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Exportable engineering expertise for 'Development': a story of large dams in post independence India

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Abstract Unlike any other technological artifact, large dams are unique stamps of human technological superiority over nature. Large dams however, have been analysed and critiqued in detail from various angles. Despite their seemingly apolitical nature, large dams are wired politically. Investigating the process of their assembly reveals a whole gamut of ideas—modern water, expert control and national space—that are stitched together to yield a hydraulic bureaucracy. In my paper, I draw upon engineering narratives to understand the rationale for technology-transfer in an overtly apolitical fashion. Ideas about 'modern water' and technology formed a template through which the hydrocracy—which in India took the form of the Central Water Commission—thought through, discussed and justified technological interventions. This seemingly stable template became a kind of bedrock for post independence engineering narratives for greater, scaled up technological interventions on riverine landscapes. By fixing the nation state as the object of development, the contours of the nation state were established whilst simultaneously casting it as an independent, self-sufficient unit. By portraying the nation state as one distinct freestanding unit, India could be represented as an empirical object. Its socio-political and economic processes could be represented as internal functions that were far removed from other socio-political forces outside the system. Listening closely to engineers, this paper will seek to bring to the fore the ways and means through institutional power is made and realised.

Keywords Radical geography · Environmental history · Hydraulic modernity

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> Perhaps more than any other technology, massive dams symbolize the progress of humanity from a life ruled by nature and superstition to one where nature is ruled by science, and superstition vanquished by rationality (McCully 2001, p. 104).

Water always finds its level. Rivers eat into the ground that sustains them, building new land. They do not always understand boundaries and politics; however, as cradles of civilization, rivers are rife with politics. It is perhaps inevitable that structures in and around rivers would also be full of politics. Dams and weirs are not new to rivers, definitely not rivers in the Indian subcontinent. Large dams hold up water. They cut off rivers from their flood plains and fish from spawning grounds. The history of large dams has often been presented as a story of technological triumph: controlling flows, 'taming rivers'. As technological artifacts, large dams were meant to fundamentally rearrange natural and social geographies, and alter the distribution of resources across space and time. Offering more than just a promise of agricultural development or technical progress, for many postcolonial governments, large dams became 'the means to demonstrate the strength of the modern state as a techno-economic power' (Mitchell 2002).

A large dam, however, is more than brick and mortar. In holding back a wall of water, it upholds a gamut of ideas around the asocial and apolitical nature of water itself, i.e., 'modern water'[1] (Linton 2010), expert control, and national space that are stitched together to yield a hydraulic bureaucracy (See Molle et al. 2009). Large-scale water resources development projects led by hydrocracies—a felicitous term coined by Molle et al. to describe powerful state hydraulic bureaucracies—became a dominant feature of the twentieth century. Anchored in 'modern' ideas about water, nature, and technology, these bureaucratic regimes became synonymous with the project of 'development'. Whether it was to feed the teeming millions, modernize villagers, or build stronger, more democratic states, the 'hydraulic mission' (Molle et al. 2009) was accepted across the globe and entrusted to hydrocracies. These hydrocracies have left an indelible impression on national economies and geographies, constructing massive damming projects i.e. what India's first Prime Minister called 'temple[s] of modern India'. The effects of these projects have been a mixed bag. In India, these ideas about water and technology formed a template through which the hydrocracy—which took the form of the Central Water Commission (CWC)—conceived, discussed, and justified technological interventions. Rivers came to be described as natural features without history, ecology, and society. This template became a bedrock for post-independence engineering narratives for larger, scaled-up technological interventions on riverine landscapes. Consequently, the hydrocracy drew upon and represented a certain bed of ideas and politics of power. Unpacking these ideas offers an

