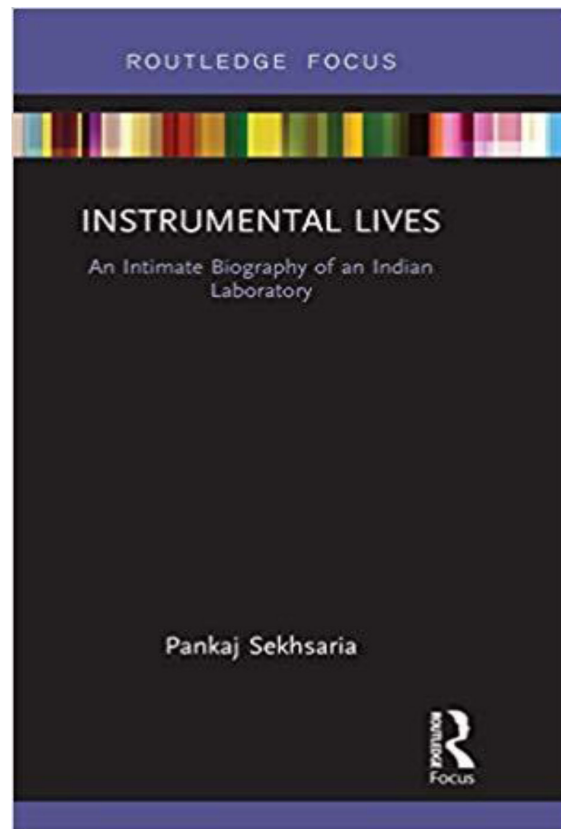


Instrumental Lives- An Intimate Biography of an Indian Laboratory



Instrumental Lives: An Intimate Biography of an Indian Laboratory

By

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The Book tries to weave an intimate biographical account of a physicist, Prof. CV Dharmadhikari, and his work on the scanning tunneling Microscope and Atomic Force Microscope. The book begins by author's encounter with the scientist in a very realistic and interesting manner. He begins opening up the potential of his work for STS studies, in terms of its ethnographic methodological engagement. There can be divergences of his conceptualization of social construction of technology and its entanglements with the democratization of S&T, a unique conceptualization of an Indian "Modernity" of sorts, as

it were. But even in doing so, one does recognize the absence of neat categories and ideal types that exist in other sociologists' conceptualization of Life inside the laboratory as a conceptual "Black Box". The Book does remind one of the undercurrents of the Laboratory Life by Bruno Latour but somewhat retains its unique biographical flavor. The account of the first encounter serves to underscore how and to what extent the scientist is to be placed within society and whether they can be seen as distinct from it and its concerns. Also crucial is the episode where the scientist comes in touch with society through communication in public media (p. 4). The entete of the author with the laboratory life comes across as routine, exciting yet idiosyncratic all at once. The archetype and material embodiment of disorder from which the production of order and meaning takes place, as recorded by the author, does convey the excitement of a maverick. His attempts at tracing the scientist's history, trajectory and chronology of the

