nearly 12,000 today and 18,000 people are buried in quake-hit city of Mianyang.

A day after the 7.9 magnitude quake struck, state media said rescuers had reached the epicentre in Wenchuan county - cut off by the disaster and where the number of casualties was unknown.

But rain was impeding efforts and a group of paratroopers called off a mission to the area due to heavy storms.

Nearly 10,000 people died in Sichuan province alone and 300 others in other provinces and the mega-city of Chongqing with its surrounding rural areas, the official Xinhua news agency reported.

Meanwhile the British Foreign Office said around 100 British tourists in the area had all been accounted for.

The tremors caused a wide swath of damage across central China, sending people fleeing with their few salvaged belongings.

Aftershocks rattled the region for a second day, sending people running into the streets in the city of Chengdu. The US

A LIFELINE EXCLUSIVE FOR SIKKIM

Infrastructure developers unveil 53 km Gangtok-Sevoke dream highway

STAR UNIVERSAL RESOURCES COMPANY PRESENTS PROJECT THAT WILL RESCUE SIKKIM FROM VAGARIES OF LANDSLIDES AND BANDHS

RANJIT SINGH

GANGTOK, 13 May: The Proposal: Four tunneled highways, including two roadways and two railways; Technology: state-of-the-art; USP: fully air-conditioned, lighted, fire proof with the latest safety equipments; Icing: Only for Sikkim; Cost: at Rs. 8,000 crores.

This is the magnificent proposal prepared by the Star Universal Resources Company for construction of an alternative highway connecting Gangtok to Sevoke, a concept which was presented by the company's Asia operations president, Somnath Sur, along with Dr. Johann Golsar at Chintan Bhawan today before the Chief Minister, Cabinet ministers and Heads of Departments. Also present were representatives of the army and BRO.

Says Mr. Sur in an exclusive interaction with NOW! "After hearing the proposal, Minister DoNER, Mani Shanker Aiyer, offered to be the representative of the central government during the signing of the agreement".

The concept, before its presentation at Chintan Bhawan today, was also shared with the DoNER Minister before the team arrived in Sikkim.

Chief Minister Pawan Chamling was delighted at the presentation and very agreeable to it, informs Mr. Sur. In fact, the signing of the agreement between Star Universal and the State government would have taken place today itself had it not been for the desire of DoNER Minister to be part of the agreement.

As Mr. Sur says, it is to be a tripartite agreement. The agreement is expected to be inked in June next month.

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Containing Bird Flu in West Bengal

NEW DELHI, 13 May [PIB]: Department of Animal Husbandry, Dairying and Fisheries, Govt. of India has notified Avian Influenza in poultry in Village

SVSS polio camp treats 48 patients from State and outside

LUBHANA RAI

GANGTOK, 13 May: The free polio camp organized by Sikkim Viklang Sahayata Samiti [SVSS] in collaboration with Narayan Seva Sansthan [Trust] of Udaipur recorded a total 48 patients from all over the state as well as neighboring Darjeeling district being treated today here at the SVSS office premises.

Of the 48, 10 have been referred for further treatment.

tended his membership to SVSS on the occasion. Gangtok MLA, NK Pradhan, present as a special guest, also lauded the initiative.

The organizers also donated 12 wheel chairs to STNM hospital today, handed over to Medical Superintendent, Dr. IL Sharma, while the patients were provided with wheel chairs and crutches after their check-ups.

