RATIONALIZATION, STANDARDIZATION, AND CONTROL IN DESIGN

A Cognitive Historical Study of Architectural Design and Planning in the Public Works Department of British India, 1855-1901

PETER SCRIVER

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A Cognitive Historical Study of Architectural Design and Planning in the Public Works Department of British India, 1855-1901

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ABBREVIATIONS

BA-Map Maharashtra State Archives (formerly Bombay Archives) Maps and Plans Collection, Bombay
GG Governor-General (of British India)
IOL Indian Office Library, London
IOR India Office Records Collection, London
NAI National Archives of India, New Delhi
PWD Public Works Department
SS Secretary of State (for India)
TNSA Tamil Nadu State Archives, Madras
PREFACE

This study examines how design reasoning is supported and mediated by the social and the conceptual "frameworks" in which it is practiced. The research and reasoning process that lie behind it have—like their object—been supported, shaped and directed within various social and conceptual frameworks. It is my great pleasure—now that a product has finally emerged from that process—to acknowledge those frameworks and the many persons whose knowledge, shared interests, enthusiasm or cogent disagreements, experience, friendship and companionship have enabled me to better understand and exploit those constraints.

The project has a long history, and the objectives and the scope of the research have evolved considerably over that period. My historical interest in the Public Works Department of British India stems from an earlier study of architectural design in postcolonial India, which Vikram Bhatt and I conducted in the mid 1980's. In present day India, we observed, architectural practice is a story of two cultures: that of the private practitioners, and that of the government servants employed in the extensive system of design and planning departments and related agencies descending from the previous colonial administration, and collectively responsible for the major engagement of India's public sector in building and urban development, at all levels of government administration and enterprise. To explain the postcolonial development of architectural practices in that social context, or the broader phenomenon of the reception and diffusion of the discourse of "modern architecture" beyond the Eurocentric "space" in which it first emerged—the problematic of which contemporary Indian architecture was a paradigmatic case, in our view—it became apparent that the material and conceptual legacies of colonialism comprised an overbearing framework from which our critical, "cultural", historical, and technical questions concerning architectural design, could not be extricated. The present study is a further product of my efforts to better understand and explain that most fascinating and unresolved case of cultural development and change in the framework of past and present colonialism.
Preface

For the *problematic* which this study has attempted to elucidate, my intellectual debt goes back to the late Peter Collins, who first asked me and my fellow undergraduates at the McGill University School of Architecture to consider the historical and the cognitive implications of the standardization, *by design*, of the social environment.

The "cognitive* hypotheses and methods with which I have attempted to frame that problem in the present work reflect the intellectual and institutional context in which I have been inspired and supported most recently in my work at the Delft University of Technology. My relationship with my thesis advisors, Alexander Tzonis and S.J. Doorman, has been highly compelling intellectually, but at the same time delightfully convivial; a paragon of mentorship. To them, and to Liane Lefaivre, and my colleagues, past and present, in the Design Knowledge Systems research group—Yu Li, Hoang-El Jeng, John Heintz, Nan Fang, Xiaodong Li, Marc van Leusen, Jelle de Boer, Abolfazl Zandi-Nia—I owe my sincere thanks, on many counts besides the intellectual stimulus of our seminar. I would like to thank Yu Li, and Hoang-El especially, for their wisdom and selfless assistance in the final preparation of this document for publication. I also owe special thanks to Liane Lefaivre for her dependable candour as a critic, but most particularly for her encouraging and hopefully perspicacious fascination with "thermamidotes", among the more obscure arcana with which this study is concerned.

I am indebted to Anthony King for first defining the domain of inquiry into the colonial built environment and for formulating many of the problems which I have revisited in this case study from a somewhat different viewpoint. As the domain expert on my examining committee, he has played his role very sincerely and helpfully, much as he may have wished I had framed my questions differently. I also wish to thank professors Ed Taverne, P.G.M. Hesseling, P. Schmid, and H.J. Rosemann, for serving on my committee and offering me their insight and considered responses to this rather voluminous text, from their respective viewpoints.

At different stages in the course of this research I benefited from helpful exchanges with other experts in the various historical domains into which the inquiry has ventured. In this regard I would like to thank
Preface

B.V. Doshi in particular, as well as Thomas Metcalf, Norma Evenson, William Curtis, G.H.R. Tillotson, Robin Evans, and Pedro Guedes. Earlier still in the intellectual and social history of this project I am indebted to the seminal advice of several teachers and later colleagues of mine on the faculty of the McGill University School of Architecture, including Adrian Sheppard, Witold Rybcynski, and my excellent friend and earlier collaborator, Vikram Bhatt.

In India my debts—professional, academic, institutional, and social—are many. To the Bhatt Families of Bhavnagar and Bombay, I am deeply thankful for all manner of logistical, moral, biological, cultural and diplomatic support. In Delhi and Ahmedabad, I have enjoyed and benefited from a similarly exceptional degree of support from the principals and staff of Stein, Doshi, and Bhalla, architects; my former employers, as a young architectural trainee in India in the mid eighties. J.R. Bhalla was invaluable to my research in advising me and facilitating my inquiries in the labyrinth of Indian Government and institutional bureaucracy. To Joseph Stein, and the late Margaret Stein, I am especially thankful for the home they opened to me during my months of lonely research in the archives of Delhi, and for the indelible memory of "sun-downing" whisky and soda's on their verandah, on a certain steamy Friday evening in high Monsoon, to the accompaniment of Jascha Heifetz playing Bach and the contented grumblings of the lions in the neighbouring zoo.

The Shastri Indo-Canadian Institute was my official home and institutional base on two separate funded research trips to India. To the Institute and to Mr. P.N. Malik and the staff of the Delhi Office, Naresh Roy in particular, I am very thankful for untold assistance. For the professional assistance in my research, I would also like to thank, collectively, the staff of the National Archives of India, The Tamil Nadu State Archives in Madras, and the Maharashtra State Archives in Bombay. At the Central Public Works Department in New Delhi, Chief Architect, M.K. Rishi and Senior Architect, Jeevan Kothari made every effort to make my access to data and drawings as easy as possible. I would also like to thank retired Chief Architect (CPWD), Habib Rahman, for an insight giving series of interviews early in my inquiries. Many others contributed

Many friends and colleagues in India have also contributed socially and substantively to the making of this work. I wish to thank Deb Guha, Murali Murugun, M.T. Nathan, Yatin Pandya, Vikramaditya Prakash, my publisher Bipin Shah, and Fiona and Peter Duby in Dacca. Finally, a very special thanks to my good friends Umesh and Shachi Atree.

Among my Canadian friends, Danny Pearl, Ken Reid, and Graham Livesey will recognize how grateful I am to them for helping me through some of the more difficult moments of the past two years.

In the Netherlands, where this dissertation was finally written, I wish to express my warmest appreciation to the Schroeters of Nieuw Niedorp—Jack, Hanneke, David, Sander and Moriko—who have made their time resources, and their wonderful cottage home available to me on many occasions. In logistical respects, Toos Schoenmakers and Elizabeth Quarles van Ufford have been a great help. And on technical matters Peter van Staveren donated much of his valuable time trying to liberate this text from an an archaic word-processing programme—alas, unsuccessfully.

Very special appreciation is due to Lara Schrijver, and to Ripke Sierksma for their diligent efforts to translate my difficult English into the just and precise Dutch words that might carry their intentions effectively. I only wish I had had the opportunity to make myself sufficiently conversant in the Dutch language to make the translation myself.

In addition to my targeted grants for research in India, this project has been supported by fellowships from Les Fonds pour la Formation et l'Aide a la Recherche (FCAR) of the Government of Quebec, and the Netherlands Government Graduate Scholarships Programme. For that support I am very grateful.

Family come last in the accounting by virtue of their "deepest", most fundamental position in this framework of supporting and inspiring social relations. To my parents, Esther Pierce and Charles Scrivener; to my
siblings, Do-Ellen, Julie, and Paul, their partners and children; to Margo and Georges Asselin, and to Manon, as ever, my love and profound thanks.

This work is dedicated to Jessie Boyd Scriver, the matriarch of my little clan, who accomplished the major opus of her 100th birthday as this seemingly interminable project was brought, finally, to a close. Her generosity, and faith in her grandchildren, and her intrepid example above all, have made this comparatively nominal accomplishment possible.

P.C.S.
PART ONE

FRAMES AND CONSTRAINTS IN DESIGN REASONING

and

THE FRAMEWORK OF THE RESEARCH
CHAPTER 1

INTRODUCTION

This introductory chapter defines and describes the problematical issues and the specific questions with which those issues have been addressed in the present research. A novel methodological position is defined and choice of case described and explained. The findings of the case study with respect to the principal research questions are briefly outlined. The chapter concludes with an overview, chapter by chapter, of the structure and content of the dissertation.

* * *

The thinking practices of designers could be described in terms similar to those with which Thomas Kuhn\(^1\) has described the practice of science. At a given time, within the communities of their specific design disciplines, designers tend to share particular sets of received beliefs about their practice—"conceptual boxes" into which creative reasoning is strenuously devoted to forcing all and sundry design problems. Like the "paradigmatic" theories that govern "normal" science, the normative practice of design has its privileged theories and methods, its aesthetic and technical conventions, and indeed its paradigms (in the literal sense of the term\(^2\)) in the form of canonical design precedents. Such commitments comprise a framework for coherent and consistent design reasoning within a professional or broader cultural community of designers. They also furnish a datum with which the relative novelty or anomaly of the artifacts produced may be gauged.

In this latter respect, the observation of science as a collective intellectual practice indicates a further instructive parallel with design. Inconsistent with the idealized notion of scientific method, it is observed, the manner of compelling hypothetical conjecture on which scientific discovery ultimately relies is routinely eschewed in the practice of normal science.\(^3\) Similarly, for all the potential for change

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2 "Example or pattern...". The Concise Oxford English Dictionary, s.v. "paradigm".

3 According to Popper's well known description of the logic of scientific discovery, "...the task of the scientist is...to propose bold conjectures (hypotheses) and then attempt to falsify them by deductive
inherent in the act of design, genuine innovation is rare. It is "standards", rather than perennially inventive intentionality, on which reliably productive practices tend to be based.

This study addresses this pervasive normative tendency in the social practice of design. Specifically, it examines the roles that socially framed and imposed standards may perform in constraining reasoning in the domains of architecture and urban design, thereby enabling the collective production of coherent and socially relevant built environments.