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scientific journey is laudable and contributes well to contextualizing a scientists' thinking process within the laboratory and how he goes about doing his business as it were. The context provided by the end of life perspective to one's career trajectory outlines a vivid account of a modern physics laboratory located in the subcontinent. Chapter 2 outlines the artefact and the scientific journey behind it. This demonstrates how awards and recognition in the form of the Nobel prize remains a focusing device in the evaluation of the potential of the innovation. It also shows how the journeys begin in developing countries on the back of reverse engineering of existing innovations in the Indian context. The serendipity involved in participation in the communities of practice, labelled by the author as the Instrumental community, defies the conscious conceptualisation of technological effort in STS Literature. The author could have done well to uncover the co-creation aspects of this community of practice (p. 13). The black box opened by the chapter is essentially the design and product development decision aspects which is a known case of bounded rationality. The new instrumentality was admittedly developed without a central role to the dramatis personae of this Intimate biography or historiography. This points to the nuanced effect of participation within global innovation networks and an assumed problem-solving role, as opposed to a problem framing one. The nature of knowledge-intensive business services provided alludes to an organizational decomposition of innovative activities in a rather unconventional site, namely the public scientific industrial research and educational system (Schmitz and Strambach, 2008). It is not clear if the primary basis of his engagement was the collaboration with an Indian or foreign company on a project basis for problem-solving, arising from its deployment or the problems faced in using this technology. Nonetheless, it comes across as a form of user-centred innovation which is commonly found in the case of instrumentation technology. The significance of surface science to STM development is articulated in terms of the networks, coupled with the impact of spillovers generated through informal meetings and travel is well-outlined. Curiously enough, the attribution of problem-solving capabilities to Western Science is more a function of retaining strategic innovation functions and first-mover advantages, which has been known for a long time. Today, it is this attribution which is witnessing a change. The section on "history and geography, space and place" fails to offer a coherent narrative or explanation for the coordinated nature of activities going on in different spaces, nor as to the role of space and time in the location of innovation activities. Also, the geographical concentration or stickiness of knowledge arising from its tacit nature, known in Literature, does not seem to be corroborated by the narrative offered. At a first reading, it may confuse the reader as to "Social construction of technology" (Author's self-professed theoretical leanings) and the Social

production of technology given the absence of treatment of historicity in his narrative and the contingent nature of technological development thereon. His alluding to material, temporal and social conditions is somewhat sketchy (p. 18). The author's characterization of the scientist's first encounter with the STM Microscope is supportive of his argument of the framings in terms of the micro and the contingent, macro and the contextual. One would ask whether the former does not require contextuality and if so, what phenomenology does that entail. He further attempts the macro framing and splits it up into two contrary framings, that of modern Indian S&T based on the self-reliance paradigm and *jugaad*, which does not emphasise anything more than local problem-solving. Much less, the two do not converse with each other, as the latter does not focus on organizational aspects of innovation. They appear to be two conflicting parallel universes of sorts. Chapter 3 on the Modern Indian S&T narrative invokes mixed reactions as to its relevance and validity. At least it outlines how Indian S&T policy priorities have been off-kilter to the realities of both developmental needs and existential realities. To imagine and aspire for self-reliance as a trajectory could have been deeply engaged with (p. 20, 21) to demonstrate its contribution to the post-colonial, globalization-oriented narrative. It could have explored Gandhian thought on globalization and extended it by seeing the underlying narratives of how these paradigms were shaped in the first instance. The History of S&T narratives is rather tepid and does not engage with its developmental dilemmas (p. 22, 23). The changing social contract between science and society could have been more critically examined for the processes underlying the generation of a uniquely Indian modernity as it were, in terms of the professionalization of science. The author could have well-avoided the halo of scientists' objectives, as driven by "state imperatives or needs" narrative, as that has had a Life of its own and the exact alignment thereof is a myth, worthy of contradiction. That scientists faced with the dilemma of doing what they do best or need to do, could have stuck to performativity, as opposed to performance, variously understood is no surprise. The rhetorical extolment of their task by such jingoistic articulations does not serve to create respect for them, more so creates resentment within society, as to their role in the event of non-performance. A survey into public understanding or perception of scientists would reveal the same insight. The reflexivity or democratization that Science needs to develop has not been discussed. The articulation of science movements and citizen science furthers the activist zeal demonstrated by the scientific community but does not render them open to public scrutiny or accountability of any sort. The proposed Social Responsibility Initiatives thus anchor themselves in such positivist, hortatory visions of the scientist within society aimed at self-regulation, as opposed to public accountability. That is a theme that defies post coloniality

and external influence. The possibilities of the entrepreneurial university and modes of knowledge production remain cursorily addressed and show how not much has changed with such social movements, in terms of the conduct of scientific research in the country. It is ironic that we seek participation in global networks yet remain sanguine about the performativity it demands of the community, in terms of civil society orientation and the social negotiation implicit therein. The simultaneous negotiation of the different framings appears slightly abrupt (p. 26). The methodology appears like a shifting goalpost as is evident from the subsequent chapters.