Narayan Seva Sansthan, in collaboration with the

Figure 25 Dream Highway

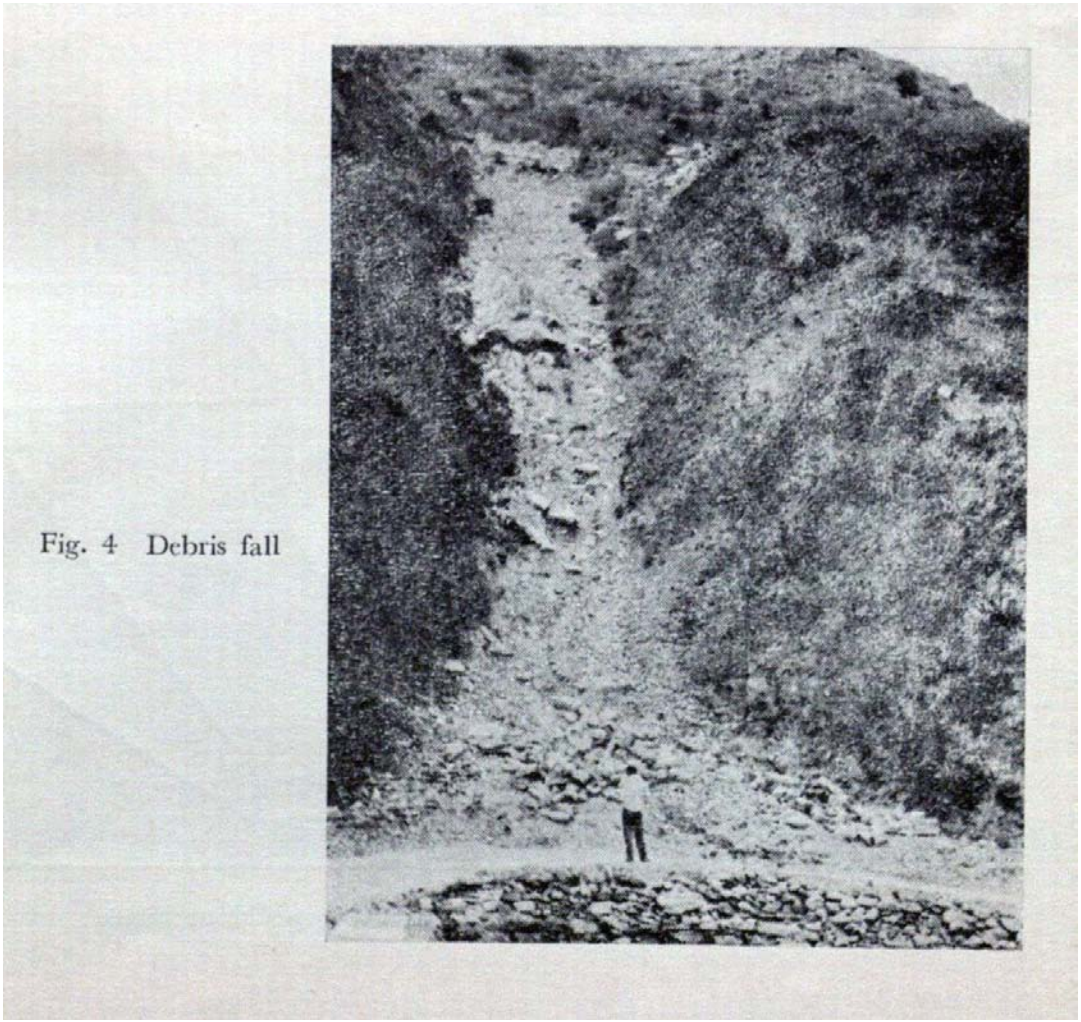

Figure 26 Image illustrating a kind of landslide

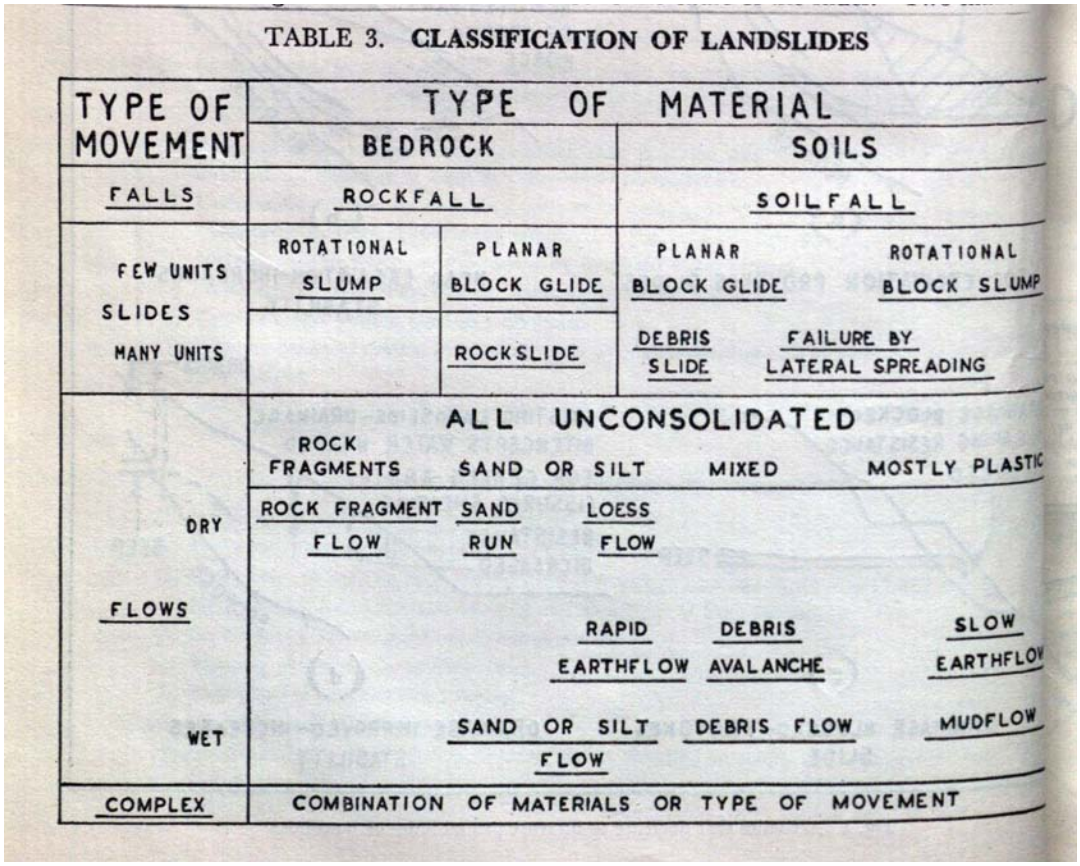

TABLE 3. CLASSIFICATION OF LANDSLIDES

TYPE OF MOVEMENT	TYPE OF MATERIAL			
	BEDROCK		SOILS	
FALLS	ROCKFALL		SOILFALL	
FEW UNITS SLIDES	ROTATIONAL SLUMP	PLANAR BLOCK GLIDE	PLANAR BLOCK GLIDE	ROTATIONAL BLOCK SLUMP
MANY UNITS		ROCKSLIDE	DEBRIS SLIDE	FAILURE BY LATERAL SPREADING
	ALL UNCONSOLIDATED			
	ROCK FRAGMENTS	SAND OR SILT	MIXED	MOSTLY PLASTIC
DRY FLOWS	ROCK FRAGMENT FLOW	SAND RUN	LOESS FLOW	
			RAPID EARTHFLOW / DEBRIS AVALANCHE	SLOW EARTHFLOW
WET		SAND OR SILT FLOW	DEBRIS FLOW	MUDFLOW
COMPLEX	COMBINATION OF MATERIALS OR TYPE OF MOVEMENT			

Figure 27 Landslide classification chart 1. What is interesting here is that classification aside, diagnosis occurs in the 'complex' row at the bottom, that combines all possible forms and is dependent on the expertise of the engineer.

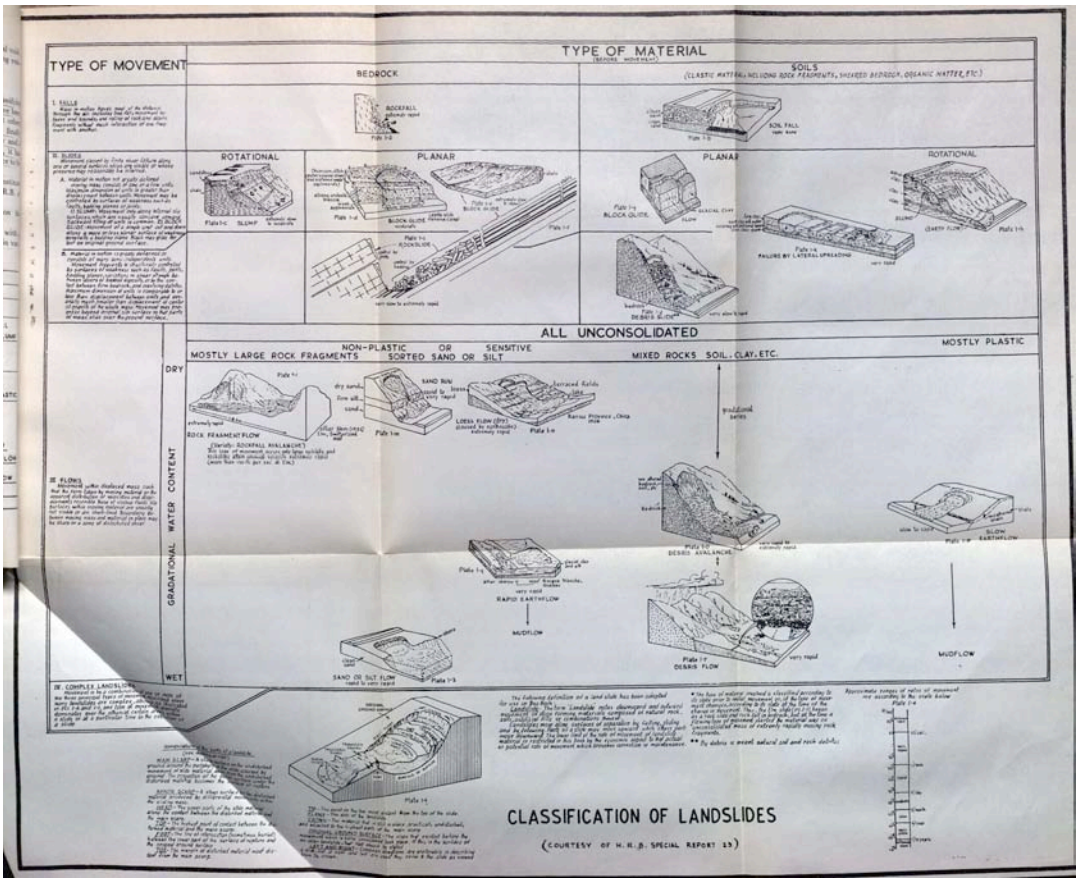

Figure 28 The ability to understand a landslide is the ability to apprehend it visually, this chart provides that visual reference, in turn aestheticizing the landslide.

Creating Expertise

The purpose of the CRRI's 1966 'Handbook on Landslide Analysis and Correction' that I discuss in the previous chapter is not simply to classify and create an all inclusive reference book for engineers, and this is made clear in the preface,

> "It is certainly not the intention that the Handbook will eliminate the need for an expert or a specialist in the solution of all landslide problems. Nor is the intention to suggest that all landslide problems are capable of direct scientific solutions."[65]

Quite the opposite of eliminating expertise, it creates expertise in the field of making roads in mountains, it produces the 'landslide specialist,' the engineer that could exercise 'good judgment.'[66] Good judgment is precisely the site of intuition that the engineer uses to gauge the site of failure. Expertise is intuitive intervention. The handbook trains the engineer to read the mountain visually. If the state was not able to access the mountain through a scientific discourse because it lacked the resources to, then it had to access it visually, and what it could not access visually, through geometry, that is, 'interpolations and projection'. The attempt at creating a field of visual expertise can be seen in the "Rules relating to Field Investigation of Actual Landslides with a View to planning Control and Corrective Measures."[67] What follows is a series of

> 'rules [meant] to guide the engineer as to the steps he should take and the manner in which he should go about with regard to field investigations when a landslide has actually occurred, with a view to planning the appropriate measures for repairs and reconstruction.'[68]

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65. p. 1 ibid (check)
66. ibid (add p. no.)
67. p. 103 ibid
68. p. 103 ibid

The rules are interesting in how they conceive of the task of the engineer.