[1] Jamie Linton contends that the 'modern idea of water as an objective, homogenous, ahistorical entity is complimented by its physical containment and isolation from people and reinforced by modern techniques of management that have enabled many of us to survive without having to think much about it'. He states that the twin processes of the formulation of water as a chemical formula, i.e. H_2O and the development and dissemination of the concept of the hydrologic cycle represent an important contribution to the idea of abstract, modern water. In a philosophical investigation elaborating the fundamental incompatibility of modern water with people, Linton argues that despite being produced in relation to social practice, modern water is nevertheless taken to be entirely independent of social relations. Borrowing from Bruno Latour and Actor Network Theory, he claims that the 'fictional' independence of water from society is at the core of the 'constitution of modern water'. This constitution of modern water holds together 'only so long as the appearance can be sustained in hydrological and popular discourse'. See Jamie Linton, *What is Water? A History of a Modern Abstraction* (Kingston and Toronto: University of British Columbia Press 2010, p. 21 and 175).

epistemological entry point to understanding how and why hydrocracies came to work the way they do.

This paper will look at how the Indian hydrocracy forwarded arguments for big dams in India as a way to foreground the tenuous idea of 'India' itself. These arguments anticipated a distinctive national space for development, underscored the need for large-scale technological interventions on riverine landscapes, and justified "basin-wise" development of rivers to yield maximum returns. Embedded in technocratic discourses, these arguments were projected as being avowedly apolitical. Hydraulic engineers in India built up an idea of India as a nation. This idea managed a double maneuver of simultaneously sustaining, as well as being sustained by, the emerging contours of India as they were being realized post-independence. Through a specific posturing of arguments by engineers, India was shored up as a coherent unit, for without this coherence no nation-building project could continue. It was precisely when the nascent nation state did not have set boundaries and was possibly at its weakest that it initiated these elaborate acts showing coherence and strength. The arguments by engineers were performative as much as representative acts.

I outline four principal rationales that are used to organize arguments for self-perpetuation of the hydrocracy. The first rationale fixes the nation state as the object of development by invoking a long history of hydraulic manipulation. This contiguous history of water resource development, I argue, displaces local conceptions of place and anticipates a national space for development. In doing so, it fixes the nation as the site and object of development. At a time when the postcolonial state was still finding ways to legitimize itself, these narratives, in their constant invocation of a contiguous 'India', gave the state much needed stability. This fixing allowed for a new coupling between development and expertise: development could only be achieved if experts led it. The hydrocracy presented itself as the most important benchmark of the nation's progress. The second rationale drives indigenous expertise in dam building to increase self-reliance. Engineers such as A. N. Khosla and Kanwar Sain of the CWC observed that such expertise would reduce the need to look towards the West. In addition, over time, indigenous expertise could itself be exported to other developing countries. The third rationale is a neo-Malthusian trap of over-population, underproduction and imminent scarcity; the only out was to maximize the scale of interventions on riverine landscapes. Drawing upon the third rationale, the fourth rationale called for basin-wide development of rivers. It was argued that only by looking at the development of entire river basins, and by looking at one river basin after another, could one ensure that rivers did not run to 'waste'. Being constituted of and through these rationales, rivers became data sets.

To support my central argument I will draw upon *The Indian Journal of Power and River Valley Development* (IJPRVD) and several government publications about the Central Water & Power Commission (CW&PC) and CWC. First published in 1951, the IJPRVD is a rich source of engineering viewpoints on the development process as a whole, and on the then ongoing projects. The IJPRVD published two special issues (called 'numbers') on the CW&PC in 1959 and 1970, which specifically highlighted the hydrocracy, its work and projects. The second special number of the IJPRVD coincided with the 25th anniversary of the CW&PC (in 1970). To commemorate the occasion the CW&PC also brought out a Silver Jubilee Souvenir consisting of 43 contributions about the CW&PC and its work in India and abroad.

As the narratives below will show, rivers were not denied history as much as given a new one, including an element of creative editing. Locality was the peg on which the nation was to be built, but at the same time, it could not be overtly visible; the specificity of

the local therefore had to be subsumed and eventually effaced in order to be part of the new national identity.