The Chapter on Jugaad is well structured and brings the contradictions of the westernized conceptualization of creative improvisation through a “Radjouvian” theme (which positions the global economic order as the operative paradigm for innovation) juxtaposed with that of popular media discourse. The critique of the “need to make profit” framework appears to emphasise the lack of scalar aspects that underly the neo-liberal economic paradigm of industrialization which doesn’t converse well with sources of the competitiveness gained, if any. It also does not establish how that serves to make it more inclusive in nature. More importantly, how something seen in the margins can be used to define the totality is also equally a matter of contestation (p.31). While this may be criticized for methodologically, it is gainsaying that conduct of formal R & D has demonstrated idiosyncrasies in the Indian context, both at the level of problem solving and market orientation focus. This is the basis of his understanding of the technological jugaad involved in the innovation of the STM Microscope, particularly in using non-standardized techniques. However, his examples, particularly those citing use of an existing artefact in a new way could have stressed on how new use arises in the first place, giving it some theoretical grounding (p.35). While it does serve to outline the fact that there exists a lack of comparability among case studies pertaining to informal, inclusive innovations in general and jugaad, in particular, it does not outline what is the materiality involved, other than in terms of the functionality achieved. The lack of ends-means comparability shows how product design thinking is not hardwired, even in the instrumental communities within India. The materiality envisioned in Western Industry is turned on its head as it appears. The paradox resulting from this contradiction is that the marginal has entered the categories of the formal R&D System, whereas the reverse is not seen. A question arises as to the exact value that capability building results into from two very distinct trajectories of technological effort, yet involving informal networks and learning processes. The granularity of the focus of innovative activities in both forms of innovation has to feed into the micro and meso, if not macro levels. In terms of the dynamic of Learning underlying jugaad, it is not clear whether it is the dispensability of Learning or of the incremental nature of

its precursor i.e., absorptive capacity that is of essence to the functionalist “object-oriented” elements identified in the two forms of innovation. The existence of the artefact outside the mainstream of regulation, a formal institution, comes across as par for the course. The social construction underlying informality could have been explored more (p. 34). The fact that we see the finest microscopes made from the glass lenses, ground in less precision-oriented units, hidden in the crevices of social existence reveals how skilling within formalist laboratory R&D system is a non-starter. The sacred and profane of informality and jugaad exists, irrespective of the analysts’ and lay persons’ judgment of the values that embody them and the value underlying their existence. On a total assessment, jugaad is more of an enigma, despite its transvaluation from the commercialization narrative to a problem solving one.

In Chapter 5, the reconfigured materiality, the author describes runs parallel to the formalist means-ends paradigm in part. The essential change in function is said to result in the site of its implementation i.e. the microscope, yet its conceptualization in terms of functionality does not entirely visibilise in it. In all his examples of the parts used in the microscope, including the casing of a fridge and compressor and the overall contribution they make to the functionality sought to be achieved, especially insulation demonstrate no such deviations on which the change of functionality narrative is based. Rather it seems to me, a granularization of function into various components sort of complementing each other, even in parts mainly peripheral in nature viz., rubber tubing. This has strong association with a modular product development paradigm and the organizational decomposition of innovative function resultant. There are however limits to such a system integrationist perspective and modularization resultant in terms of the services underlying the processing of the parts. Perhaps a greater engagement with the grounded empirical imperatives would have resulted from the careful narrative analysis, possibly by extending the investigation into the quality parameters and how the scientist sought to achieve and the problem solving inherent to the parts available and the iterative deductions and inductions, hits and trials involved in doing so (p. 37). In contrast, it is shown as if the innovation was the product of an untrained mind that did not understand the parametric conceptualization of parts (p. 38 to 40). The narrative on the local geography redeems the skilling and materiality critique offered earlier in this review. The construction of the laboratory as an ethnographic form of geography and space brings us back to the material contribution of the skilled scientist, failing which one would risk implying that such a device could be constructed, let alone be conceptualized by the untrained mind, in any alternative site. The construction of the laboratory in terms of the power of the local is therefore partially actualized (p. 41). The possibility of its occurrence in more advanced contexts not arising does not