> 'The 'investigator... should obtain a knowledge of the general setting... all the factors that make up the physical environment - geology, soils topography etc... he should try to obtain the necessary background knowledge by studying available aerial photographs and all topographic, geologic and soil maps of the locality if possible.'

It was through a detailed observation of the site that the mountain could be reassembled as an epistemological object. The mapping of a landscape to understand its susceptibility to collapse onto itself was a project that fell into an aesthetic realm: a project of careful observation. The instructive rules continue,

> "The surface of the rupture is easily recognisable at the crown and on the flanks, where it is the limit of displacement and where it may, in fact, be marked by a cliff or scarp... the recognition of the plane or surface of rupture may have to be based on the striations or slickenslides developed by motion of the slide mass on the 'plane of failure.'commonly this plane of failure is a series of closely spaced subparallel surfaces in and between which detrital rock fragments, if present, will be oriented in parallel with the plane of failure."[69]

In this passage (point number 12), the engineers ability to read the surface of rock borders on an aesthetic reading, the first apprehension of the plane is an aesthetic one. The point before this (number 11) explains the basic parts of a landslide,

> 'The upper part of the slide is the crown, or that point where the slide mass breaks away from the original ground slope. The cliff-like face below the crown is the main scarp. The contact of the mass of the slide debris with the main scarp is the head of the slide. These together mark the upper limit of the slide. The lower limit of the slide is the toe, which is the margin of the disturbed material most distant from the main scarp. The tip is that point on the toe most distant from the crown of the slide, or the flanks... Displacement at the toe may not be measurable because the foot (the line of intersection between the lower part of the surface of rupture and the original ground surface), may be buried. This displacement at the toe, however, may be inferred by interpolation and projection."[70]

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69. p. ibid

70. p. ibid

I quote these points particularly because they illustrate how the mapping of a landslide depends so crucially on a metaphorical and aesthetic reading of rock formations, a reading that results in the description of rock formations as body parts (Fig 29). The landscape gets re-written through visual tropes, and the parts that cannot be accessed visually, by 'interpolation and projection,'[71] that is, through trope of geometry (Fig. 30). From the debris of the landslide what emerges is the expert, laying claim to Indian modernity, who then classifies, and reassembles the mountain from the fallen debris.

The problem for the 'landslide specialist'[72] is that of translating the complex geological into the manageable and the technological. This is his interest.

> "Many minor landslides probably will deserve no more than a cursory inspection by the landslide specialist who will be interested in merely classifying the slide before prescribing corrective measures."[73]

What was professed to be a "considered individually..., classification... be used only for purposes of general description," now in chapter 5 of the handbook, becomes what the 'specialist' would be 'interested in.'

The production of a language with which to speak of landslides was primarily about the production of words for geological phenomena that occurred on site. The surface of the earth had to be described, and then analyzed. Words were needed for its description and its subsequent analysis. It also required the production of the surface as an aesthetic field that could be read using those words. How, for example, would an engineer know if a portion of a slope was susceptible to

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71. p. ibid
72. A new field of expertise invented by the institute?
73. p. 36 ibid

slumping, how would one be able to tell? The task was to read the surface of the mountain, the cracks, where they were, the shape of them, the sizes, the depths, the section of the crack along the depth. Cracks were windows into geological time, registers of forces that could not be seen. The task was to look at the trees, their bending, tilting, their direction of growth. The cracks and trees become registers of movement in time, markers of how the earth had changed (Fig 31). The description of cracks slide into a tropological field, cracks that 'wedge' shut indicate earth that is creeping. Cracks that maintain uniform width indicate a block slide. En echelon[74] cracks delimit the area of a slide, their oblique nature indicates the unhappy joint between two soil types that move at different rates, as the shear forces between them move the earth, they mark the portions most likely to fall.

This landscape of tropes become rigorously coded into a geological language that refers to the same meaning across the discipline.[75] This process undoes the central problem with metaphors: it contains epistemological risk and prevents epistemological damage.[76] The metaphor

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74. echelon - 'A formation of troops in which the successive divisions are placed parallel to one another, but no two on the same alignement, each division having its front clear of that in advance' (Stocqueler). Also attrib. in echelon (also Fr. en échelon): drawn up in this manner. direct, oblique echelon.

In a dictionary of geology en echelon is defined as " adj. [Geology] Describing parallel or subparallel, closely-spaced, overlapping or step-like minor structural features in rock, such as faults and tension fractures, that are oblique to the overall structural trend. "

75. One of the fallout's of this that I am not sure how to make sense of, occurs in geology where the instability of the earth is predicated on plate movements from pre cambrian eras, a realm where disciplines force language to draw from current political contingencies and twist them into etymological knots like that of the Gondwana supercontinent, that comes from the Gond tribe of Maharashtra, currently one of the most dispossessed people, who I talk about in chapter 4 as the tribals, that the state uses the roads to make legible.

76. Here I borrow from Man, Paul de. 1978. The Epistemology of Metaphor. Critical Inquiry 5, no. 1 (Autumn): 13-30. doi:10.2307/1342975.

of soldier marching in ranks, oblique but parallel, (en echelon) can no longer smuggle in unwanted meaning, bringing with it ghosts that emerge in the interstices between the figurative metaphor and rigorous language of science. From the tropes that refer to the human body, the discipline moves on to the more abstract trope of geometry, and these controlled metaphors continue. If one encounters a spoon shaped slide (and there is a photo with a spoon in the earth, Fig. 32), how can it be thought about geometrically for the purpose of analysis?

When treated in a cylindrical way the landslide can be reduced to a section that can then be understood in terms of the geometry of its forces, it can be farther divided into slices of soil that each exert normal and rotational forces that can be resolved into horizontal and vertical forces that can be added up to determine the magnitude of force that lies potentially in a volume of the mountain. (fig 33)

The portion of land susceptible to slumping itself needs to be thought of in terms of an object with different properties. It has a head, and a crown that exerts the most pressure, whose excavation considerably quells chances of slumping by reducing the weight that exerts the most force (Fig 34). The lower end is concordantly called the toe of the landslide. It is the portion that holds back the mountain, the excavation of the toe greatly increases the chances of the sliding of the land. The words become shorthand and seem relevant in the context of a handbook, as shorthand terms to be used on site.

For the expert attempting to calculate the magnitude and volume of a landslide (and therefore the economics of rock cutting and future damage), geometry becomes the means by which the inaccessible and unseen can be apprehended, the realm where forces of nature can be triangulated and resolved (Fig. 35). Geometry allowed for the diagramming of forces that were not

material and the making visible of depths that were inaccessible. Geometry allowed access to those parts of the earth that aesthetic methods of observation could not access. The slip circle method and the concentric circle method (Fig. 36 & 37) impose geometries onto the landscape so that calculations of magnitude and scale can be made. Resolving forces through geometry is far more economical than the boring of holes and the analysis of rock samples in the process of determining risk, and the engineers of the state are painfully cognizant of their use of assumption because the contingencies of economy dictate largely the process of knowing the landslide: we cannot bore every landslide, we cannot test all earth. The visual tropes, simultaneously, produced as a field of language had to be systematized through a conceptual notion of expertise, so as to prevent epistemological damage.