The basic problem we will explore in this regard rests in the fact that standards, and other such normative devices and relations, may come strictly to prescribe design solutions rather than simply constrain design reasoning; that is, to perform an essentially conservative or even coercive role, rather than an enabling one. This problematical relationship between standardization and control is especially prevalent where the institutionalization of design practices is concerned, and it is from that perspective that we shall approach it here.

Through the agency of institutional design and planning organizations, design norms and conventions may be explicitly codified to insure the efficiency and consistency of their application, but thereby rendering them particularly amenable to prescription. At the same time, the authority to impose such standards, and the organizational means to implement them, are generally well defined in such organizations. Both the productive and the coercive potential of design standards may therefore be significantly augmented when the standardization and control of design practices become institutional operations.

A detailed study of such a case of explicitly institutionalized design practices will furnish the empirical basis for this inquiry into the problematical relation between standardization and control in design.

We need to accept and develop the role that institutionalized

tests." Kuhn, on the other hand, describes actual scientific practice, from an historical rather than an epistemological point of view. "Normally", he argues, scientists are a far more conservative lot than Popper's idealized prescription implies. While appropriately skeptical of any new hypothesis, they are rarely eager to falsify their own. Rather, communities of scientific investigators endeavour to save their paradigm from challenge as long as feasible. P.N. Johnson-Laird and P.C. Wason, eds., Thinking: Readings in Cognitive Science, (Cambridge: Cambridge U. Press, 1977), 260-261.
systems of design knowledge may play in enabling the productive cooperation of designers and planners in the generation of multi-functional solutions to increasingly complex design problems. This study aims to improve understanding of this most explicit and consequential form of normative design reasoning. The case study indicates that the pattern of normative behaviour in an institutionalized context of design reasoning may be explained with respect to the relative type of rationality in force in that context at a particular time. Such historically specific rationality may be explained, in turn, in terms of the prevailing goals and beliefs of the designers concerned; a function both of their adherence to collective belief systems at the level of professional and more general social communities, and of the specific modes of reasoning sustained by the specific expert practices in which they are professionally engaged. The normative rationalization and standardization of design decision making practices and their solutions—with their potentially problematical implications in the control of social relations—must therefore be assessed historically. I propose, with regard to the phenomenon of conceptual change rather than any intrinsic malignancy in the structure of institutions or in normative reasoning per se.

1. RATIONALIZATION, STANDARDIZATION, CONTROL

Problems with the "institutionalization" of conventions:

In the day to day practice of designing and constructing buildings, informal conventions commonly emerge. These may reflect the logistical constraints of the local building industry, as well as the prevailing norms of a society with respect to the organization and meaning attached to the spaces it inhabits.\(^4\) When such conventions are explicitly defined

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\(^4\) Amos Rapoport, "Vernacular Architecture and the Cultural Determinants of Form." In A.D. King, ed. Buildings and Society. (London: Routledge and Kegan Paul, 1980), 283-305. Among other culturally specific practices, anthropologists have described conventions of house form and environmental design in tribal societies as a "ritualization" of a set of operations originally found to be effective in sustaining and renewing homeostasis in a particular environment. See: C. Levi Strauss, The Savage
and regulated, however, they become a more conspicuous form of social knowledge, at once more tangible and hence more instrumental as tools for collective agency, but potentially problematical by the same token. The utility of institutionalized knowledge is often particularly apparent when conditions of development and change prevail and the normative criteria on which equilibrium depends are in flux. In such cases, institutionalized practices may become the primary basis for action; an object and a model for behaviour, where the goals of action are themselves ambiguous. In such respects institutions may be regarded as "enabling"; as normative frameworks that support and sustain decision-making, socially and historically. This is the essential point that emerges from the historical case study that follows.

However, the above point cannot be argued without due consideration of the more problematical implications of that social phenomenon, for institutions are not only tools that enable other processes and actions to occur; they also tend to be self-sustaining organizations of knowledge. As an institution becomes, over time, an inertial phenomenon in itself, the rationality with which it operates, and with which it is explained and defended, may tend to become more formal than substantive.

The demise of the paradigm of Modern Architecture, for instance, could be explained as one of the more conspicuous recent examples in the history of architectural design of an ultimately counter-productive manner of institutional control ensuing from the ossification of an inertial normative practice. By the middle years of this century the Functionalist ethic of programme-driven design orginally propounded by the pioneers of the Modern Movement in design had become subsumed by the prescribed aesthetic of the International Style, as such had been effectively institutionalized through its description and diffusion in the art and architectural literature.

In the more general case of institutionalization, the rationalization of practices in institutionalized forms has been seen to bring into being what Max Weber called the "cage" of bureaucratic forms and strictures within which human society tends increasingly to confine itself, driven by a compulsion to define, classify, constrict, and

thereby control the behaviour of its members. But this study indicates
that these more coercive potentialities of the institutionalization of
knowledge are not the "normal" case. Rather, when the norm of "control"
becomes a central criterion in reasoning, we observe, such may well be an
indication of slippages, shifts or pending failures in the conceptual
frameworks in which such reasoning has, to that point, been supported.

The case of scientific investigation offers further insight in this
regard. In Kuhn's historical reading of such reasoning practices, the
ossification of institutional beliefs and methods is the exception that
proves the rule of "normal" practice. A shift from the productive
application of a paradigmatic theory to an increasingly doctrinaire
insistence on conformity with that theory rather than confirmation of its
validity, is generally an integral factor in a process of conceptual
change and the potential harbinger of a scientific revolution.

Paradoxically, then, the institutionalization of conventions can be
assessed historically as both an enabling and a constraining operation,
but as an ultimately creative process in either respect.

Intentional and institutional normalization:

The normalization of design knowledge is a social phenomenon, a form of
negotiation about conventional design practices. Once such shared
knowledge has been recognized and explicitly described, however, it may
come to be perceived as "institutional", as an externally constituted
form of knowledge seemingly imposed upon the individual designer. This
impression may be furthered, moreover, by the fact that formally
constituted institutional organizations may develop around such

5 A. Giddens, Capitalism and Modern Social Theory: An Analysis of
the Thinking of Marx, Durkheim and Max Weber. (Cambridge: Cambridge

6 In Kuhn's argument, it is only when repeated anomaly becomes too
conspicuous to sustain collective belief in a paradigmatic theory and the
normative scientific practices developed upon it, that the hypothetical
method of inquiry is employed in earnest to exorcise its fallacies, and
to posit alternatives. "...Then begin the extraordinary investigations
that lead the profession at last to a new set of commitments, a new basis
for the practice of science." T.S. Kuhn, The structure of Scientific
Revolutions, 5-6.
standards, to protect and promote them or to co-opt them into some larger framework of control.

By virtue of this institutionalization of knowledge, both bureaucratically and by convention, there are ultimately two quite distinct sets of normative compulsions in design reasoning. The first may be classified as "internal", what we will refer to as "intentional" compulsions. These are biases or inclinations resulting from the particular composition of cognitive constraints and conceptual frameworks that comprise the consciousness or "cognition" of a given individual. The other set of normative forces will be referred to consistently as "institutional" compulsions. These are effectively "external" in their relation to design reasoning, exerted by society through the medium of institutionalized descriptions of shared design knowledge such as academically defined architectural styles or legally enforced building codes.

How the former is transformed into the latter and how, thereby, explicitly rationalized and institutionally standardized design norms may become instrumental in the mediation and control of productive relations, are key concerns of this study. Most importantly, however, it seeks to describe how these two sets of normative forces may interact productively in practice to check and balance the design reasoning process.

A case of formally institutionalized design reasoning:

This problematical interface between cognition and institution will be explored in subsequent chapters, in an historical case study of normative design reasoning in an explicitly institutionalized context of practice: the Department of Public Works of the British colonial administration in India, in the second half of the 19th century. We will examine in detail the form and the product of the codified standards by which that "departmental" design reasoning was constrained. We will seek to explain how and why such standards emerged in that particular historical context, and how these were utilized in practice, enabling an efficient and

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7 These terms will be defined more fully in Chapter 2 in relation to the cognitive model of reasoning employed in this study.
effective production of design solutions in several respects—technical, logistical, bureaucratic and not least, cognitive, as an explicit medium for precedent-knowledge based design reasoning.

The case also provides insight, with respect to the issue of control, on the possible epiphenomenal implications of such institutionalized design practices in their immediate social relations of production. Specifically, we consider the authoritarian utility of codified design knowledge and decision-making procedures in a bureaucratically structured organization.

As a salient precedent of institutionalized design reasoning, we will furthermore consider to what extent our findings with respect to this case may be generalized and, hence, how that precedent knowledge may be useful in interpreting similar cases, and in developing improved strategies for formalizing normative design practices in future.

The broader relevance of the case and it's issues:

The relevance of the problematic, as with the case, is underscored by the increasingly apparent need of our global civilization of the late 20th century to return in earnest to organized, normative strategies for integrating physical planning and design. In conditions of increasing social complexity at the level of design programmes and implications, and increasing interdependence with respect to the social agency of design professionals and institutions, the issues of rationality, standards, and control in design can only conceivably grow in significance.

The "rationalism" and other normative "determinisms" attributed to modern bureaucratic institutions have been much criticized, not least the ostensive role of institutional mechanisms of production and control in the design of oppressive social environments. But some such

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8 See for example T. Markus, Buildings and Power, (London: Routledge, 1993); M. Foucault, Power/Knowledge: Selected Interviews and Other Writings by Michel Foucault 1972-1977. Colin Gordon, ed. (New York: Pantheon, 1980); Hillier and Hanson, The Social Logic of Space (London: 1984). For an alternative interpretation which argues that the roots of the perennial problem of the oppressive environment are to be found, not in the institutions and utilitarian objectives of social agency, but in the underlying "methodology" through which the design objectives of a society are formulated at a particular historical moment. see: A. Tzonis,
institutional frameworks for the collective mobilization, coordination
and application of knowledge will surely continue to be a primary basis
of social agency. Computer-based information networks are already
redefining traditional bureaucratic structures in this regard, and the
need to rationalize and control the flow of information through
standardized protocols, to enable productive communication and decision
making, is if anything more acute than ever.

Meanwhile, to design and maintain the sustainable environments and
social systems that policy makers in many fields now recognize as
imperative for responsible planning and development in the long term, we
will need to recognize the intrinsic normative processes in forms of
social production such as architecture and urban design, and to define
and develop these more explicitly to enable better integrated design
reasoning.