Recent scholarship has demonstrated the intimate link between 'modern water' and the modern state (Linton 2010). In his seminal study of the reordering of the American West through multipurpose river valley projects and pork-barrel politics,[2] Historian Donald Worster remarks that the last two centuries have seen an 'immense ballooning of the state, which is to say, the federal government and its bureaucratic apparatus' (Worster 1985, p. 279), beginning in the American West. To the engineering mind, notes Worster, a rational world would be one where yields were steady, uniform, and reliable—deviations would not figure in such a world. Unlike nature that was so prone to vast extremes, a rationally ordered world could be easily controlled. In such a world, rivers would be transformed into steady, uniform flows; there would be no waste running to the seas. Stream flows would not be variable and would instead irrigate lands and provide electricity in an orderly, controlled manner. In essence, argues Worster, such a view would correct natural flows by recasting nature as a function of technology.

Engineers thus sought to order rivers rationally through territories and geographies to yield sustained, uniform flows. Through the twin logics of productivity and technological domination, rivers were rendered legible across landscapes and geographies. Such a rendering made comparisons and models possible. The instrumentality of nature also lent itself well to surveys and other empirical means to fathom the extent of resources available at hand. Nature, especially rivers, came to be imagined as a "standing reserve" (Heidegger 1977) amenable to efficient, expert control. Such a resource-centric reading of rivers formed the basis of many explorations into riverine frontiers. Ideas about water as an ahistorical resource/object divorced from social formations that were amenable to expert and technical control (i.e. 'modern water') thus formed a template through which the hydrocracy was able to carry out large-scale technological interventions. Engineering narratives drew upon this template to envision interventions on riverine landscapes of a hitherto unknown scale and form.

Writing hydraulic history: falling into the territorial trap

Hydraulic manipulation has a long history in the Indian subcontinent. Irrigation has been practiced by agriculturalists for millennia. The novelty in the narratives presented by engineers in the twentieth century, however, was in the recasting of modern irrigation as the logical conclusion to millennia long hydraulic manipulation practices. By projecting irrigation, specifically dams and canals, as an age-old component of the riverine landscape, continuity with the unbroken tradition of hydraulic manipulation was established.

This projection was selective: it did not acknowledge the role that the colonial state played establishing a radical break in hydraulic principle in the subcontinent by

[2] Etymologically, the term *Pork barrel* (used as national pork barrel) was first used in 1801; meaning "state's financial resources (available for distribution)"; it was noted as an expression of U.S. President William Howard Taft: "Now there is a proposition that we issue $500,000,000 or $1,000,000,000 of bonds for a waterway, and then that we just apportion part to the Mississippi and part to the Atlantic, a part to the Missouri and a part to the Ohio. I am opposed to it. I am opposed to it because it not only smells of the pork barrel, but it will be the pork barrel itself. Let every project stand on its bottom." ["The Outlook," Nov 6, 1909, quoting Taft].

Today, the term refers to the practice amongst members of the US Congress jostling for federal funds for big-money schemes in their home districts.

introducing perennial irrigation; barrages and weirs that effectively flattened a river's variable flow (see D'Souza 2006, 2009). Instead, this recasting drew upon the World Wars and the 1943 Bengal famine as reasons for the ambitiousness of post-independence water resource development in India. Independence was remembered as the watershed moment at which the millennia long project of hydraulic manipulation would reach fruition in the form of large dam projects.

Irrigation, dams, and inland navigation were narrated as having long histories, often across thousands of years. In their constant invocation of 'India', these narratives helped to fix the nation as a freestanding, self-contained unit that could be comparable across geographies. As R. D. Dhir, the director of Hydrology of the then newly formed Central Water and Power Commission remarked:

> There is much evidence to suggest that irrigation from wells and inundation from swollen rivers during the monsoon have been practiced in India since the earliest times even before the commencement of the Christian era. Later, the Grand Anicut of Madras is known to have been built in about 200 AD The practice of inundation canals was a feature peculiar to northern Indian from very ancient times. During the Mughal period in 14th to 17th centuries, irrigation development received the attention of ruling dynasties. In fact, it is these ancient works that provided the framework for the subsequent build up of irrigation systems (Dhir 1952, pp. 2–3).