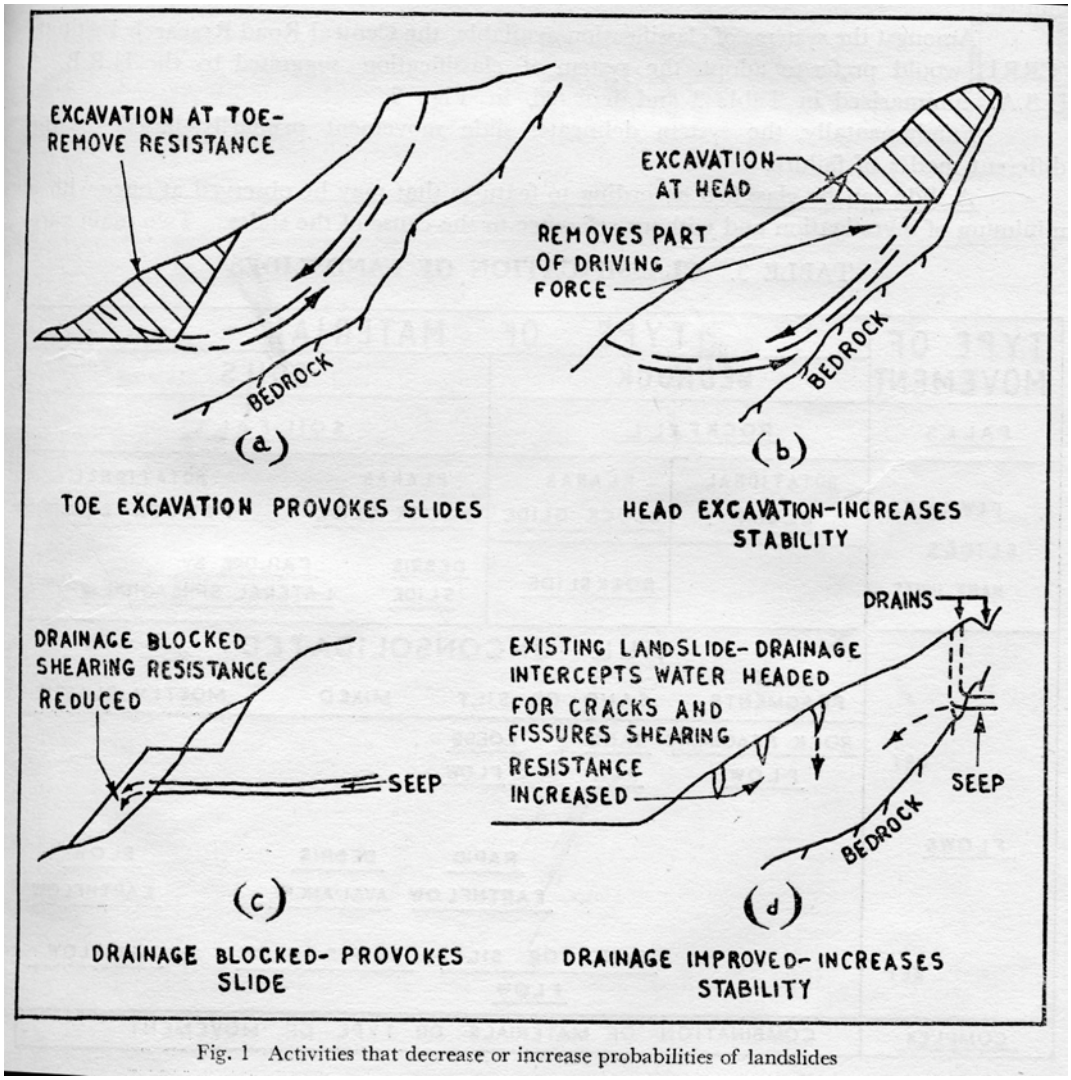

Figure 29 Image explaining the head and the toe of the landslide

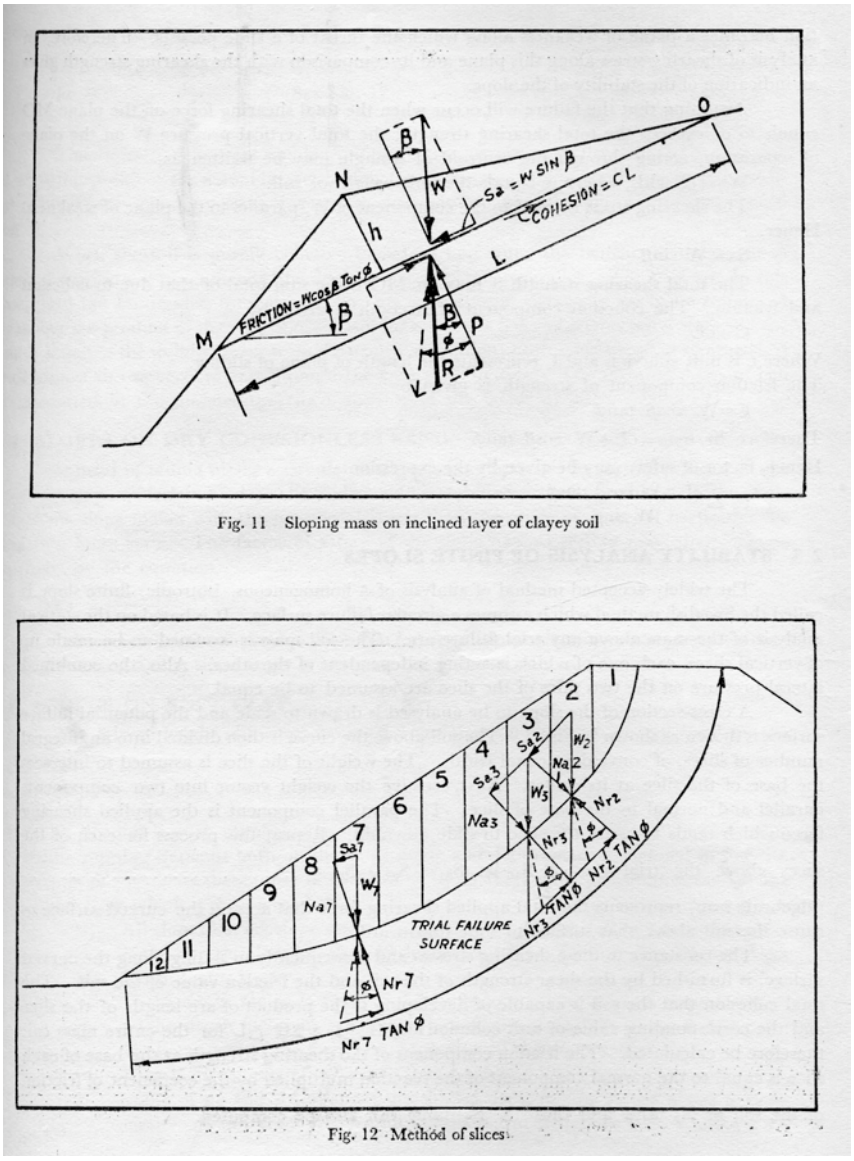

Figure 30 Showing the geometrical calculation of the landslide

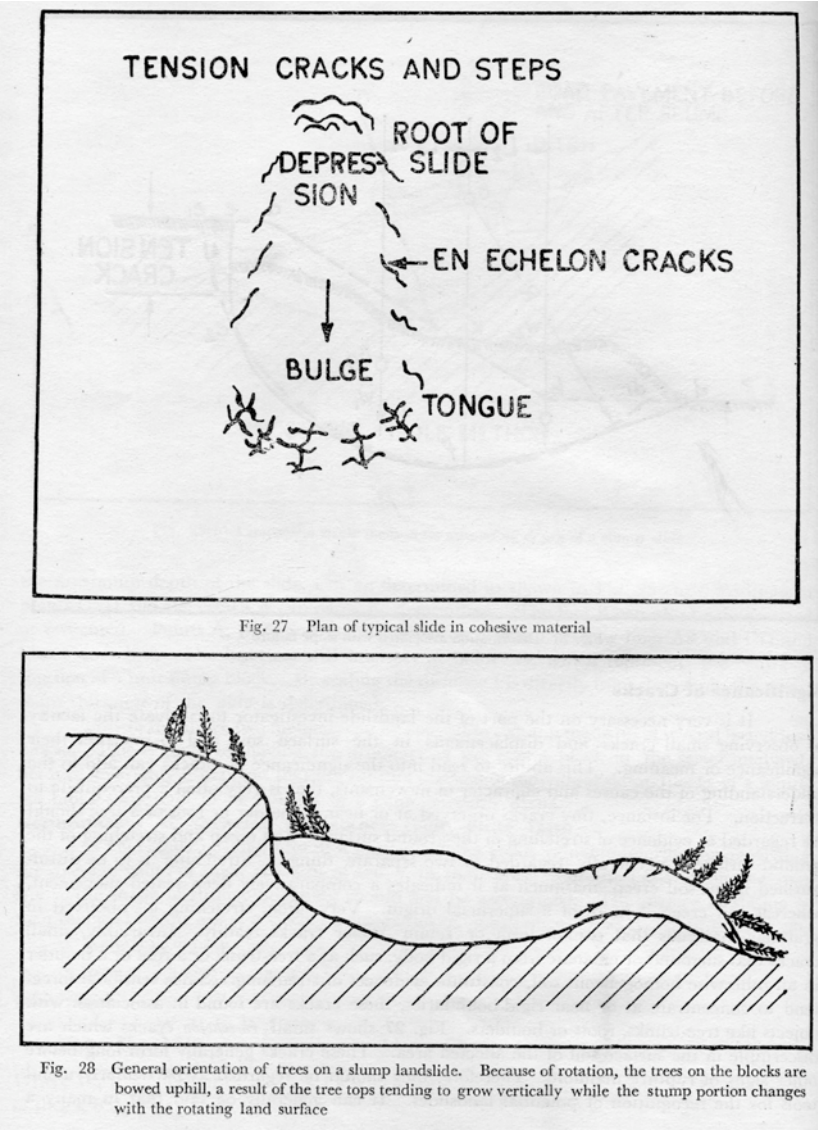

Fig. 27 Plan of typical slide in cohesive material

Fig. 28 General orientation of trees on a slump landslide. Because of rotation, the trees on the blocks are bowed uphill, a result of the tree tops tending to grow vertically while the stump portion changes with the rotating land surface

Figure 31 En-echelon cracks delimit the area of the slide, the trees register the creep of the land, and most oddly, the tongue of the landslide is drawn to look like a tongue in section.