render “lateral” or “out of the Box” thinking that western societies advocated (Edward De Bono, 1970) any less comparable to the localist perspective being offered, at least on the creativity related aspects. The context of discovery cited in support does seem to bear out in terms of geography though. Use of materials and skills as being contingent on such idiosyncratic elements even in a formalist environment, shows how thinking in terms of problem solving, reduced to make do and mend with what one has access to is not automatically inculcated. This connects well with his critique of university as an institution (p. 45). The Gordian knot of the crisis of mission-oriented science in universities and national research laboratories is seen to manifest in the situations facing the scientist and the underlying motivations to overcome shortage of resources whilst meeting the aims and objectives imposed on them. The tension between the enterprising and the vocational laboratory has been cursorily exemplified in terms of the individual agent i.e. the scientist. Also, the narrative derived in relation to the instruments themselves, their construction, their operation and use, the results they produced and the potential they did or did not have could have been more explicit on the points outlined. The narrative on incentives and peer recognition within instrumental communities presents a realistic yet conflicting picture of its intrinsic value basis. The valorizing principle has been side-stepped. As a result, any concrete answer on the commercialization orientation, in terms of underpinning on quality and value generation is missing. Then a question arises that despite the absence of such a principle, required perhaps for commodification, does it by necessary implication render the intrinsic value derived thereof different qualitatively or otherwise. And does doing away with the quality or value standpoint as a result be the basis of the inferior nature of science and scientific practices involved. More so, does the nature of innovation not being technologically related, render any STS perspective a non-starter. It is equally likely that the latter is the case. In terms of the investigated attitudes of the scientific community, the functionalist perspective is not widely expressed as a source of our competitive advantage (p. 47). Despite the validity of the argument advanced on the imposed nature of this logic (p. 47), it is worth stating that in a resource-constrained setting like ours can the bounded rationality of the individual agents involved overcome the desire to commercialize (read make available to the public at large) or mass produce. Here, while it is valid to state that the capability to commercialise as the differentiator or motivation, yet it be recognized as running counter to the overall narrative of locational and market situated knowledge being a key source of Learning for product development (“Learning by Doing” in Arrow’s terms) in developing countries, as outlined in the Innovation Literature. Even if we were to consider the long run value of such capabilities towards product design