This same paragraph is repeated almost verbatim in the 1959 special number of the IJPRVD. This history formed the background of almost every article in the first special number of the IJPRVD and was used to underscore the need to develop water resources.

In an article on inland navigation, M.L. Sood, then Director of the CW&PC in charge of inland navigation, drew upon sources as diverse as the Greeks, pre-Buddhist Indian 'Jatakas', Old Tamil poets and Chanakya's *Arthashastra* to underscore his point: navigation was highly developed along the country's rivers. Sood contended that the 'great maritime activity of those days could have only followed inland navigation' (Sood 1959, p. 15). This claim was based on various sculptures of the age that depict the different features of inland craft. Tracing the flourishing trade routes on Indian riversēespecially the Ganges and the Indus—Sood marked the development of the railways as the beginning of the decline of inland navigation. Inland navigation later became an important premise and product of river linking.

These age-old structures provided a platform for more sustained irrigation development in form of dams. According to Dhir, '…it is these ancient works that provided the background for the subsequent building up of irrigation system in this country' (Dhir 1959, p. 59). However, it is 'mainly during the past 100 years that extensive works have been constructed, extending the benefits of irrigation to vast areas' (Sain 1959, p. 37a).

In broad surveys, both Dhir and Sood projected irrigation and flood control interventions as having a contiguous history. More importantly however, this projection served as a means to justify further technological interventions at a national scale. Enumerating a series of local interventions, with very different social and political contexts, both Dhir and Sood rallied their ideas around 'India' as a nation. The fact that these interventions were conducted in India as it came to be configured post independence was enough to cast aside individual differences within interventions themselves and render them constituents of a national space. As the object of development, the nation-state came to be recognized in certain ways; the coming of national space over local place, and made the nation-state into a modular entity (Giddens 1990; D'Souza 2009; Goswami 2002). This modularity, as Timothy Mitchell points out, gave it mutability and mobility (Mitchell 2002). Interestingly,

in these narratives there is not an engagement or even a reference to colonialism as it was experienced in India. Expansive histories served as a means to avoid commenting on colonialism, and laying the 'territorial trap' (Agnew 1994). At a time when the nascent nation state was still figuring out its contours, the long history of hydraulic manipulation in the subcontinent was another attempt at uniting India across its diverse geography. The shared history of hydraulic manipulation as narrated by engineers and experts rewired a political question into a technological one. The solutions, as the engineers pointed out, lay in engineering expertise. More importantly, by proclaiming the shared idea of India so publicly they worked to further legitimize it.

It is important to point out that, in the eyes of engineers such as Kanwar Sain, colonialism was not entirely bad insofar as it helped bring modern science and technology to India. In his study of 'nationalist engineering', Daniel Klingensmith remarks that engineers such as Sain 'did not want to free modern science and technology in India from their colonial connections' (Klingensmith 2007, p. 137). Analyzing the careers of A. N. Khosla and Sain, Klingensmith argues that engineers did not recall the British as selfish or corruptible. For engineers like Sain and Khosla, 'colonialism's only flaw seems to have been that it constituted an insult in that it denied that Indians could fully be partners in the enterprise of modernity' (Klingensmith 2007, p. 233) As self-avowed nationalists, these engineers understood modernity as an inevitable process that had been denied to India pre-independence. For these engineers and scientists, modern science was a universal, emancipating category. Modern science and modernity came to be understood as conditions that made greater exploitation of nature possible. According to S. N. Gupta: '[S]cientific, engineering and industrial research directed towards greater understanding and greater control of material surroundings is the keynote of the modern search for progress and power' (Gupta 1970, p. 3). The unfinished business of modernity, thus, was the complete control of nature, which could only be realized through the nation-state.