Three facets of normative behaviour in design:

A point of departure for the present inquiry into these normative
processes is the recognition of the multifaceted nature of the object.
The three key-words that form the title of this work are interpreted here
as defining three distinct facets of normative behaviour in design, each
problematical in their own ways but generally necessary in any process
through which a collectivity attempts actively to generate and sustain a
consensus of beliefs and practices concerning design.

There is, first of all, a need to "rationalize" design reasoning;
that is, to make that process conscious and consistent with the expert
knowledge of the design community and the basic goals and beliefs of the
larger social community to which it belongs, for the sake of the
collective utility of the artifacts produced and the relative efficiency
of their production.

"Rationalization" is a problematical term in contemporary critical
discourse, and we should clarify immediately the sense in which it is
employed in this study. "Rationality" is here understood in the simple,
inclusive definition of the term going back at least as far as St.
Augustine who described man's rationality as his capacity to strive after
a goal and to be able to introduce an order into his behaviour. It
should be noted that this does not exclude "ideology" from consideration
under the category of rationality, such that one may indeed act
consistently in accordance with an ideological system of goals and
beliefs. As we will observe in the case study, however, beliefs may
become irrational in themselves, thus undermining the rationality of
decisions taken on their account.

As applied to architectural design, "rationalization" will be
understood here to mean the consolidation and correction of practices
toward greater coherence and efficiency in the collective production of
the built environment, and the greater utility of the same with respect
to the social order and the needs of the society that builds and inhabits
it. It will be a key premise of the interpretation that follows, however,
that there are different kinds of rationality, and that such may vary
with the specific object or context of reasoning. Moreover, we will
observe that different kinds of rationality may be demonstrated by
decision makers in different states of belief concerning the parameters
within which design decisions are to be made, regardless of whether the
actual parameters vary, or not. The objectives by which rational actions
are gauged—that is the norms of rationality—tend to vary with
differences in the socially and historically mediated framework of norms
and beliefs, or what we will describe in greater detail in Chapter 2 as
the "conceptual system" in which a designer reasons in a particular
situation.

Rationalized design thinking must necessarily be instantiated to be
productive. A second facet of normative design behaviour is then invoked
to evaluate the relative consistency of such instances, to discern and
describe a mean instance or "standard" representing the consensus of the
design community. "Standardization" is, thus, the essential act of

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9 as cited in A. Tzonis, Towards a Non-Oppressive Environment
Elster offers a similar fundamental definition: "...rationality minimally
implies consistency of goals and of beliefs". J. Elster, Explaining
codifying such collectively acknowledged standards.

A third facet of normative behaviour in design is the need to "control", that is to regulate the use of standards once they have been described to ensure their effective application as a basis for a socially constructive practice of design. The norm of Control does not alone entail coercive power. Such appears to depend on the relative hierarchy of that norm in the pertinent conceptual system of the designer. As the case study will indicate, innovation, responsiveness to change, and the desire for individual freedom of expression—that is, to retain responsibility for conscientious design decision making—are also variable norms. Such variations have significant implications for the relative utility of institutionalized knowledge and practices, from one historical context to the next.

Arguments:

The study argues the following fundamental points with respect to the problematic of rationalization, standardization and control in design:

First, the three forms of normative design reasoning we have described, comprise a dynamic relationship between innovation, routine and doctrine, respectively. It is perceived that routine-based reasoning is not simply "routine", but a difficult middle ground between "internal" and "external" normative compulsions.

Second, it will be argued that doctrine differs from routine in the fundamental distinction between prescriptive and proscriptive modes of normative design reasoning; the former "controlling" in the narrow coercive sense of the term, the latter "constraining".

Institutional standards perceived as contextually determined strictures—that is, externally imposed—tend to become inflexible, essentially prescriptive tools of control. Such ossification of institutional norms is most likely to occur in decision-making situations where a "parametric rationality" prevails; that is, where the decision maker believes (often naively) that the context and criteria of the problem are unchanging or sufficiently predictable to be fully within
their competence to control.\(^{10}\)

In this argument we distinguish fundamentally between such parametric modes of reasoning and decision-making in a state of "strategic" rationality. The latter is defined by an axiom of symmetry; that is, the agent acts in an environment of other actors, none of whom can be assumed to be less rational or sophisticated than she/he is theirselves.\(^{11}\) In such contexts of interdependent decision-making, the nature and utility of "standards" is as heuristic "means" rather than preemptive "ends"; as a dominant strategy for efficiently initiating an open-ended decision-making process. Such heuristic constraints are in general "intentional"—that is internally imposed. As a cognitive tool they enable problem-solving and decision-making in which relevant precedent knowledge may be efficiently and flexibly exploited as a form of default reasoning, to directly circumscribe a category of potentially felicitous solutions, without prescribing any particular instance.


\(^{11}\) Ibid., 77.

**Types of Rationality**

![Diagram](image.png)

Fig. 1.1.
A further important point emerges from the historical case study. It is observed that the specific mode of reasoning with standards—i.e., prescriptive or proscriptive—tends to relate to the prevailing state of belief, or "preferred belief", about the context in which design takes place. In the case, a process of conceptual change is observed which, indirectly, had implications for design reasoning through the evolving intentionality that such historical changes in the general beliefs and higher standing norms of the designers are perceived to have engendered.

Finally, it is argued—from a methodological perspective—that these are essentially "cognitive" rather than "contextual" issues. The cognitive historical interpretation of the case indicates how the critical-contextual notion of design artifacts as embodied representations of social knowledge, which has informed and directed much recent scholarship on rationalism and control in architecture and planning, may fruitfully be superseded by the cognitive analysis of design reasoning as a socially and historically mediated process of knowledge-engineering.

A cognitive viewpoint:

In this study I take the view that relationships between reasoning and action in the social realm are structured phenomena, and that these can be modeled systematically.

In this argument, I accept and incorporate the notion of inter-subjectivity fundamental to much recent thought and writing about "culture" and social history, particularly the centrality of the thinking subject in any such interpretations. However, I maintain the essential premise that the cognitive agency of this thinking subject in society may be studied, and that such an analysis may be objective and amenable to generalization. I do not insist on describing intentionality as rational, but suggest that the reasoning of the subjective mind may be given a reasonably objective explanation.

As human cognition is investigated with ever greater conviction we

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12 These methodological concerns of the "cultural studies" movement will be discussed in Chapter 2.
begin to be able to speak of the "actual mind" with a degree of certainty with which some may be skeptical, but which was unknown to earlier generations of rationalist and empiricist thinkers for both of whom the psychological domain of cognition has traditionally been discounted for being (presumably) inaccessible to objective inquiry. The more we understand about how the mind operates, the more we can begin to speak, with reason and objectivity, about the "possible worlds" the mind may construct. In short, the mind need no longer be regarded as a black box.

When we begin to look inside -- as investigations from the various disciplinary perspectives comprising the cognitive sciences have been doing for some time -- the structural basis of the knowledge of the world we both receive and construct as biologically, and socially and historically cognate beings, becomes increasingly apparent.

2. A CASE

The system of institutionally regulated design norms and practices that prevailed in British India in the second half of the 19th century, to enable and to constrain the physical planning and development of the Indian subcontinent under colonial administration, was a product of a concerted rationalization, standardization and control of design reasoning practices. The development, accomplishments and longer term implications of that system present a case history especially rich in both the productive and the problematical aspects of institutionally constrained design reasoning, which we have begun to discern.

Parts II and III of the study will submit that case to an extensive cognitive-historical investigation in which we will focus on the conceptualization of design and planning problems in that rather particular socio-historical context. How the perception of such problems, and the design decision-making procedures through which they were tackled, evolved over time, and how such changes related to changes in the social and, hence, normative and conceptual frameworks in which that design reasoning took place, are the basic questions that this historical

account will attempt to answer.

The case of the British Indian Public Works Department:

The physical planning and development of British India in the second half of the 19th century by the engineers of the Public Works Department presents a quintessential case of design as knowledge-engineering. Between its establishment in the middle decade of the 19th century and the close of the Victorian era, the Public Works Department of British India devised a corpus of explicitly defined design standards, norms and regulations which were employed as a form of cognitive technology enabling predictable and sustainable design production appropriate for the specific development intentions of that colonial administration.

The accomplishments of the Public Works Department, on account of this departmental design system, were significant. British India was transfigured by the modern transport and communications networks which the PWD was mandated to build, and through which the colony was to be controlled and its economic resources exploited. In the wake of their major engineering works—the great networks of roads and railways, irrigation canals, municipal water works and sewers—the PWD engineers erected a panoply of purpose-built architecture. From the simplest of utilitarian service buildings to entire settlements they undertook the planning and construction of the basic accommodations for virtually every facet of the colonial administration’s residential and working needs. This included all government offices; all civil buildings and institutions such as courthouses, police stations and jails; all military works and buildings; public service buildings such as post offices and railway stations; and a wide array of residential "quarters" and "bungalows" to house the growing ranks of meticulously graded and categorized government servants, European and Indian.

For close to one and a half centuries, under the British and subsequently the central and local governments of post-colonial India, this powerful department of the Indian bureaucracy has continuously exercised its exclusive mandate to provide for the changing spatial requirements of the formal sector.

Embodied in the PWD’s largely standardized designs for these
official residential and work environments were both the prejudices and
the innovations of a calculated but essentially heuristic engagement of
the colonial administration in the consolidation and selective
"improvement" of its vast dominion. With a handful of practical theory,
and considerable frontier empiricism, tempered by an unslacking grip on
economy, the PWD engineers methodically developed a distinctive canon of
standard building designs and details.

But the general modesty of those designers' intentions and the
pragmatism of their methods belied the significance of their achievement
in the longer term. Beyond their mundane official functions the
"departmental" designs of the PWD engineers provided physical and
conceptual models that, one could argue, furnished the essential catalyst
for the progressive re-patterning of the spatial norms and forms of whole
sectors of modern Indian society. They were, in this sense, the first
incursion of Modern Architecture and planning in India.