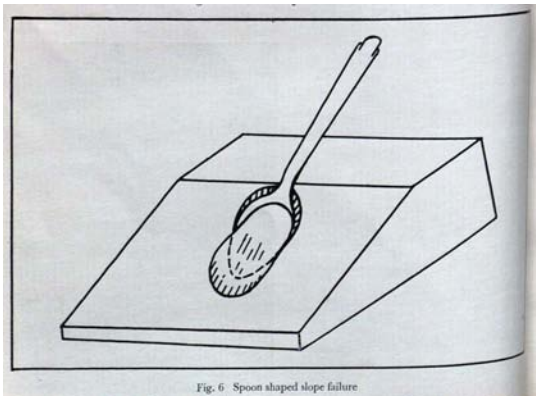
Fig. 6 Spoon shaped slope failure

Figure 32 Spoon shaped failure

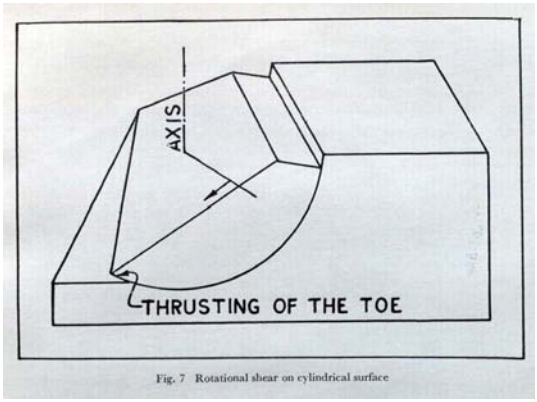

Fig. 7 Rotational shear on cylindrical surface

Figure 33 Cylindrical landslide

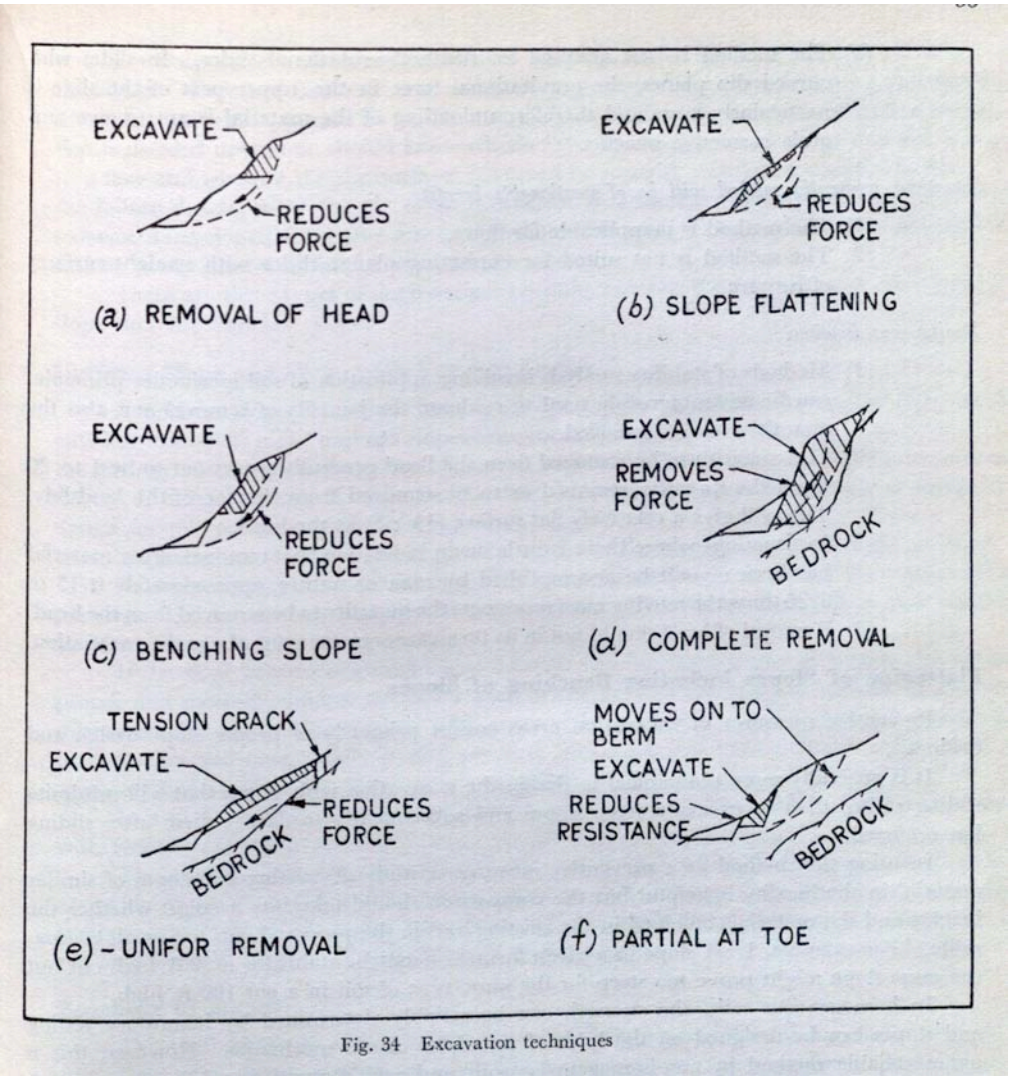

Figure 34 Body metaphors

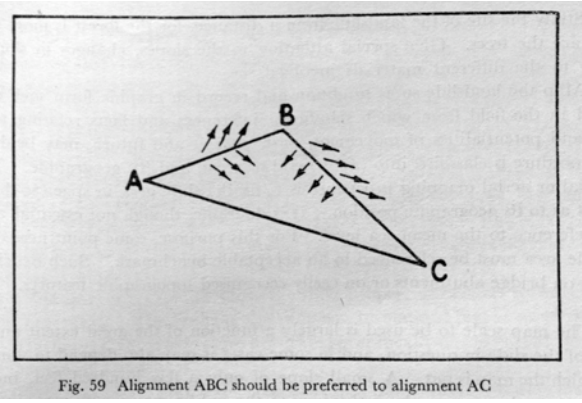

Fig. 59 Alignment ABC should be preferred to alignment AC

Figure 35 resolution through the triangulation of forces

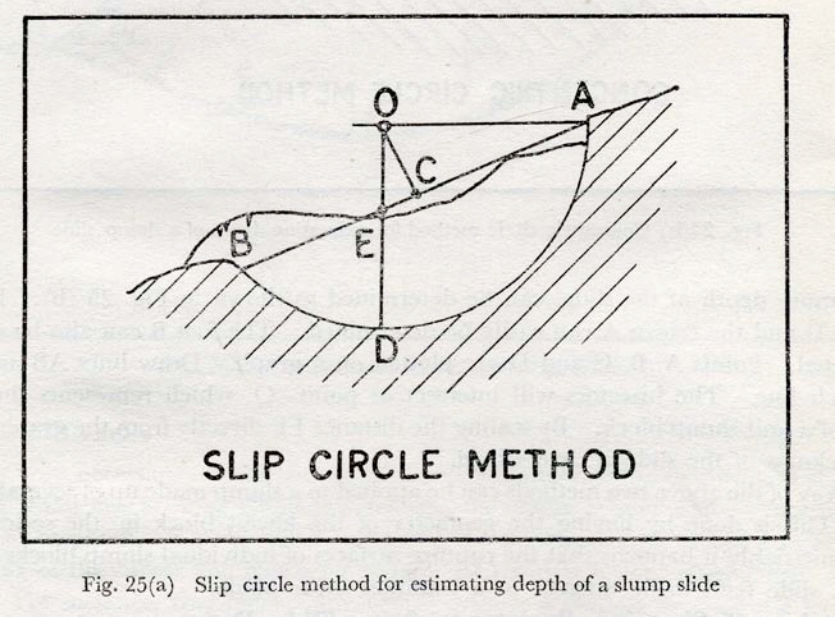

Fig. 25(a) Slip circle method for estimating depth of a slump slide

Figure 36 Geometrical determination of the depth of the potential slide

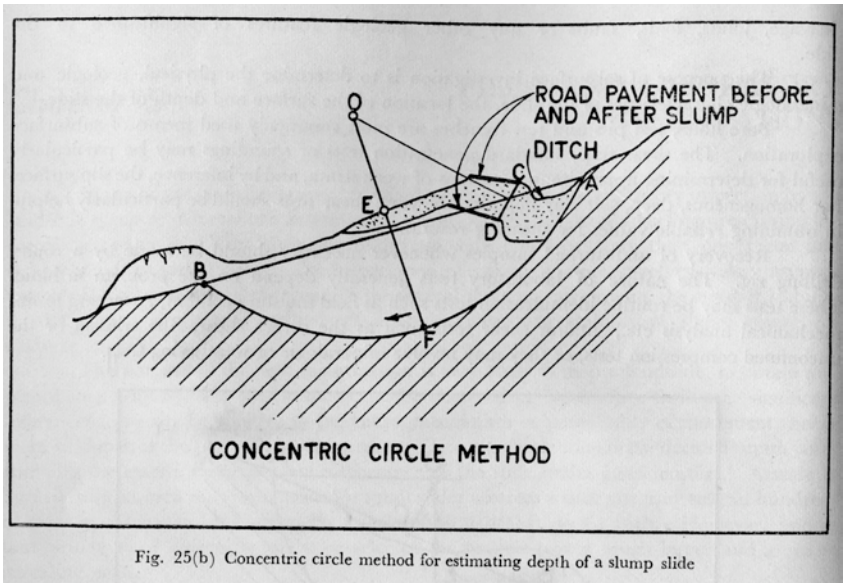

Fig. 25(b) Concentric circle method for estimating depth of a slump slide

Figure 37 Geometrical determination of the depth of the potential slide

| In Conclusion

+ Public Works post LPG | Tracking Shifts[77]

In 1991, the collapse of the Soviet Union and the sharp rise in oil prices caused by the Gulf War created a balance of payment crisis. India, facing bankruptcy, asked the International Monetary Fund (IMF) to help bail it out. The IMF in return demanded economic reforms. The congress party was in power and their leader, Prime Minister PV Narasimha Rao, appointed oxford economist Manmohan Singh as Finance Minister, who, (through what came to be known as Manmohanomics) began the process of deregulation, which initiated the beginnings of privatization, tax reforms, inflation control, and began removing obstacles to pave the way for Foreign Direct Investment. The term of PM P. V. Narasimha Rao (who led a minority government) was followed by political turmoil, with the country seeing three different governments in three years, and finally and the Bharatiya Janata Party (BJP) came into power in 1998 with Atal Behari Vajpayee in the seat of the Prime Minister.

One one hand, the country saw a radical change in terms of its economic framework, on the other, the instability of the government and the rise of many national parties forced the various parties to define their national agenda vehemently.

The economic reforms had an important impact on road research, the story of which I pick up from where I left it off in the introduction. The revenue that the state earned from a levy on petrol was around 25 crores in 1998. The levy charged had remained the same for 67 years, across

77. LPG is shorthand for Liberalization, Privatization, and Globalization

different governments and political ideologies.[78] In 1998 this changed. The gap between an income of 25 crore and the expenditure of 10,000 crore was suddenly attempted to be closed.[79] In the 1990s there was a specific shift in the agenda of the state as to how it formulated its imagination of road building.