In the interim between the first and second special numbers of the IJPRVD a lot had changed politically. India had fought wars with China and Pakistan, while on the domestic front there was a certain amount of political stability and pronounced progress in the dam building technology and expertise. India's riverine landscape had fundamentally changed: Bhakra Nangal, Hirakud, and Nagarjunasagar were all up and running. The CW&PC had emerged as the premier design and development organization for dam projects in India. In the period spanning the 1950s and 1960s there was pronounced interest in design and development of large dams across India. The CW&PC was now seen as leading the development project by leading the dam development, and with it, food security and poverty alleviation. In the two special numbers of the IJPRVD there was a subtle shift of focus: from single-mindedly emphasizing this coherence through the perpetuation of 'historic' narratives—e.g. the long history of hydraulic manipulation in the sub-continent or the imagined continuity of religious identity—to stressing the need to develop this now-coherent unit.

Compared to the first special number, the second special number focused far less on irrigation and dam development as ancient practices. Independence came to be constituted as the radical break that provided the necessary impetus to water resource development in India. Indeed, the two special numbers mark a shift: from using the contiguous hydraulic manipulation to fix the idea of the nation, to the deeply entwined relationship between a burgeoning hydrocracy and national development. The CW&PC came to represent 'progress'. Development of the 'nation' was deeply intertwined with the further development of the CW&PC. As S. K. Jain remarked:

> It's [sic] (the CW&PC's) development and march towards organizational expansion has been linked up with the development and planning of projects in the country since Independence and thus the stature of the Commission today is a barometer of the progress achieved by the country in the fields of irrigation and power (Jain 1970a, p. 21).

This statement is indicative of the heady times; however, it was not the only one of its kind. Rapid and sustained development of the power sector came to occupy a similar place in the engineering imagination. Throughout the second special number, there are numerous mentions of the need for a national power grid and the development of power for the nation. As M. Hayath said while commenting on the intertwined nature of national development and power development: '[E]lectricity has today become so indispensible that the extent to which a nation has developed its use is more or less a yardstick of its economic development' (Hayath 1959, p. 39). Kanwar Sain summed up the times emphatically: '[*K*]*ey to the production of wealth is the Kilowatt*. Underlying the country's capacity to produce anything else is our capacity to produce power' (Sain 1959, p. 37b. Emphasis added).

In their detailing of technological interventions at various levels, these narratives articulated a need to scale up. Further, they underscored the need for strictly expert-led interventions. Such a technological narrative strengthened the rationale for technical expertise to manage water. According to H. S. Desai,

> [V]iewed purely from technical angle, and given all the goodwill that such cases deserve other angles, it is felt that engineers could and should have the last word on the development of the water resources of the country (Rao and Desai 1970, p. 82).

Development could best be achieved if it was driven by expert-led organizations like CW&PC. The long history of hydraulic manipulation helped the project of development acquire a national scale. The narratives pursued through the special issue(s) underscore the inextricable relationship between water resources development, nation building, and the hydrocracy. Development and progress were inextricably tied to the hydrocracy, which was seen as a measure of development and progress; the growth of the hydrocracy inevitably indicated development. This championing of a burgeoning hydrocracy helped incubate and insulate it from overt political and social questions. A large-scale hydrocracy guiding the project of development was symptomatic of the belief of engineers, as well as the propelling logic of the hydrocracy itself.

A system of limits and solutions

One of the foremost challenges facing post independence India was food security. Narratives for water control underscore this challenge. There were carefully worded alarms about scarcity and impending catastrophe. Such warnings are found with striking regularity in the IJPRVD and the Silver Jubilee Souvenir of the CW&PC. For instance, S. N. Gupta asserted:

> [T]he fateful year 1947-the year of India's independence brought both responsibilities and opportunities. The country was faced with the basic question: Adequate production of food for the growing millions (Gupta 1970, p. 1).

The only way to meet this ever-increasing demand was to increase the area under cultivation by providing more water:

> [T]he food production has to keep pace with the ever increasing requirements of population. The principal remedy for meeting this increased demand is to steadily extend irrigation facilities (Kanwar Sain 1959, p. 37a).