practices, it comes across as a short- or medium-term measure and cannot lend the promise of future growth potential or a source of competitiveness. In that event, it is noteworthy that this “granular” disintegration of activity and its reintegration lends itself into a task-based perspective. Also, that the impact of global or regional geography in effecting this slow, incremental, path dependent Learning not being visible renders the entire notion of technological effort, as a function of globalization or otherwise, even less promising to be of any consequence to the larger capabilities narrative, centred on external sources and stickiness and tacit nature of knowledge. It does not seem to be the case in case of products, where the market entry barriers are high, due to the technological content involved. The moral or ideological compulsion to replicate such a paradigm appears sub-optimal and counter-intuitive in terms of the appropriateness referred to by the author. The contrast presented by the atomic force microscope initiative is discussed in a limited manner (p.48). Irrespective of the overall commercial viability focus, the motivation to bring out something tangible of quality intended or of something of value- intrinsic or extrinsic to the communities of practice cannot be said to go away with time during the developmental cycle. To infer vocational or enterprising nature of the site of innovation from this narrative, renders the unique nature of innovation and its subject-matter in a romanticized way, which ignores the standpoint of making such assessments in the overall constrained systemic context. The discussion of the same as a pedagogical tool refers to the conflict between what constitutes “vocational” academic knowledge capable of communication, its social enculturation in Learning processes and throws what is the essential nature of instrumentation technology wide open. In terms of the institutionalization of the decision-making process in such sites, the vocational impetus would render it no different than an industrial training institute and the overall quality of vocational efforts would remain sub-optimal. Absent the race to the top or any aspirations to do so, it would be a sad reflection on the value of the education, skills and training that enable the scientist, as distinct from other members of society with a non-technical background. That said, it appears to be realistic and representative in part. The pedagogical use of knowledge-based practices as feeding into the research decisions and in turn fed into by it is not different from that of formal R&D. It is not clear to what extent that the logic advanced, in relation to external search for capabilities and organizational coherence would imply the trade-off applicable to a firm, in terms of relational proximity valid in this context (Sierra and Blanc, 1997). The evolutionary dynamic of this process would have the unintended effect of undermining traditionally held notions of the nature of knowledge development process as being path dependent, tacit etc. and whether what is involved is knowledge. Assuming what is inferred is a spillover, the measurement of

its impact would be limited by its relatively uncodified nature in the traditional sense. As to how this is different from the passage of traditional knowledge, which is known to have similar patterns of codification is unclear. The lack of codification of operational practices standardized on the shop floor as distinctly developed science base, while appearing to be flexible renders the incremental nature of changes invisible. This would pose conceptual and measurement problems which would be insurmountable. To replace traditional indicators like publication, known to be embedded into practices within scientific community, while breaking the monolithic characterization thereof does little to the analytical case of *jugaad*, at least in terms of outcomes. This bears out a narrative that is neither self-sustaining nor capable of generating outcomes in terms of tasks and skills. Perhaps truth is stranger than fiction in this case, yet it leaves many questions of empirical and theoretical validity wide open. The demonstrated inability to use high end automated tools shows the mismatch of such dynamic to the object of acquisition of sophisticated skills, which is not promising enough. The author hints to a culture of innovation in relation to instrument building, while not demonstrating the cultural elements of such practices, in terms of anything beyond specific groups. The theoretical abstraction resorted to by the author is thus ineffective. An alternative explanation is that of ambidexterity. The incremental value of internalizing the practices within different laboratories that Patil had worked to his thinking patterns is discounted, as a result of using what is termed a more resilient approach everywhere without any difference (p. 49). The characterization of the technological in the technological *jugaad*, in terms of a culture of innovation talks of how dominant cultural values shape technology and vice-versa, without outlining how they become dominant, by design or otherwise. The characteristics outlined for further empirical investigation as signposts, especially the reconfiguration of materiality in terms of recycling is not specifically outlined, except in terms of contextual contingencies of knowing and doing, which is rather nebulous (p. 53). The prospect of what is understood as waste, being redefined in this process, is at once interesting, yet elusive (p. 54). The intersectionality with policy discourse sought to be established with significant implications for innovation and S&T policies appears abrupt in comparison to the chapter on decentred cultures of innovation.

Chapter 6 defies a fallacy which he himself submits in characterizing the *jugaad* as technological. The theme of policy mismatch with the realities of this dynamic within the laboratory demonstrates the failures resulting from supply side factors like education, skilling and capability building on the system-wide basis. The developmental focus on economic development and growth, global competitiveness, high technology while not visible currently doesn't support the notion of society as recipients and beneficiaries alone in view

of this dynamic outlined. If the requirement of skills is not absolutely indispensable to their actualization within the scientific community, then perhaps the bureaucratic structure of Science that we misnomer for the professionalization of Science, as it exists is a myth and should be dismantled given our limited resources. Also, that reduces the importance of coalitions surrounding policy making processes as contingent on a supplanted, imposed context, capable of self-perpetuation, as opposed to systemic sustainability, rent seeking, as opposed to creation of knowledge rents. That would undermine their political economy in a similar manner in which the failures of capitalism have been cited. The alternative political economy appears as a policy paradox, as much as the traditional one, which does not offer solutions.