What this means is the the unstable state in the 1990s invested in a technological symbolism to represent the nation as a totality. This techno-nationalism manifested in a nuclear test that upset many diplomatic balances and a significant investment in highway projects that conversely engaged the global system and the movement of capital. Although this trend worked across opposing political parties, the presence of Bharatiya Janata Party (BJP) in the driver's seat post 98, coloured saffron the details of this trend towards liberalization. The BJP stood for a volatile combination of masculine aggression,[80] and technological super-plans, characterized by Pokhran-II nuclear test, the Golden Quadrilateral Highway project, and the interlinking of rivers project.

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78. In 1929, as a result of the recommendations of the 1927 Jayakar Committee, the Central Road Fund was created through a levy on petrol at the rate of 2 annas a gallon (2 annas a gallon is equivalent to 6.25 paise a liter of petrol). In 1931 this tax was raised to 2.5 annas a gallon (at the rate of 10 annas a gallon of petrol this tax amounted to a tax of 25%) and from the March of 1931 up until the March of 1998, across different regimes, different governments, petrol price hikes and increasing consumption quantities, the levy on a gallon of petrol remained 2.5 annas in absolute terms. As of 1998, while the central government earned 25 crores from this fund, their expenses on road development were in the region of 10,000 crores. This asymmetry was balanced by the decision to tax diesel. What is of import is that before 1998 it was always petrol, the luxury fuel for cars, not diesel, the more ubiquitous fuel, used by busses, trucks, and also in gas stoves, generators and in rural houses, that was taxed.

79. I have not translated the figures into millions or dollars because I am only attempting to give a comparative sense not an absolute sense.

80. Sarkar, Sumit. "The BJP Bomb and Aspects of Nationalism." Economic and Political Weekly 33, no. 27 (July 4, 1998): 1725-1730. Sarkar argues that the grassroots training of the young Hindu male by the RSS uses motifs of militarisation that resonate in the aggression that manifested in the symbolism of Pokhran II

Again, although the road as symbol of the BJP's agenda seems an obvious answer to the question of meaning, the road performed a more careful and important function for the state. It became the site for the landing and materialization of global capital. The material road was required, so that global finance would have a real site of investment, and so, the road became a material iteration of the state's emergence in the global economy. The aggression of the nuclear tests forms the backdrop to the Golden Quadrilateral project that the state embarked on through the National Highway Authority of India (NHAI) and the two events exist as interesting counterpoints to each other in the story of nationalism.