Posed as technological rather than political or social problems, the solutions were also necessarily technical/technological to ensure maximum utilization. Often the answer was simply put: greater investment in developing water resources to ensure that the twin challenges of a rising population and looming food scarcity could be met effectively. Technology would drive solutions forward and ensure nature could be tamed to human needs.

> There are two equally important elements in human progress. They are the development of spirit and character on the one hand, and the mastery of the physical world on the other… Without mastery over nature, our earth, as it stands would support but a small fraction of the present population… I submit that hunger and poverty are no longer beyond solution. The mastery over the physical world gives us the key to the problem. The most thickly populated regions on earth can be satisfactorily fed if the most effective known methods are applied. The technical possibilities of feeding the world will probably always run far ahead of the increase in population (Kanwar Sain 1957, p. 1).

This neo-Malthusian trap anticipated more than just technological problems and solutions; it was the scale of interventions that drove the point home. The rhetoric about looming scarcity and overpopulation served as a vantage point to drive home arguments for large multipurpose projects. Relieving flood, food and irrigation problems, these projects would also ensure the entire basin of a (given) river was under use. This was an unprecedented move by Indian engineers in conceptualizing Indian rivers. Modeled on the TVA, these projects would render rivers into a ledger of flows and returns. As a complete system of inter-related projects, the aim was to ensure rivers would no longer 'run waste to the sea' (Khosla 1951, p. 2). Basin-wide development therefore came to be premised on the scarcity trap.

A. N. Khosla invoked the projected rate of rise of population at 2 % per annum. When combined with an increase in the standard of living because of industrialization, the resultant rise in demand for food and water would be consistent and possibly uncontrollable. But with modern technology for 'conservation and utilization of water resources' (Khosla 1970a, p. 15) making rapid strides, the problems of agriculture and irrigation could be easily met. If development were not jumpstarted through extensive water resource development, scarcity would become a hard reality. These visions of scarcity were axiomatic in two ways:

(1) The ability of science and engineers to forewarn such a possibility due to the exact nature of their science and scientific method.
(2) The need for planned development to ensure that fragile and unreliable natural resources could be trained into reliable flows to provide consistent maximum returns.

The need of the hour, therefore, was planned development to yield maximum returns. Without large multi-purpose dam projects to control floods, manufacture electricity, provide water for irrigation, and utilize an 'inexhaustible source of water supply in the form of rainfall', all that water would go to waste (Khosla 1970a, p. 15) Indeed, immediate concerns were for food and large dams. It was increasingly argued that large multi-purpose projects would hold back enough water for irrigation during the dry season as well as

produce enough electricity for irrigation and industrialization—a claim that wasn't fully realised. More immediately, however, these projects would meet the pressing needs of the country:

> [K]eeping in view the need of the country, priority has been accorded to projects likely to yield additional food at an early date. Large multi-purpose projects have been phased with a view to an early completion of their irrigation aspect (Dhir 1959, p. 57).

Indeed, as K. L. Vij stated while commenting on hydro-electric resources in India emphatically:

> [E]ssentially the problem is simple, in that it resolves itself into an examination of the possibilities of utilizing "available water supplies" at the maximum possible head (Vij 1959, p. 64).

It was only through such a thorough examination of hydraulic heads that entire river basins could function as measures of water resources. As stocks of volumes, rivers held enormous possibilities, provided they were planned well and holistically. In a country where overpopulation and resource scarcity was a real and looming threat, only large-scale technological interventions could ensure optimum usage of resources.