Historiographic significance of the case study:

This case study of institutionalized design reasoning has a parallel
significance, with respect to the preceding paragraph, as a basic
contribution to the study of "modern" Indian History. As such the
narrative aspect of the exposition that follows may strike some as
excessive for the theoretical objectives of the study. On the other hand,
historians may fault the cursory treatment of certain themes in the
broader social, political and economic interpretation of the case. These

14 The term "modern" is in most every respect a problematic one, in
this time of aggressive re-appraisal of the basic assumptions on which
the Europe-centred notions of "modernity" and "progress" have been
promulgated, historically; most obviously in any discussion of European
colonialism. I will use it as little as possible in this study, and
advisedly, in the sense of a distinctive "colonial modernity" which I
will argue—with a consensus of scholars presently at work in the
field—was, in important respects, the necessary precursor or counterpart
to the processes of social and spatial transformation that took place
between the 19th and 20th centuries in the "modern" metropolitan
societies of the European imperial states. See: A.D. King, Urbanism,
Colonialism, and the World Economy: Cultural and Spatial Foundations of

15 Furthermore, I forewarn the "critical" reader that this text makes
shortcomings acknowledged, the study hopefully contributes substantively to both domains, not least by virtue of the alternative points of view that these two very different facets of the inquiry bring to a common object.

In the small but growing body of literature on the architecture of colonial and modern India, the historical significance of the

no pretense to "theoretical" sophistication, with regard to the semiological, epistemological, and historical concerns articulated in the current discourse of postcolonial cultural criticism; pertinent and valid as such questions are; and necessary as it would be to take such into account if this study had the scope to examine the social reception and diffusion of the architecture produced by the colonial department of Public Works. As is, the present inquiry has had to be rather more limited in its ambitions. It examines a specific "European" design discourse, to which the contributions of the British colonial engineers in India is, to a significant extent, a generalizable case.


In the present inquiry into the building design methods and rationale of the Public Works engineers of British India, we will actually have very little to add or to borrow from this primarily art historical literature, which is predominantly concerned with the restoration of this neglected corpus of Georgian and Victorian architecture to the record of European architectural history, and to the conservation of those colonial buildings of note which still survive in India today.

utilitarian design and planning practices of the Indian PWD is generally recognized, albeit negatively for the most part. However no study has yet attempted to explain substantively the actual practices and contextual and conceptual factors that might have constrained the design reasoning through which that purpose-built architecture came into being—for better or for worse. The present study has attempted to redress that lacuna in the literature, and to do so by addressing the actual records of routine decision making within the Indian PWD, concerning building design and related issues.¹⁷ To the best of my knowledge the mundane "Proceedings" of the Department of Public Works records have not been studied broadly and systematically with regard to the general design history of that institutional organization.¹⁸

phases of British Indian architecture will be discussed in Chapter 2—along with other works in urban history of more direct relevance to the present study.

¹⁷ Specific data, sources, and archives are described in Chapter 2.


On the basis of primary research with the records of the Royal Engineers corps, the architecture and building knowledge of the military men who formed the professional nucleus of the Indian PWD has been described in at least one recent study: J.M. Weiler. "Army Architects—The Royal Engineers and the Development of Building Technology in the Nineteenth Century", (unpublished doctoral thesis, University of York, 1987). However, Weiler’s exclusive emphasis on technology, from a perspective of metropolitan diffusion, sheds little light on the particular modes of design reasoning of those engineers in the actual colonial contexts to which they took that technical knowledge. (I wish to thank Pedro Guedes for bringing Weiler’s study to my attention.)

The history of the Public Works Department of The Government of India has been recounted, partially, from various other perspectives. In the contemporary account by Sir Richard Strachey, a former Chief Engineer and Secretary to the Government for Public Works, the administration and finances of the Department take precedence: see John Strachey and Richard Strachey, The Finances and Public Works of India From 1869 to 1881,
The exceptional historical context of the case in question has held a central place in previous cultural, political and sociological analyses of colonial architecture and planning in India. From the internal "cognitive" perspective on the design process adopted here, however, that context is only considered indirectly—though of no less ultimate consequence, on this view—insofar as it was represented in the socially constructed "conceptual systems" of the engineer-architects on whose cognitive agency (individual and institutional) the inquiry centers. On this view social context is regarded as no less consequential, in the final analysis, for the explanation of historical processes. However, the study proceeds upon the premise that the causal links between context and specific processes such as architectural design are of a complex and indirect nature which the broad and inevitably imperfect correlations


Of course, these other facets of the departmental history had their own bearing on the design production of the PWD. The implications of the departmental engineers' technical education, and their technocratic administrative practices, in their design reasoning will be examined in detail in Chapters 6 and 8, below.
commonly posited in conventional notions of historical change do not adequately explain.

Critical examination of the product and performance of this departmental design system foregrounds the problematical notion of institutional rationality. But it is also a case of design reasoning in a complex and problematical social context in which different cultures, with their different knowledge, goals and beliefs, came into contact in a situation of unequal political and economic relations. This context of colonial domination in which that agency exercised its mandate to plan and design, inevitably raises the question of "power" with which many recent interpreters of modern social history and the role of institutions and institutional knowledge therein have been much concerned. 19

But the particular transparency of this case, as an instance of explicitly institutionalized design reasoning and practices, as well as the relative extremity of the colonial historical context, give us critical distance to observe these phenomena more acutely and to recognize, thereby, their ambiguities. Further questions arise from these observations which indicate the operation in this case of a more multi-functional and essentially productive rationality than the singular

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emphasis on "power" would imply.

It is important to emphasize that the Indian Public Works Department was, above all, a substantially effective system of design production.

Colonial criteria:

The colonial situation presents a complex of issues which might appear to distract from the object in question. Could not the issues raised by rationalization, standardization and control in design be more conveniently and relevantly studied in the conventional context of mainstream metropolitan architecture and society? An essential understanding I wish to establish at the outset is that colonial cultural history is regarded as a fundamental and equal facet of the global cultural and economic models of modernity that will be employed in this study. In fact the largely neglected cultural and conceptual implications of European imperialism in the evolution of modern western society in the late nineteenth and early twentieth centuries are in need of far more rigorous study. The spate of nostalgic lore concerning the lost age of empire, and the British Indian Raj in particular, that has reemerged in print in recent years has done anything but demystify this immensely important first phase in the global restructuring of human economy, society and identity that is the ultimate legacy of modernity. 20

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20 It has been proposed that the problem of "modernity" rests in part in the Eurocentric pre-suppositions in which that notion is couched. The term "modern" has only assumed meaning in a larger social framework of relations wherein the supposed "belatedness" of peripheral societies--provincial, colonial, and alien "other" cultures--to become modern is a necessary condition for the metropolitan to be the "first modern". But in a substantive spatial and historical sense as well, King argues, the original phenomenon of modernity was not the metropolitan experience of the industrializing societies of the European core, but the complex social "space" of the colonies, for it was there that "...the first globally multi-racial, multi-cultural, multi-continental societies on any substantial scale..." were formed. A.D. King, ed. Culture, Globalization, and the World System. (Binghamton: State University of New York, Binghamton, 1991), B. For a cogent discussion of "modernity" in contemporary architectural discourse from the perspective of "the periphery", and the postcolonial deconstruction of such in the light of current critical theory, see Abidin Kusno, "Architecture and Postcolonialism: Transplanting a Critique." unpublished thesis (M.A., history and theory of art and architecture), State University of New
A more specific retort concerning the relevance of examining institutionalized design and planning reasoning and practices in the colonial setting of British India, is the significant fact that the European colonial administrations tended to be more organized and aggressive in this regard (if not necessarily "progressive") than were their own politically ham-strung governments back "Home". England, in the period in question, did not even have a Public Works Department, nor any ministerial jurisdiction for such undertakings at the level of the national government. The enterprise of modernizing the fabric and infrastructure of Victorian Britain was almost entirely undertaken at the level of local government initiative, and even then by private enterprise on a contract basis for petty works, or in the case of larger works such as docks and railways as almost wholly speculative ventures for the profit of private investors. Legislators were typically the last to move for any public expenditure for such undertakings. 21

The general belief system of the Victorian Englishman—his "modern" notions of liberty and propriety—is a matter of some interest in this regard, to which we will return at length in the following chapters. At "home", as in their colonies, the technocracy of modern society was abhorred by the British even as "progress" itself was embraced and propelled forward by a free-enterprising public as in no other society of the day. The contrast, for instance, with contemporary French attitudes and initiatives at home and abroad vis a vis public works was marked, and self-consciously so. The ostensibly collective submission of the Frenchman to the centralized authority of the state—in the imagining of the English, both Liberals and Tories—was always held up as the image of what the independent, responsible, free-thinking, free-dealing Englishman was not.

In the historical account that follows, we will return repeatedly to such comparative contrasts with the parallel metropolitan and colonial experiences of French engineers in the 19th century, which a spate of valuable new research in that vein has coincidentally brought to light in

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York, Binghamton, 1993.

21 "Foreign Criticism of our Public Works Administration," THE BUILDER, XXXIII/1677 (March 27, 1875): 269-270.
the course of the present research. This will aid us in discerning and explaining the particular rationality of their British counterparts in India—as technocratic engineers of colonial space and society.

Domain specific objects investigated from the cognitive standpoint of the study:

This study seeks to describe and explain how cultural presuppositions and professional prejudices such as those we have begun to consider in the above passage, among other sub-systems of belief, comprised the conceptual frameworks that constrained the design reasoning of the engineers of British India. How such conceptual frameworks may have been embodied in the norms, regulations and standards of the Public Works Department, and how, thereby, explicitly rationalized and institutionally standardized design norms became what we will call "normative frameworks", implicated in the mediation and control of colonial social and productive relations, are key concerns.

These questions are addressed to three distinct facets of the case history:

1. the artifacts, or design products, in themselves. In this respect we describe the designs and actual buildings produced by the PWD engineers, and interpret the "substantive rationale" of those "forms" as discernible from the documentary evidence of the design reasoning of those engineers with respect to specific projects and common design problems.

2. the institutional frameworks of design production. We describe the explicitly codified design procedures, regulations, and means such as standardized prototype designs, with which the routine design reasoning processes of the PWD engineers were "formally rationalized" and

I. Introduction

controlled.

3. the conceptual frameworks of the actual designers. In this respect we examine the professional training and ideology, social class relations, and other indices such as documented argumentation regarding the ethical debates of the Victorian engineers, from which we may discern the beliefs, biases, higher standing norms and general states of knowledge—that is, the "conceptual systems"—of the individual PWD engineers, which might explain their particular decision-making behaviour as designers, builders and bureaucrats in the colonial social context of British India.