Chapter 7 on decentred cultures of innovation uses the verb and noun in the title which perhaps seeks to establish the dilemma between the processual and the morphological nature of practices *jugaad* is said to embody. While it seeks to challenge the centrality and pre-eminence of certain ideas and notions in policy discourse, academia and the larger mainstream discourse, it does not reconcile how the divergence between the diversity at the level of the laboratory engages with the meso and macro levels occupied by society can be overcome. Secondly, it does not recognize how the different realities of innovation that he perhaps characterizes as technological *jugaad* factor in with the other two aspects, even on a liberal view of what he discusses earlier (p. 72-73). In his attempt to do so in terms of implications, it appears post haste to fit into a reality that is by his description admittedly alien to practices within the laboratory. How can one site be the basis of such a generalization is also unclear. The attempt at defining cultures in general and that relating to innovation is valiant considering that he seeks intersectionality where none exists (p. 73). He could have been better served by demonstrating how the other cultures appear, in terms of their inherently cyclical and iterative nature. The simultaneous existence, relevance and interaction is characterized as the decentred cultures of innovation appears contradictory, as these facets are ideally to be present in what is centred. In evolutionary terms, establishing feedback loops of interaction is even more difficult in the inherently decentred cultures like *jugaad*. But making the assumption that they assume the features like networks, which become evident for formal innovation systems is falling prey to the same trap of structure. Exactly how these weak ties, if they exist make for strength and resilience is perhaps a challenge to the decentring argument. Also, the contingency on place and context dictated that he compares Indian situation in the laboratory with those outside it or qualify the lack of comparability which is key vulnerability of the *jugaad* innovation Literature. The decentring inferred from examples not embedded in our culture tends to undermine the argument (p. 74). The narrative on user driven innovation appears

abrupt and piecemeal when discussed in relation instruments developed in a western context (p. 75). The questions raised itself demonstrate that there can be no comparability in the level of problem solving and working with constraints. The follow up on the decentring of practices with something developed within a laboratory is weak, then how does the author expects us to believe that this will be visible in a context of the jugaad, which is a parallel universe, in terms of a site of construction is totally a paradox. It is a matter of no surprise then that our laboratories function in a not so ideal-type way. The decentring in terms of nature of power in political and knowledge hierarchies considered by the author perhaps then do not need to or cannot be overcome (p. 77). To test jugaad on the symmetrical terms with other cultures of innovation is therefore misplaced. He ends on a confused note, as regards the difference with user driven innovation and his technological jugaad and more importantly the impact of the decentring processes he carefully constructed. While his narrative on the invisibility of other cultures of innovation as situated in terms of a discourse is a point well-taken, it is worth saying that impact is different from visibility, both in terms of scope and degree. The

epilogue appears like a requiem to modernity as the decentring of the innovation behind the STM Microscope of the Professor Dharmadhikari appears like the Time Machine of Back to the Future, where certain elements are repeatedly revisited, deconstructed, constructed and reconstructed to suit the narrative that subsumes exceptions to yield nothing generalizable. The author finally acknowledges the unsung heroes behind the genius of the laboratory called the Professor. Exactly how his approach is based on his experience, a thing say his junior or student is incapable of replicating is perhaps a decentring, nobody wishes to consider then. The enculturation of what embodies the practices of the particular scientist is perhaps a process that exists in the crevices of the decentring. The Book leaves you with a grounded, yet incomplete picture of the idiosyncratic elements of work in a laboratory. This doesn't fully converse with how technological jugaad is constructed in any manner different from that in the outside world. The decentring is perhaps more of a Paradox and a tautological oxymoron as the technological cannot embrace the nature of jugaad and never the twain shall meet.

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