Holistic planning for basin-wide development

Planning water resource development required rearranging rivers into basin-units instead of geographies or people. Rivers as basin-units, like the larger nation state were comparable and amenable to technological solutions for resource optimization. Basin development reordered rivers and landscapes apolitically. Sain clearly charted out a course for the same:

> [T]o make effective use of waters for irrigation, navigation, power and other allied purposes, it is necessary that a careful and unified development of the whole basin is planned irrespective of that number of States or Provincial boundaries that may be involved. It is only in this manner that optimum utilization of resources of the entire water-shed can be made and waste of any potential resources of the valley eliminated. If the entire basin is not developed as a unit there is the possibility of confusion arising when each State starts controlling the river from its own point of view (Sain 1959, pp. 37b–c).

Sain was not alone in supporting a basin-based approach. Some of the many voices include those of M. L. Sood, A. N. Khosla and S. K. Jain:

> Practically all the river systems of the country run through more than one State. Their balanced development in the interest of navigation and other objects, e.g., irrigation, hydro-electric power and flood control, demands that the entire valley is treated as one unit irrespective of State boundaries (Sood 1959, p. 52).

> Modern technology for conservation and utilization of water resources is making rapid strides. With a unified and integrated approach to the development and utilization of surface and ground waters and to problems of agriculture and irrigation, this challenge (of looming resource crunch and a steady population rise) can be met (Khosla 1970a, p. 14).

> It has been well recognized that river basin should be considered a single unit for development of water resources (Jain 1970b, p. 12).

Such a basin-based approach across rivers was repeatedly invoked as the most efficient means to develop the nation's water resources. Marking a radical break from the earlier 'compartmental' (Jain 1970b, p. 12) approach to one based on entire basins would envisage the development of '[T]he water and power resources of a region, basin and sub-basin and the transfer and interchange of both water and power between regions, basins and sub-basins in the overall interest of the country and regions concerned'(Khosla 1970a, p. 12). These arguments combined to form the basis for a National Water Grid—an idea first proposed by the famous colonial engineer Sir Arthur Cotton in the nineteenth century to ensure navigability and irrigation for all parts of India in addition to being an alternative to the railway network then under development (Headrick 1988; D'Souza 2003). Post Independence the idea was promoted as means to ensure that the excesses of one river could replenish the deficiencies of another:

> Large areas in Western, Central and Southern India have a very low rainfall while in the Northern and Eastern regions heavy monsoon rains cause extensive floods and large volumes of water flow waste to the sea. The National Water Grid has been conceived for remedying this imbalance to a certain extent by transferring waters from surplus regions to deficit areas by interlinking the various river basins so that transfer of water becomes possible (Rao 1979, p. 104).

Rivers, thus, came to be re-conceptualized as units that could be rationally developed for maximum usage through multi-purpose projects. The natural world came to be arranged as a system of excesses and deficits that could be corrected with mathematical precision to yield steady, uniform returns. To the post-independence engineering mind, the National Water Grid was not a possibility but a certainty; the question was when it would become reality:

> [T]hese policies will have to be implemented sooner or later for the survival and prosperity of our country (Rao 1979, p. 100).

Basin-wise and basin-wide development would ensure that rivers could be developed to the maximum possible extent. As the statements above demonstrate, the best way to manage this was through a hydrocracy that was imagined as being able to eschew political and social boundaries. The National Water Grid would render the riverine landscape entirely legible and amenable to complete development. As a closed system, this grid would also give impetus to power sector development, as there would be reliable flows for hydropower generation. Rivers in this schema were resources to be utilized to the last drop to ensure development. Tapped from source to mouth, rivers would cease to flow freely. Instead, they would populate chains of man-made lakes; the tail of one reservoir would be the beginning of another hydro-project. This would also ensure that the navigability of rivers would be far more reliable, boosting trade and exchange.

Rivers as datasets

Rivers came to be ordered as calculable, comparable units that, when developed optimally, would help eradicate poverty and looming resource shortages. At the same time, by

treating river basins as units that could be developed, there were no limits to nature's instrumentality. The long history of hydraulic manipulation in the subcontinent helped define a unique national space for development. Careful planning would ensure this manipulation could achieve all its goals. Rivers were thus reified and reconceptualized as prospective models that could be reproducible; a function of heads and cusecs. The development apparatus thus acquired 'the character of calculability' (Mitchell 2002, p. 92) that mediated between material realities and the abstractions of science and politics. Numerical indicators came to speak for themselves and became tangible enough to mold facts. Rivers came to be organized in a linear fashion, as reproducible units across landscapes that were framed and solved technologically.