Following a brief introductory overview of the historical frame of the study, the principal three chapters of Part II will address each of these broad facets of the case, respectively. The final three chapters of the study (Part III) synthesize these discrete perspectives on the case historically, in respective discussions of the three facets of the general problematic: that is, the rationalization, standardization, and control of design reasoning, and institutionalized design production, in the British Indian Public Works Department over the particular historical period of development and change under study.

Cognitive-historical interpretation of the case:

The findings of the latter cognitive historical interpretation may be summarized in two broad categories:

1. The Cognitive technology of the British Indian engineers: The case of the British Indian Public Works design system draws attention to the instrumentality of design reasoning practices. The panoply of mundane architecture which the government engineers of British India erected throughout the country to accommodate the colonial administration, and the thousands of civilian and military personnel—European and native—in its employ, was among the more ubiquitous facets of the infrastructure on which the administration depended for logistical support; a "technology" enabling Europeans to survive and function productively in an extreme
physical environment. But the design reasoning that produced that infrastructure and distinctive built environment may be described as a technology in itself. Within a mechanistic conceptual framework and the exceptionally centralized and authoritarian institutional framework of a colonial administration, the Public Works Department of British India developed what we may characterize in the language of our present day computer paradigm as a "case-based system" for the production of architectural designs. Through prescribed consultation of a "data-base" of "sample" plans of designs developed previously for a wide range of common building-types—a systematic application of architectural precedent knowledge—the department endeavored to fast-track and delimit the design process. This enabled the efficient output of a large volume of design solutions by a small number of men working at great distances from each other and departmental headquarters. Individual designs could be tailored nominally to local variations in program or specifications but the embedded precedent plans insured the generic uniformity of this "departmental" architecture while controlling the projected costs of construction within known parameters.

2. The consequences of conceptual change: The historical analysis of this case discerns a pattern of conceptual change at the level of the European colonial community as a whole, from a general state of belief characterized by a "strategic rationality" to an altered "parametrically rational" state of belief by the end of the period in question. In considering the role of the distinctive built environment devised by the PWD engineers in supporting and conditioning relations of power in the colonial society (and its post-colonial social palimpsest), an historical transition is discerned; from the felicitous cognitive praxis of the utilitarian minded problem-solvers of the mid 19th century, to the increasingly sclerotic system of bureaucratically institutionalized design standards on which the acutely self-conscious colonial regime in the final decades of British rule was to rely, with its overriding concerns for stability, predictability, and control. This fetishization of the stereotyped conventions of the PWD was one facet of a more general re-evaluation of the colonial built environment in terms of cultural representation—a tableau depicting a presumably static social order. The
sober simplicity and uniformity of the buildings prescribed for the colonial administrators and their military counterparts contrasted conspicuously with the ostentatious Indic designs that began to be built at that stage to represent the various cultural and racial constituencies of the colonial society and the pervasive notion of the collective "difference" of those "Orientals" from their European rulers.

This "high" architecture of the late colonial era (and that which followed to counter it, such as Chandigarh) was an alternative technology, for constructing identity. Obsessed with the artifice and affect of the architectural artifact, however, it was an architecture concerned more and more exclusively with the shaping and controlling of specific world-views, at the same time resistant to the creative "praxis" of world-making, resistant to the prospect of social change.

As a contribution to the historiography of colonial India, this case study allows us to interpret our more general findings in the light of current critical issues concerning that domain. Decolonization obliges the deconstruction of the ossified notions of identity represented in such colonial architecture and other facets of colonial cultural production. But it should also entail a concerted new engagement in a consciously instrumental cognitive praxis, I would argue, in which norms, values and beliefs, and the conceptual systems these comprise, could be directly addressed and altered as variables in a design process from which socially relevant and responsible new architectures might emerge.

We need to understand and thereby more productively "constrain" and exploit such practices in future. This study offers some evidence and understanding of the cognitive basis of institutional structures, hence the potential—through better knowledge and hence more critical action—to retain creative control over such potentially powerful tools of design and production; for social change, or social control.

3. OUTLINE OF THE DISSERTATION

The text is in three parts. The first two chapters (PART I) deal with the general formulation of the problem, and the methodological premises, theoretical models and documentary sources with which the study has been conducted.
This introductory chapter has considered the pervasive normative tendencies of design reasoning in social practice. The specific problematic to which the study is addressed was identified in the issues of rationalization and control in design reasoning, arising from the explicit codification of design norms and practices in socially constituted and regulated institutions such as standardized design typologies, codes of regulations, and bureaucratic design and planning organizations. Several important distinctions and definitions were established. With respect to "standardization" a fundamental differentiation was described between prescriptive and proscriptive modes of standardization, the former "controlling" in the narrow coercive sense of the term, the latter "constraining". We also distinguished between "intentional" and "institutional" forms of normative compulsion in reasoning. The cognitive historical point of view of the study was briefly introduced and the relevance to this inquiry of an historical case study of the rationalization of architectural design norms and methods in the institutional context of a bureaucratic design agency was established. The general content of the selected case was then briefly introduced. Finally, the general findings of the case study with respect to the principal research questions were summarized categorically.

Chapter 2 is an essential excursus on the cognitive nature of the problematic, and according methodological considerations. It begins with a review of the state of research in the domains of architectural, urban and social history, with respect to the problematic of rationality and control in the design of the "modern" social environment. We will also discuss other methodologically relevant research in the specific colonial historical domain of the case study. The chapter proceeds to a discussion of the fundamental role of cognition in mediating the relationship between intentional and causal aspects of decision making in social and historical context, in design as in other domains of human activity. A basic model of cognition is developed for describing and analyzing the problematic historically. The various key terms of that model are defined and described. We then focus in particular on the basic structural elements and principles of what we call "conceptual systems" -- the intentional reasoning structures in which individual or socially specific states of belief, norms and actions tend to be sustained in consistent
relation to each other over time, and on which basis we may speak of historically specific "patterns of intention", or "local" or "limited" rationalities. We then briefly discuss methodological considerations relevant to the detection and analysis of conceptual systems in historical design documentation. The chapter concludes with a description of the primary data on which the case study was conducted, and practical aspects and limitations of the field work and archival research.

With Chapter 3 we enter the case study, comprising PART II and PART III of the dissertation. In that introductory overview the historical parameters of the case are established. We begin with an observation of the broad change in the pattern of intention of the British Indian colonizers between the early and late 19th century. This is followed by a chronological survey of the historical content of the case. The key events and developments are outlined briefly, along with a preliminary sketch of their cognitive historical interpretation, to be developed in detail in later chapters.

Chapters 4 to 6 comprise an extensive multiperspectival exposition of the content of the case, and relevant historical background. Following Baxandall's inferential critical method of historical reenactment, each of the three chapters presents a preliminary portrait of one facet of a triangular intentional relationship between design artifacts (i.e. the buildings and built environments produced by the PWD), the design context (i.e. the historical and institutional framework of the technical development efforts of the British administration in India, and the design agents (i.e. the actual design decision makers in practice—the PWD engineers)—whose design reasoning the study seeks to explain.

Chapter 4 addresses the primary facet of this relationship—the built "solution" as it were to the architectural requirements of the colonial society in question. It consists of a detailed description of the range and qualities of the markedly standardized physical environment of buildings and planned settlements which were grafted on to the Indian cultural landscape in the process of colonial development under the

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British in the second half of the nineteenth century. The general range and character of this peculiar colonial-modern built environment is described; and working hypotheses are established concerning its formal development, its operational criteria (i.e., its ostensive utility in the historical context in which it was developed), and the qualitative criteria by which its users judged its performance. We proceed first to gather a sufficiently comprehensive description of this architecture, both of its general spatial order as a planning unit at the level of the individual "compound" and in colonial settlement planning, and of its generic elements and forms. In later sections we consider the historical derivation of this Anglo-Indian building practice, the apparent rationale behind its particular forms and styles, and the "logic" of design implicit in that building practice which the engineer-builders of the Indian PWD evidently exercised in their development of the colonial built environment.

In chapter 5 we proceed to examine the historical and institutional frameworks--i.e., the design context--in which that architecture emerged. The chapter opens with a discussion of the major popular rebellion of 1857-1858--the so-called "Indian Mutiny"--which marked a paradigmatic shift in the attitudes and policies of the British in India in the mid 19th century, significantly altering the course of social and technical development in the years that followed. Those subsequent developments are examined in PART III, whereas Chapter 5 considers the period preceding the Mutiny to assess the state of colonial development and commitment on the part of the colonizers, at that crucial juncture in modern Indian history. We take account of key shifts in social and political patterns of intention in the emerging colonial polity of India in the first half of the 19th century, with special attention to technical development. The early milestone accomplishments of the British Indian engineers are charted in a discussion of the growing commitment of the colonizers to environmental engineering as a tool of power. This account culminates with the establishment of the Public Works Department in the Government of India in the years immediately preceding the Mutiny. The chapter concludes with an outline of the organizational structure and operations of the PWD as an official institution within the larger administrative system of the mature British Raj.
Chapter 6 closes the triangle of alternative descriptions of the cognitive historical content and context of the case, comprising PART TWD of the study. The perspective shifts from the general political and institutional frameworks of the evolving British colonial regime in 19th century India, to the particular conceptual frameworks of those decision-makers within the administration who were actually responsible for physical planning and the design of all official buildings and accommodation. We attempt to determine who these men were, how they were categorized in the general belief system of the colonial society, and what were the characteristic beliefs, values, and norms that comprised the "content" of their historically and contextually particular conceptual systems.

As it developed and matured in the second half of the 19th century, the Public Works Department brought together a heterogeneous mix of persons in both its executive and subordinate staffs. There were important vocational distinctions between military personnel and civilians which had a bearing on their respective professional values and the nature and quality of the technical knowledge that each staff member brought to the department. The PWD was also among the more heterogeneous departments of the colonial system with regard to the races and social classes of its personnel. In time even the highest engineers' cadre, in the stratified departmental organization, was to admit qualified "natives" to its ranks. The rivalries and factionalism that arose from these differences had an important bearing on the hierarchy of authority that evolved in the administration of the department, and on its later restructuring in the last decades of the century as a function of social and conceptual change in both England and imperial India in that period. These intra-departmental power relations also had both a direct and implicit influence on decision-making in many facets of the Department's operations. How these power relations affected decision-making in the design process is a question considered in later chapters. With regard to the "conceptual" questions of chapter 6, however, these rivalries within the ranks are particularly relevant for the revealing argumentation such provoked, in the official records and professional discourse of the day, concerning the respective values, beliefs, and norms of professional practice of these various competing factions among the departmental
personnel. We will investigate in some detail the sometimes bitter rivalry between the military and civil engineers of the PWD. We consider the military service tradition of the British Indian engineers in the era preceding the Mutiny and how this was challenged by the accelerated recruitment of civil engineers in the years following that crisis. That colonial forum of competition was a significant case of a more general contemporary issue, which we will examine in the concurrent professional developments and debates of Victorian England. Central in those debates was the issue of technical education. We discuss the respective "practical" and "academic" traditions of professional training of the British civil and military engineers of the mid 19th century to ascertain the differing knowledge and skills, and the consciously articulated professional "ideals", with which these rival groups pursued their careers in India.