The National Highways Authority of India (NHAI) Act was passed in 1988 by the central government and the body was made formally operational in 1995. It is 'responsible for the development, maintenance and management of National Highways entrusted to it.' This authority was mostly an executive body formulated to recast the nature of doing public works in a liberalizing and later on, a neo-liberalizing state. To them was assigned the National Highways Development Project, a project inaugurated in 1998 that was to revamp the major arterial highways that moved traffic across the length and the breadth of the country. Embedded within this sentence itself, "revamp highways across the length and the breadth of the country" is implied a shift in the conceptualization of roads as connecting places to roads as straddling terrains. To execute this administrative project, the state had to create a resource. This was the point at which the gap between the 25 crore income and the 10,000 crore expense (coming from general taxation) was bridged. The state decided to alongside the levy on petrol, tax diesel as well. The compromise that went with this decision to tax the ubiquitous and non-luxury fossil fuel, diesel, was that half of the income from taxing diesel would go into rural development (not rural road development, just rural development.)

The two projects that form the core of the NHDP are the Golden Quadrilateral Project and the North-South and East-West (NS-EW) highway project. In their names is coded their imagination of straddling the length, breadth, and perimeter of the country. The Golden Quadrilateral Project was inaugurated by Prime Minister Vajpayee in September 1998. This 6000 kilometer project was to connect the four metropolises, Mumbai, Delhi, Kolkata, and Chennai. It was subsequently merged with the National Highways Development Plan (NHDP), a 7000 kilometer east-west, north south corridor project, the execution of which was entrusted to the NHAI.[81] This approach implies a fundamental shift from social equity of the 1960s and 1970s to a new geometrical equality, one that conceives itself as free from the inequalities of geography. This technological solution to a political problem evokes the difficulty with inserting the arithmetic and geometric imagination of the state using a geographical entity, public works. While the 'quadrilateral' traces the edges of the conceptual rhombus that is India, connecting the four major metros, the NS-EW project draws the conceptual diagonals to this rhombus, geometricizing the country through its language and its project (see fig. 1 in ch 1). Not only did these projects require a reformulation of the way in which the system worked, but also a fundamental reconstruction of how we thought about concrete (self compacting, pumpable), superplasticizers, fly-ash, bitumen, cement kiln dust, paving stones, four-leaved clovers, and even geographical information systems (GIS).[82]

The shift in technology involved a shift, or rather a displacement of earlier models of tenders and contracts so that a more precise and controlled system of road building could come into place. The impact of this on the construction industry is transformational. An example of this is

81. Sarkar, Kshaunish; The Statesman (India), October 31, 1999, US Expertise Sought For Highway Plan

82. All references taken from papers written since 2000 by researchers at the Centre for Road Research Institute (CRRI) http://www.crridom.gov.in/crridom/j02-03.jsp

the use of ready mix concrete in the city of Mumbai for the purposes of building flyovers in tight urban conditions. This, by its introduction of ready mix concrete to the city, began to transform the way in which the building industry functioned. The thumb-rule concrete mixes of 1:3:6/1:2:4 done by volume on site was displaced by the need to engineer specific and contextual concrete mixes for each part of a flyover, for instance, that required to be assembled in the sterile conditions of a concrete factory and transported to site using ready mix machines.[83] The fields of expertise required for these new projects shifted as well. More than an engineer, a supply chain manager was required. Supply chain management (SCM) emerged as a major shaper of the construction industry in the 1990s. The field was a response to its own claim that, "actual practice in construction not only fails to address issues of supply chain, but rather follows principles that make supply chain performance worse."[84] Construction transformed in a way that it no longer occurred on site, but in various spaces of expertise, sometimes across the globe. SCM then created methods and models for the movement of these objects that were the conduits of global capital, to come together in the form of roads or buildings, which were the ultimate sites of the iterations that capital.

These transformations were set to the backdrop of the diplomatic disaster that was the bomb. Pokhran-II was the conducting of five nuclear tests in Pokhran, Rajasthan. The bomb, simply with the power of suggestion had the possibility to create tensions in South Asia. Even the suggestion of it was destructive. The “usefulness” of the bomb was easy to dispute. It was a huge unnecessary expense and it alienated China, diplomatically, without providing any real military

83. Dordi, C. M.; Lectures at the Kamla Raheja Vidyanidhi Institute for Architecture, 2004. (Ambuja Cement)

84. Ruben Vrijhoef and Lauri Koskela, Roles of Supply Chain Management in Construction, Proceedings IGLC-7

advantage. It led to the testing of missiles in Pakistan, accelerating tensions between the two nations. Tariq Rehman says, of Pakistan's missiles,

> "If these missiles are never used, then they will eat up our resources, increase tension, multiply mistrust and keep South Asia poor and backward. If they are used, the destruction they will cause will be so devastating that nobody will win the war."[85]

The same is true for the Indian bombs.

What it did do, was become a symbol of the BJP's commitment to techno-power in India. It made clear its stand on the Comprehensive Test Ban Treaty (CTBT), which it did not sign (although for different reasons).[86] Sumit Sarkar, in his 1998 EPW essay BJP and the Bomb, argues for the bomb as the physical manifestation of Hindu male/phallic power. This military chauvinism, he argues, mirrors itself at the grassroots level, where the *Rashtriya Swayamsevak Sangh* (RSS) (National Volunteers Organization)[87] train young recruits in aggressive and militaristic ways. Sarkar's essay echoes other positions that the country's intellectuals took against this issue: that all possible prognoses of the bomb led in directions that were undesirable in terms of humanity and in terms of foreign policy. But aside from the hesitations that were expressed, the argument that emerged had a sinister undertone to it, of the web of jingoistic nationalism, chauvinism, and its connection

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85. Narula, Sunil, Kremmer, Janaki B., Joseph, Ludwina A., An Arms Race On A Slow Spiral, Outlook India, May 04, 1998 http://www.outlookindia.com/full.asp?fodname=19980504&fname=indo_PAK&sid=1&pn=1

86. T. Jayaraman, The CTBT and scientific issues; The Frontline | Vol. 15 :: No. 21 :: Oct. 10 - 23, 1998; "India's main objections to the CTBT lay essentially in the fact that the treaty did little to advance disarmament in time-bound fashion, and in practice preserved the nuclear hegemony of the five nuclear powers while limiting so-called horizontal proliferation. The nuclear weapon powers, above all the United States, could maintain and improve their arsenals without any need for further explosive testing. The national security factor was important to the decision to stay out of the CTBT, but it was only one of a set of well-articulated objections. India's security, it was asserted officially, was best guaranteed by the elimination of nuclear weapons."

87. A right wing, grassroots, fundamentalist Hindu organization.

to hindutva, anti secular propaganda. This massive project of making a Hindu nation was the sinister undertone of the texts.

One of the direct links between road building and nuclear testing is that the bomb caused the World Bank to defer three loans to India meant for road and energy development.[88] In lieu of this occurrence, bomb testing and road development seem to be contradictory projects and in fact critics of the bomb were supporters of development projects. Instead, it was within this very contradiction that the Indian state constructed itself in its new avatar. The symbolism that was so inherent to the nuclear testing parallels the symbolism within the highway projects. Not only do they announce the new Indian state to the world, both events imbricate the Indian state into global politics and economics. Their concern is not at all similar to the concern of the India of the 60s where through the slow and painful process of experimentation, the state attempted to negotiate its relationship with its own modernity. This turn of events allows me to bracket off the end of my thesis with a note on the transformation that occurred within the CRRI and the BRO. The CRRI patrons are no longer the state, but the contractors who engage in road building. The BRO no longer works against an external enemy, but instead works to combat an internal voice of dissent against the state.

+ Final Thoughts and some Questions

88. Nuclear Tests in India and Pakistan retrieved: http://hansard.millbanksystems.com/lords/1998/jun/01/nuclear-tests-in-india-and-pakistan HL Deb 01 June 1998 vol. 590 cc52-64; "And last week the World Bank deferred three loans to India for energy and highways projects of almost a billion dollars as a result of objections by member states including Britain."