In light of these rationales, dispossession in the name of 'development' was perhaps inevitable; post 1947, India came to be characterized by gargantuan projects. In couching arguments for large-scale development in numbers and as purely technological processes, other forms of knowledge were delegitimized. Dispossessed peoples are still struggling to find a place in this development narrative.

Technological impetus came to occupy a central position in postcolonial India. The making of a national place for development through large-scale hydraulic manipulation, as the narratives above chronicles, came to be recognized as seminal parts of the process of modernity that India had long been denied. By disempowering local place vis-à-vis national space, the narrative of development was easily tied to the project of nation building. In the development discourses of engineers, India was presented as the possessor of an economy defined in national terms and responsive to national government policy. The national economy came to be seen as something that came about because of planning and development projects; a lack of 'development' was therefore the result of government neglect.

It must be remarked that the construction of rivers as data sets was by its nature selective and exclusionary. Despite their self-assuredness, these claims only appeared complete and coherent. As an inexact science by engineers' own admission, hydrology was more or less a game of making calculated estimates. As K. L. Vij remarked:

> When the position regarding the resources of the country began to be reconsidered after the attainment of Independence in August 1947, it became apparent that there was very little data to enable an accurate estimate of the power potential to the country. Even selection of schemes for immediate detailed investigations had to be done on an *'ad hoc'* basis (Vij 1959, p. 64; emphasis original).

Indeed the Central Water Commission (CWC) admitted:

> Hydrology as a discipline is different from most of the engineering disciplines. Natural phenomena, with which hydrology is concerned, though have underlying physical processes, are complex and not amenable, to deterministic approach: They do not lend themselves to rigorous analysis not offer unique solutions as are possible in engineering mechanics [sic]. *Since water resource development activity cannot be delayed for want of data of adequate quality and quantity, best judgement has to be resorted to*. In the field of hydrology one has to devise methods to suit the data available and come out with solutions. Accepting a solution in turn needs judgement with due consideration to sociological, economic and political situations (Patil et al. 1994, p. 7; emphasis added).

Thus, by its own estimation, the CWC and its predecessors had no hard data about river flows or riverine systems to fall back upon while making plans for development. Using A.

N. Khosla's pioneering formula to calculate stream flows based on certain assumptions, massive plans for river development were formulated in the 1950s and 1960s. It was only in 1958 that the erstwhile Ministry of Irrigation and Power (now the Ministry of Water Resources) set up a number of gauge and discharge observation stations on the Ganges and its tributaries to assess the flow. Thus, it was only after plans for large-scale river development were established across India that actual measuring of stream flow could begin. Because the project of development could not be halted for lack of hard data, projections would have to suffice.

Voices of dissent were nonetheless audible from the very beginning. Such voices constantly called for a more reflexive, inclusive, and engaged process of development (Karantha 1952, pp. 11–22). However, these voices quickly drowned in the din of development. The hydrocracy could not afford to engage with a critique, and thus it intentionally silenced such voices.

The idea of modern water was at the core of the hydrocracy, nurturing its intents and actions on riverine landscapes. India as represented by these narratives was far removed from the actual social processes that the larger project of development sought to solve. The political and structural reasons for poverty and over-population came to be recast as technical problems. This recasting set aside questions of politics and society, instead yielding to the arithmetic of development. Through the prism of the engineers cited above, India was cast in a firm agrarian frame, which despite its potential—both natural and technological—remained underdeveloped. Through specific engineering narratives, rivers came to be read as resources without environmental contexts. These engineering tracts drank in ideas of modern water and expert control and unproblematically disseminated them, epitomizing the self-propelling prophecy of the hydrocracy.

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