In PART III, the final of this study, we return to the historical processes and problematical issues of rationalization, standardization, and control through which the design practices of the Public Works engineers of British India were progressively institutionalized over the course of the second half of the 19th century. In those final three chapters we will examine how the professional conceptual system of the PWD engineers, and the normative frameworks of colonial government service in which that conceptual system operated, constrained the reasoning of those engineers in their roles as architectural designers and planners, and ultimately as technocrats responsible for conceiving and applying a set of bureaucratic procedures for a more or less automatic production of design solutions to the building requirements of the colonial administration.

We resume our central inquiry in Chapter 7 by considering the period of general consolidation and reform that followed the Mutiny and the PWD engineers' own particular efforts to "rationalize" their conventional building designs and planning strategies. We consider their modes of reasoning in defining and resolving the design problems they addressed, as well as the "rationale" they offered in justification for these sometimes draconian measures. The account of colonial technical development in India resumes from the point it left off in Chapter 5, with the general call to order in the colonial administration in the wake
of the Mutiny. We consider how the consolidation of knowledge in all areas of colonial administration at that point, resulted in a clarification of policy and priorities in the PWD. This was manifested explicitly in the rationalization of colonial settlement planning with respect to military security, land-use zoning, and the new technologies of public health and sanitary engineering—all of which served to harden a belief in the necessity of strict racial segregation. In later sections of Chapter 7 we turn from settlement planning and sanitation issues, to the equivalent spatial and technical concerns of the PWD engineers at the level of building design, as they attended to the major program of new construction which they were called upon to plan and execute in the years immediately following the Mutiny. In particular we will analyze the efforts of the Department to rationalize and standardize designs for all military buildings and penal facilities in India.

In Chapter 8 the historical inquiry moves beyond the dramatic events and developments of the middle decades of the 19th century, to consider the longer term patterns of intention which had become apparent in the routine working practices and design production of the Public Works Department of British India by the 1870’s. Here we consider how the design solutions devised and rationalized—with regard to the general scientific and economic criteria of the day, and the various "special" considerations of the colonial Indian context—in the decade of exceptionally dynamic technical development following the Mutiny, were progressively institutionalized in subsequent years. Explicit instances of such "standardized" knowledge and practice were the official design standards, methods and regulations developed by the Public Works bureaucracy in this period. Implicitly—that is "intentionally", according to our definition—the rationalized practices and precedents of the Department were also standardized in the evolving professional conceptual system of the departmental engineers. With a view to both these institutional and these intentional compulsions to normative reasoning, we attempt to describe and analyze the nuts and bolts of actual design practice in the Public Works Department; the explicit rules and apparent heuristics of the Department’s bureaucratic procedures, and the implicit conceptual frameworks that constrained that design reasoning engendering the increasingly standardized architectural output of the
department in the later years of the 19th century. A foundation for this analysis is established through a detailed chronological survey of the departmental records to chart the evolution of design standardization policy through the course of the 19th century. We then discuss the bureaucratic organization and procedures of the department, their ostensive rationale and probable implications for design standardization; the problematic issue of "departmentalism" in the professional practice of Victorian engineers; and finally the actual design knowledge and methods with which the PWD engineers were equipped by training to deal with their design responsibilities, by deferring to precedent knowledge through standard plans and practices.

Chapter 9 opens with an epilogue to the historical narrative of the preceding chapters. We consider the belated rise of the architectural profession to a limited position of power in the PWD, after the close of the Victorian era, as a counterpoint to the values and aesthetics represented in the building designs of the engineer-dominated department in the heyday of colonial development. In that final chapter we attempt to explain that significant development by considering the historical circumstances and changing conceptual parameters in which the utilitarian design norms, standards and practices of the PWD engineers came in time to be challenged and at least partially rejected in favour of the predominantly aesthetic and symbolic design criteria championed by the architectural profession. We first examine the various objects and forms of the critique of the public works building practices that began to be articulated in the final quarter of the 19th century. We then review the process of conceptual change with respect to colonial development policy up to that point, as observed incrementally in previous chapters, through which a relationship is discerned between the rise of aesthetics in local colonial building practices and on-going structural changes in the imperial world system. Finally, we consider how this critical urge to aestheticize the architectural product of the PWD was nevertheless consistent with the contrary commitment of the departmental engineers to utilitarian standards of form and performance, within the broader conceptual framework of colonial development, in which a compulsion to strictly define and control the parameters of action was an empowering cognitive basis for the temporarily effective control that the
authorities were able to exercise over the colonial society—both the "native" communities and their own.

The chapter closes with a concluding summary and discussion of the principal findings of the study as a whole.

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Summary: This introductory chapter has discussed the phenomenon and various problematic aspects of normative reasoning in design. The problem was further described and articulated from the cognitive historical perspective from which it is to be investigated in the present study. An historical case of institutionalized design reasoning was proposed as an empirical basis for that investigation. We considered the nature and applicability of the particular case, and the domain specific objects to be investigated from the cognitive standpoint of the inquiry. The findings of the case study were then concisely stated. This Introduction has concluded with a chapter by chapter outline of the structure and content of the dissertation.

Before entering the case itself we now proceed, in Chapter 2, to establish more fully the cognitive historical perspective and methodological considerations that have constrained the investigation.
CHAPTER 2

METHODOLOGICAL CONSIDERATIONS

Introduction: This chapter reviews the state of research with respect to the problematic, as well as methodologically relevant work in the domain of the case study. It proceeds to outline a cognitive model for describing and analyzing the problematic historically. The chapter concludes with a description of the primary data on which the case study was conducted, and practical aspects and limitations of the field work and archival research.

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1. TECHNOCRATIC RATIONALISM AND CONTROL AS A PROBLEMATIC IN RECENT ARCHITECTURAL AND PLANNING HISTORY

There are a variety of theoretical perspectives and according methodologies through which the issues of rationalization, standardization, and control in design have been addressed in the literature. To distinguish the cognitive historical perspective to be applied in the present study, let us first briefly survey those other approaches.

The rationalization and control of modern space and society:

The rationalization and control of the social environment by planning and design, have been perceived as emblematic of the "problem of modernity" and thus among the more obvious aspects, or "problematics", thereof on which the historical and critical research of scholars concerned with the revision of the canonical positivist view of modern social and architectural history has been focused in recent years.¹ Historians of architecture and planning have brought the tools of neo-Marxist ideological criticism and the post-structuralist critique of technical rationality to bear on the rationalist utopianism of architects, planners

¹ For a comprehensive though now somewhat dated review of the various shifts, and critical and theoretical incursions, in architectural historiography over the course of the 1980's, see: M. Trachtenberg, "Some Observations of Recent Architectural History", Art Bulletin LXX, 2 (June 1988): 208-241.
and social reformers in the last two centuries. The historical schism between architectural and engineering "rationalities" is the subject of some of the most pertinent recent scholarship in this vein, with respect to the content of the present case study. In Antoine Picon's studies of the diverging discourses of French architects and engineers, this schism has been analyzed from the points of view of professional norms, the codification of expert knowledge, and the institutionalization of modes of reasoning.

The social implications and—as important, in this view—the social "construction" of the rationalist visions of the engineer-architects and allied technocratic agents of modern social engineering, are the objects of another, conspicuous body of research. Studies in this vein have interpreted the rationalization and standardization of "social norms and forms" as instrumental processes in what is regarded as the overriding


3 A. Picon, French Architects and Engineers in the Age of Enlightenment, (Cambridge: Cambridge University Press, 1993). Picon addresses the post-Enlightenment schism between the architectural and engineering professions as a problematic of prevailing consequence in modern architecture and planning to this day. His study traces the emergence of an ideologically and programmatically distinct, and ultimately dominant, engineers' "system" in France over the course of the 18th century, focusing on the teaching and practice of the key theorists and pedagogues of the two professions, in that period: Jacques-Francois Blondel, and Pierre Patte with respect to architecture, and the engineers Jean-Rodolphe Perronet and Gaspard Riche de Prony. Picon's analysis is structured on an account of the evolving institutional framework of the professional academies and corps, the Ecole National des Ponts et Chaussées in particular. The eventual triumph of the engineers is explained, broadly, in the light of the gradual replacement of the conceptual system of the French Ancien Régime by that of nineteenth century rationalism. Scholarly interest in engineering history and engineering thinking appears to be growing. See also Helene Verin, La Gloire des Ingenieurs: L'intelligence technique du XVI au XVIII siecle, (Paris: Albin Michel, 1993); and A. Picon's further study of the "engineers' system" of pre and post Revolutionary France (not yet published in English).
phenomenon of "power" in social relations. Significantly, the principal investigators in this vein have been social historians, sociologists and urban and cultural anthropologists rather than architectural historians. Their approach to these issues has been not so much to question the soundness of the theory of Modern Architecture and social engineering, as to explore how that theory was understood and used by its practitioners to produce the characteristic physical environment in which "modern society" has come to be framed over the last two centuries.

In this approach, knowledge and reasoning practices are regarded, essentially, as "cultural" objects and interpreted as such, in terms of methods. As the anthropologist, Paul Rabinow, explains his methodological premises for his study of the emergence of the normative reasoning practices of the technocrats who engineered the modern social environments of France and its colonies in the 19th century: "...I begin with the standard ethnographic assumption that we can analyze reason in the same general way we approach other ethnographic objects, i.e., as a set of practices bearing complex relations with a congeries of symbols."