What has been bothering me through the writing of this thesis is the question of what the 1960s have meant in the larger context of shaping our material world in and in terms of the ideals that it propagated. At one level, it is a question of why the 1960s were important and what it is that we can learn from them. To ask that question is to ask what the social contract was, that played out through an institutional framework, in the 1960s between the modern state and its subject. What can I achieve by reading this material textually? I don't know the answer to these questions and I don't want to fold them into the easy rhetoric of state sponsored socialism but this is the space within which the state's research and my own thesis bothers me as to the larger problematics of our material reality and the politics that shape it.

Delhi's institutional landscape emerged from India's attempt at engaging in the Global intellectual arena, but not in the economic one. It is this intellectual relationship that I am interested in. The first director of the CRRI was Ernst Zipkes, a Swiss engineer from the ETH, Zurich. The first roads congress also involved a number of engineers from the ETH. Professor S R Mehra, Director of the Central Road Research Institute at New Delhi was a "leading contributor" to the conference of the Australian Road Research Board at Melbourne and photos of him emerge in the National Archives of Australia (fig 38 & 39). In another direction, papers written by engineers in the CRRI were presented at UN symposiums and housing conferences.[89] This network of intellectual relationships seems to be an important knot in the formation of architecture as a discipline and construction of as a field.

89. Paper presented by Dr. Uppal Regional symposium on "Scientific principles and their application in tropical building design and construction," Delhi, 21-24 December 1952

What changed in the 1990s is that India opened up itself in the global arena economically. This had a profound effect on the flows of knowledge, in terms of who the patrons for research would be in the next decades. The important question for me is not that what effect this had on the shapes of our material reality but in fact the opposite, how is our material reality an archive of the nuances of these politics? What can roads, infrastructure, buildings, landscapes tell us about the nature of the state?

Figure 38 Professor S R Mehra, Director of the Central Road Research Institute at New Delhi was a leading contributor to the conference of the Australian Road Research Board at Melbourne [photographic image] / photographer, Cliff Bottomley. 1 photographic negative: b&w, acetate

from the National Archives of Australia

Figure 39 Professor S R Mehra, Director of the Central Road Research Institute at New Delhi was a leading contributor to the conference of the Australian Road Research Board at Melbourne [photographic image] / photographer, Cliff Bottomley. 1 photographic negative: b&w, acetate

from the National Archives of Australia

| Bibliography

Anon. China & India: What next? http://www.rediff.com/news/2004/apr/30claude.htm.

Anon. 1971. Only the Mountains Are Serene. Economic and Political Weekly 6, no. 1 (January 2): 13. doi:10.2307/4381477.

Anon. 1982. Antulay's Fall. Economic and Political Weekly 17, no. 3 (January 16): 45. doi:10.2307/4370556.

Anon. 1986. Not the Whole Story. Economic and Political Weekly 21, no. 10/11 (March 8): 410. doi:10.2307/4375408.

Anon. 2004. The India-China Relationship: What the United States Needs to Know. New York: Columbia University Press.

Barthes, Roland, and Annette Lavers. 1972. Mythologies.

Baruah, Sanjib. 1999. India Against Itself.

---. 2005. Durable Disorder: Understanding the Politics of Northeast India. Oxford University Press, August 18.

Benjamin, Walter. 2008. The Work of Art in the Age of Its Technological Reproducibility, and Other Writings on Media. Belknap Press, May 31.

Bhanu, V. 1995. Liberalisation and Performance of Cement Industry. Economic and Political Weekly 30, no. 34 (August 26): M111-M116. doi:10.2307/4403130.

Bharucha, Rustom. 1992. Theatre of Kanhailal: Pebet and Memoirs of Africa. Seagull Books Pvt.Ltd ,India, December 1.

Bhatia, K. M. 1966. Keeping down the Costs of Construction. Economic and Political Weekly 1, no. 18 (December 17): 755-757. doi:10.2307/4357360.

Black, Charles Edward Drummond, and Great Britain. India Office. 1891. A Memoir on the Indian Surveys, 1875-1890.

Central Road Research Institute, and Council of Scientific & Industrial Research (India). Annual Report. New Delhi: Council of Scientific & Industrial Research.

Central Road Research Institute. 1964. Puzzolanic clays of India: their industrial exploitation and use in engineering works. Road Research special reports, no. 1. Delhi.

Das, Kumar Bar. 1987. Cement industry of India.

Devi, Mahasweta, and G. SPIVAK. 1997. Mahasweta Devi Breast Stories. 1st ed. Seagull Books Pvt.Ltd ,India, February 1.

Dutta, Arindam. 2006. The Bureaucracy of Beauty: Design in the Age of its Global Reproducibility. 1st ed. Routledge, October 24.

Frankel, Francine R. 1978. India's Political Economy, 1947-1977: The Gradual Revolution. Princeton, N.J: Princeton University Press.

---. 2005. India's Political Economy, 1947-2004: The Gradual Revolution. 2nd ed. New Delhi: Oxford University Press.

Geevan, C. P., and Meera Velayudhan. 1998. CTBT and National and Regional Politics. Economic and Political Weekly 33, no. 40 (October 3): 2619-2620.

Geological Survey of India. 1859. Memoirs of the Geological Survey of India.

Giedion, Siegfried. 1967. Space, Time and Architecture: The Growth of a New Tradition, Fifth Revised and Enlarged Edition. 5th ed. Harvard University Press, January 1.

Gilpin, William. 1794. Three Essays.

Jarzombek, Mark. 1999. The Psychologizing of Modernity.

Keenan, Thomas. 1997. Fables of Responsibility: Aberrations and Predicaments in Ethics and Politics (Meridian. Stanford University Press, October.

M., B. 1998. BJP's Search for Short-Cuts to Political Consolidation. Economic and Political Weekly 33, no. 22 (June 30): 1299-1300.

Man, Paul de. 1978. The Epistemology of Metaphor. Critical Inquiry 5, no. 1 (Autumn): 13-30. doi:10.2307/1342975.

Marx, Karl. 1992. Capital: Volume 1: A Critique of Political Economy. Penguin Classics, May 5.

Mehra, S. 1966. Handbook on landslide analysis and correction, New Delhi: Central Road Research Institue.

Michasiw, Kim Ian. 1992. Nine Revisionist Theses on the Picturesque. Representations, no. 38 (Spring): 76-100.

Navlakha, Gautam. 1999. Defence Spending: Cost of Fighting Imaginary Enemies. Economic and Political Weekly 34, no. 19 (May 8): 1085-1088. doi:10.2307/4407922.

Patil, Sameer Suryakant. 2007. India's China Policy in the 1950s: Threat Perceptions and Balances. South Asian Survey 14, no. 2 (December 1): 283-301. doi:10.1177/097152310701400206.

Prasad, B. K. 1980. Border Roads Workers' Woes. Economic and Political Weekly 15, no. 18 (May 3): 801. doi:10.2307/4368614.

Rajeshwar. 2000. Courting the Burmese Junta. Economic and Political Weekly 35, no. 38 (September 16): 3393-3394. doi:10.2307/4409743.

Rikhye, Ravi. 1989. Indian Defence Budget: Fact and Fantasy. Economic and Political Weekly 24, no. 17 (April 29): 905-908. doi:10.2307/4394721.

Roy, Arundhati. 1998. The god of small things.

Sarkar, Sumit. 1998. The BJP Bomb and Aspects of Nationalism. Economic and Political Weekly 33, no. 27 (July 4): 1725-1730.

Schmitt, C. 2007. The Concept of the Political. Expanded Ed. Chicago University Press, May 25.

Sharma, Ram Nath, and Rachana Sharma. 2006. Experimental Psychology.

Slaton, Amy E. 2001. Reinforced Concrete and the Modernization of American Building, 1900-1930.

Suri, P. 2003. The Border Roads Organisation - A Perspective. INDIAN HIGHWAYS 31: 61-76.

THE PUBLICATIONS DIVISION Ministry of Information and Broadcasting Government of India. 1954. INDIA'S NATIONAL LABORATORIES. April.

Wagner, Mark. 2006. The geometries of visual space.

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Public Works as Research, India circa 1960

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