The actual objects in which such reasoning is discerned is accordingly diverse. In addition to "forms" (architectural and urbanistic), Rabinow lists "fields of knowledge" such as public hygiene, and statistics; "social technologies of pacification" (disciplinary and welfare); "cities as social laboratories"; and "new social spaces" such as "liberal disciplinary spaces" and new towns. "...In each of these domains," he continues, "I describe the diverse constructions of norms and the search for forms adequate to understand and to regulate what came to be known as

4 A representative work is P. Rabinow, French Modern: Norms and Forms of the Social Environment (Cambridge Mass.: MIT Press, 1989). The concern with the problematical relation between "Knowledge" and "Power" on the part of Rabinow and many other scholars and critics in the social sciences and humanities, springs from the work of Michel Foucault. With the "archaeological" methodology he indicated for reconstructing the social knowledge embedded in institutional artifacts of rationalistic design thinking such as the hospital and the model prison designs of the early 19th century, Foucault proposed that a critical study of knowledge might transcend the power of ideological norms of thinking and inquiry by "reading" the artifacts of social production "bottom-up", as it were. See Foucault, Michel. Power/Knowledge: Selected Interviews and Other Writings, 1972-1977. Colin Gordon, ed. New York: Pantheon, 1980.

5 Rabinow, French Modern..., 9.
modern society."\textsuperscript{6}

Rabinow's topic and concerns, not least his attention to the "technologies of pacification" in France's colonies and the development of colonial cities as "social laboratories", overlap significantly with those of the present case study. What I hope to describe below, however, is an explicit model of reasoning which may be distinguished, in our understanding, from the various domains of representation and their relationships, to which Rabinow's notion of reasoning practices appears to be inextricably bound.

Colonialism as a paradigm of Rationalism as Control:

European colonialism has provided salient and provocative case material for a number of other such studies of physical and institutional planning as operations of social rationalization and control. Gwendolyn Wright\textsuperscript{7} makes a broad political reading of French colonial urbanism from the point of view of an historian of architecture and city planning. The anthropologist, David Prochaska\textsuperscript{8} offers by contrast, a highly concentrated, richly layered case study of the colonial "construction" and post-colonial "de-construction" of a single Algerian settlement—a methodologically assertive exercise in post-structuralist anthropological inquiry attendant to Clifford Geertz's notion of "thick description".\textsuperscript{9}

\textsuperscript{6} Ibid.
\textsuperscript{9} Geertz characterizes his interpretive anthropological approach to the study of human cultures as "anti-anti-relativism": "thick description" of the particular, which employs theories of structure and/or broad systematic processes in society and culture only as facets of a multi-perspectival and inherently inconclusive interpretation. Thick description is his methodological retort to the neo-rationalist proposition that cultural diversity and "otherness" are only a superstructure covering an underlying homogeneity. The latter position—with which Geertz would surely place our present approach, as a study concerned with theories of human mind and a structured view of knowledge—is considered problematic in that it leads inevitably, in his view, to the re-establishment of mistaken concepts of "primitive thought" and "social deviance", and the "...assumption of a hierarchy of beliefs
Rabinow, Wright and Prochaska are each indebted to the earlier ground-breaking urban-anthropological studies of North African colonial cities by Janet Abu-Lughod.\(^\text{10}\)

In his study of Brasilia, James Holston\(^\text{11}\) takes an interpretive anthropological approach similar to Prochaska's. The conception and construction of the new capital are interpreted in terms of the "invention" and rationalization of an ideal model of "modern" Brazil. The subsequent role of the city as a paradigm for the standardization and control of that national ideal/myth is then contrasted with the actual city as realized and re-appropriated to the norms of a more traditional, endogenous urban culture.\(^\text{12}\) In a related study as ambitious in its breadth and of forms of behaviour ranked according to different levels of rationality." For a cogent assessment of the implications of Geertz's methodological cautions for the writing of History, in recent years, see: G. Levi, "On Micro History", in P. Burke, ed., New Perspectives on Historical Writing, (London: Polity Press, 1991), 24-41.

Although these are certainly important concerns, Geertz takes an extreme view to my mind. On the grounds of an unnecessary elision between theories of human mind and theories of human nature, he fundamentally resists the claim that it is possible to identify formal consistencies (cognitive universals), developmental constancies (cognitive stages), and operational constancies (cognitive processes) in the study of human cultures. As I will attempt to substantiate more fully later in this chapter, in my presentation of the cognitive historical premises of the present study, I would argue (in concord with Levi's critique) "...that it is the very identification of uniform cognitive processes which enables one to accept cultural relativity whilst rejecting the absolute relativism of those who limit our possibilities of knowing reality, with the result of becoming entangled in an endless, gratuitous game of interpreting the interpretations." Ibid., 103.


\(^\text{12}\) Holston and Prochaska in particular represent the growing impress of "cultural studies" on colonial studies generally. Scholarship in this vein is applied to the investigation of a multifarious "cultural" problematic defined by questions concerning power and its "representation" in cultural forms and practices, and hence the "politics of identity". In colonial cultural studies, the politics and representation of race hold a central significance, as distinguished from the predominating concerns of earlier generations of social scientists with the "social" problematic of class conflict and the structure of economic relations of production as its root cause. For an astute albeit unsympathetic critique of "cultural studies", see Stefan
as is Holston's in depth, Lawrence Vale traces the themes of "power" and the post-colonial (and neo-colonial) construction of "national identity"—building on Hobsbawm and Ranger's notion of "the invention of tradition"—in a comparative study of the monumental architecture of national capitol complexes, from Brasilia, to New Delhi and Chandigarh, to Papua New Guinea.

An unconventional art-historical reading of the historically more distant colonial building efforts of Imperial Spain in 16th century Peru is developed in Valerie Fraser's The Architecture of Conquest. Fraser proposes an inferential critical analysis of historical documents and evidence, and the broader conceptual framework of 16th century Spain, to discern a "pattern of intention"—a set of implicit norms of perception and consciousness, as she deduces in the case in question—that might explain the exceptionally consistent yet effectively unregulated building practices of the conquering Spaniards.

The colonial architecture and urbanism of India have, on the whole, received less adventurous treatment from a methodological point of view, in the scholarly literature to date. As such, the problematical issues


16 Fraser is a product of Baxandall, Podro and their contemporary British school of "critical" art historiography. This economically argued book version of her doctoral thesis is a good example of the inferential critical method for discerning a specific "pattern of intention" in cultural production, as applied to a geographically and historically particular development in the realm of architecture. For a full exposition of that method, see: M. Baxandall, Patterns of Intention, On the Historical Explanation of Pictures, (Yale, 1985).
17 A review of the largely nostalgic and/or stylistically oriented
with which we are concerned in the present study have been largely avoided if not denied. Social historian, Veena Talwar Oldenburg's provocative study of the technocratic pacification of the rebellious North Indian city of Lucknow under British colonial administration, is a notable exception. The colonial development of several other Indian cities have been the object of similar though generally less politically acute historical accounts. Again, however, it is anthropologists and anthropologically inclined sociologists who may be credited for originally framing many of the more probing questions investigated in these primarily empirical studies. Oldenburg and Dossal have both applied in part the methodological framework for the study of colonial urban development developed earlier by sociologist, Anthony King. Among other issues, they follow King's attention to the specific beliefs and data on which 19th century ethno-medical knowledge was founded, and how an historically particular scientific rationale was thereby brought to bear on building design and settlement planning policies in colonial India.

King's pioneering study of Colonial Urban Development is a sociologist's reading of colonial spatial and social structures, and their extensive relationships. As an early product of the "cultural secondary literature on the architecture of British India is provided as an appendix.


20 The seminal contribution of anthropologist, Bernard Cohn, to colonial and post-colonial Indian historiography is widely acknowledged. For a particularly influential interpretation of the relationship between power, knowledge, and architectural display in British India see Bernard S. Cohn, "Representing Authority in Victorian India." in B.S. Cohn, An Anthropologist Among the Historians and Other Essays. (Delhi: Oxford University Press, 1990), 632-682. First published in Hobsbawn and Ranger, eds. The Invention of Tradition.


22 Ibid.
studies" school of British social scientific inquiry—and a novel one, in
that it looked beyond the standard problem of class issues in the
industrialized societies—King describes and categorizes the norms and
everyday cultural practices of the European colonial community of British
India, and the characteristic built environment that evolved to
accommodate and, in time, to represent and thereby reinforce that
cultural system. A methodological premise, that built environments—with
the culturally specific objects, uses and language attached to them—may
be read as a form of text about social relations and knowledge, is
further developed in Kings more recent study of the Anglo-Indian
bungalow,23 the most common and representative building type of the
European colonial community in India.

The case study developed in later chapters of the present work,
relies significantly on the empirical and methodological groundwork of
King's research, not least as studies which have drawn attention to
possible "cognitive" factors in the development and reception of the
architecture and planning described.24 We will also use the basic model of
the colonial social environment, which his initial study proposed, as a
form of "ideal type" to which the colonial settlements and buildings we
will examine may be compared, as actual artifacts, and as the objects of
actual design reasoning. But a point of departure for this study is found
in the insufficiency of King’s sociological model to explain the
historical process by which such a set of social and environmental
relations were actually achieved. King identifies the central role of
institutional agency—i.e. the colonial military establishment and Public
Works Department—in the conception and execution of the colonial built
environment, and describes that standardized, utilitarian product in
detail. However, the broad correlations he draws between the built
artifacts and the particular state of social order and knowledge from
which it plausibly emerged, leads to the reductive assumption that such
institutional agency operated as nothing other than a mechanism simply to

23 A.D. King, The Bungalow: The Production of a Global Culture
24 see Chapter 7, below.
translate that knowledge into form.  

This study takes a view similar to that of much of the more recent historical and inter-disciplinary inquiry into issues of rationality and control in design reviewed above; that is, that the description and explanation of the reasoning practices by which norms and beliefs are translated into actions, choices, or decisions, is crucial to explain the actual historical relationship between knowledge and its products.

Reasoning and decision-making as "practice":

An altogether different category of research on the issues of standardization, control, and reasoning (in and about) institutional frameworks, could be labelled policy studies. Studies of this type concentrate on the official policy and power structures through which design and planning standards are developed and administered in current institutional, primarily government, practices. Such research is concerned with practical and structural problems within ongoing design and planning processes. It draws attention to rationality, standards and their criteria, from the point of view of decision-making. In this regard, it applies the analytical framework of decision theory, among

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25 T. Markus takes such an approach to considerable lengths in Buildings and Power: Freedom and Control in the origin of Modern Building Types (London: Routledge, 1993). Markus’s methodical analyses proceed on the premise that "...it is reasonable to regard buildings as material classifying devices; they organize people, things and ideas in space so as to make conceptual systems concrete." Employing a form of topological graph technique--developed and applied variously by others such as P. Steadman, and by Bill Hillier and J. Hanson in The Social Logic of Space (Cambridge: Cambridge University Press, 1984)--Markus describes and analyses the power relations embedded in the design of buildings. The graphs represent relative "depth" of spatial relations; a factor which is correlated directly with relative degree of control in the social relations such spatial relations are assumed to enable. For example, an inmate’s cell in a radial prison will (generally) be found at the deepest level of such a graph. Similarly, the office of the chief executive officer in a classically organized bureaucracy will also be found at the deepest level of the graph, accessible only through several layers of junior executive and clerical staff spaces who "secure" the privacy (freedom from distraction) and authority of the head.

other tools for interpreting trends and patterns of reasoning within complex organizations such as government planning agencies.

The fundamental distinction to be drawn between the study of "decision-making" and the various modes of inquiry we have discussed above with respect to the problem of oppressive environments and the presumably problematical rationality underlying their design, rests in the understanding of what kind of object—that is what "kind of reasoning"—one is trying to explain. The study of standardization, controls, and criteria, as practical issues at the level of organizational policy, is the study of "management reasoning". On the other hand, the study and critique of social/environment relations is generally about causes and effects and the ostensive problem-solving reasoning on the part of designers that explains the connection between the historical perception of a design problem and the solution produced.

Management reasoning, i.e. "decision-making", is distinct from the "problem-solving" and "knowledge-seeking" that characterize scientific reasoning (in theory). Despite the notions of "scientific management" on which large bureaucratic organizations and industries tend to be structured and operated—and to which draconian consequences of standardization and control in such organizations have often been attributed—27—it is a common sense distinction that I wish to make, which would be obvious to anyone familiar with actual decision making practices in business. Nevertheless, at the risk of being pedantic, let us clearly define this difference between "decision making" and "problem solving" for it will help to re-orient this discussion to the topic of "practice" in the study of reasoning, and the methodological framework of "cognition" in which this might be investigated effectively, as I will proceed presently to explain.

A basic textbook description of management reasoning is given as follows:

The essential features of decision making—not just in business but in other administrative settings as well—is that the arguments concerned require one to make choices within certain

27 Charlie Chaplin's Modern Times, as one example, is the quintessential tragi-comic indictment of the Fordist/Taylorist mode of "scientific" management and mechanized production.
limits or constraints, particularly constraints of time and limitation on resources. Where other forums for reasoning permit the search for grounds and the analysis of arguments to continue patiently, with the major focus on the quality of the outcome no matter how long it may take, managers must usually make their decisions and choices with one eye on a deadline. Of course, they are interested in the quality of the outcome among other things—but this success itself depends on their being able to decide in time for the decision to be effective.28

The solving of scientific problems, or indeed resolving questions of justice or the merit of an artistic work, are problems of an absolute nature for which absolute solutions may never be achieved, nor even (reasonably) expected in certain cases. In this respect, scientific reasoning, legal reasoning, or the debates of art critics are not time-bound. Managers, by contrast, have no such luxury. The fundamental constraint imposed on their mode of reasoning is the obligation to make a decision at a prescribed moment. The manager cannot defer or abstain from that obligation for a failure to make new choices is, in effect, a decision not to decide.29

The institutional design reasoning practices with which we are concerned in this study could be described, by and large, as a case of management reasoning. For that matter, I believe that the "practice" of normal science (as distinguished from scientific reasoning, "in theory") could also be described in such terms.30 Practices are about process; about sustaining the momentum of a (generally) productive or useful application of knowledge to action. To the extent that such "routine" matters of consistency, efficiency and utility of practice must be "managed", intentionally or institutionally, there are aspects of management reasoning attributable to any otherwise definable reasoning practice.

This comparison is particularly relevant to the explanation of

29 Ibid., 287.
30 This discrimination of the multiple types of reasoning which we may ascribe to a single discipline is, in my view, the crux of the parallel between normative practices in design and in science which I proposed in Chapter 1.
standardization in design practices. Standard designs or canonical precedent solutions to a design problem—like the paradigmatic models for explaining or (at least) describing phenomena in normal scientific practice—are analogous to the "decisions-not-taken" by managers; a form of "default reasoning". To what extent the resort to solutions pre-supposed in standards and routine procedures can be a sustainable mode of responsible, productive design/management reasoning, in an institutional framework of practice, is a key question this study tries to address. How that question may be framed, and posed to the case in question, are the immediate questions to be discussed below.

2. A COGNITIVE HISTORICAL PERSPECTIVE

Cognition: a synthetic position in a fragmented discourse

Architects need to renew their productive engagement in the social process. But this will likely entail increasing collaboration with other designers and professionals, hence potential problems of communication. The object on which design research should be focused in this regard, I would argue, is the design-reasoning process. We must and can achieve a much more specific understanding of that "cognitive" agency; knowledge which will not only improve critical understanding of the relationships between design artifacts and the social environments that they make and in which they have meaning, but which may "empower" designers to take more direct control of their own cognitive faculties as a "technology" in their own right, for creative and critical design practice.

Ongoing re-thinking of architectural and urban theory and practice in a context of cultural globalization has benefited critically from the alternative historical, sociological and "cultural" modes of inquiry employed in much of the recent literature discussed above. Nevertheless, I don't perceive that these can be truly productive strategies for transcending current problems in architecture or in "theory" generally. Moreover, new problems are emerging; problems for which altogether new hypotheses are needed. To identify such problems (and prospects), however, we need to reconceive the problem/solution space wherein the
actual engagement of intentional agents with society and its contexts is presumed to take place. That "space", I propose, is defined neither by the external parameters of a deterministic material context, nor, at the other extreme, in an autonomous realm of epistemic objects. It is clear, rather, that contexts must be (re)cognized, just as "ideas", arguments, or theories must be constructed and comprehended, in the common space of the individual mind. Only in that space of cognitive representations, I would argue, can disparate forms of knowledge and experience be regarded as commensurable.

Such that one exists in the world (any world) it must exist in one's mind. The role of knowledge in this phenomenon of world-viewing and world-making is fundamental; the ways in which that knowledge is structured, evidently, as much as its content. Whereas "Thought" is conventionally regarded as a form of socio-cultural state, what we might call "intellectual context", it is treated in this study as, rather, a complex of socially conditioned "conceptual frameworks". In conjunction with deeper cognitive constraints of a universal order, these flexible frameworks are, in effect, the structural basis of our notions of individual, and collective consciousness.

With varying terminology but similar concepts, research in many different disciplines in the social sciences and humanities, over the past two decades, has been moving toward the cognitive position argued here. Some have recognized this for some time. An emerging consensus on what some have called a "symbolic realist" paradigm in sociological

31 that is, what Popper distinguished as the "third world" of knowledge, in his attempt to do away with what he regarded as the problematic psychologism of a traditional epistemology "...interested in the second world: in knowledge as a certain kind of belief--justifiable belief, such as belief based on perception." K. Popper, "Epistemology without a knowing subject", in Logic, Mathematics and Philosophy of Science III, B. van Rootselaar and J.F. Staal, eds., (Amsterdam: North Holland Publishing Co., 1968).

32 Popper's concern that epistemology should transcend the "knowing subject", to concentrate on the "third world" of objective knowledge, was a reaction in part to what was a rather fuzzier state of cognitive psychological theory, a generation ago, than is the case today. I contend, simply, that the significant advances in the cognitive sciences generally, in recent decades, renew the possibility of valid and potentially useful discussion of the "second world knowledge" of the reasoning subject.
thought was described some 15 years ago: "...All these schools (of sociological thought) posit the lived world as the framework out of which formal cognition must emerge, and all of them understand knowledge to be relational to an intersubjective community of discourse. Thus each school, with its own particular voice, urges us to attend to the tensions between the given and the constructed and, in so doing, to remain true to the dialectical mediations through which structure, consciousness, and history achieve expression." In a more recent methodological essay on the study of social movements, Eyeam and Jamison have attempted to renew that cognitive position by emphasizing foremost the constructive, "historical" nature of cognition—that is, as a creative interaction between changing "dimensions" of knowledge, over time.

The cognitive model described here is proposed as the theoretical basis for an explanation of design reasoning that is, necessarily, both structural and historical. In these respects, it is regarded as a synthetic model which may provide a common framework for the reconsolidation of the fragmented social object of current social scientific and historical research. Moreover, the foundations of the model in a similar consensus of beliefs concerning the structural nature of consciousness as "symbolic form", on the part of the cognitive sciences, indicates a potential for a further important synthesis of


35 Eyerman and Jamison call this, "cognitive praxis": a re-working of a set of static categories they called "knowledge interests", (after Jurgen Habermas' "knowledge constituting interests") in their earlier work. Cognitive praxis is a dynamic process, in their view, readable in terms of its "dimensions", rather than static, abstract "aspects" of thought. Eyerman and Jamison, Social Movements: A Cognitive Approach, 62-70.

Eyerman and Jamison evidently offer their notion of "cognitive praxis" as an alternative concept and improvement on the overworked notion of "dialectics". Such that we will use either of these terms in the present work, they should be understood in the simple sense indicated above: i.e., "interactive" reasoning, generally in creative relation with products of prior reasoning.
knowledge and views—between social and scientific disciplines.36

The present inter-disciplinary inquiry exploits that potential, and its liberties. It is a study about design reasoning in practice; both a scientific and a "cultural" question. It attempts to examine the ways in which certain designers actually reasoned in a particular historical and social context. As such, the nature and form of the inquiry are predominantly historiographic. A highly technical analysis of reasoning is not proposed, and we will resort to a primarily narrative form of exposition in subsequent chapters, in the account of the case. Nevertheless, our interest is to explain the instrumentality of that design reasoning; to explore the technological nature of reasoning in practice. An aim of the study is to improve understanding of domain design knowledge, in terms of design precedents and the general design principles such may demonstrate. Such improved understanding is needed in the development of more efficient and effective design methods.

With the particular focus of the case and problematic, the study is immediately concerned with the improvement of institutional methods of designing and design reasoning. However, the cognitive perspective of the inquiry hopefully furnishes insights of potential further relevance to the future development of computer based design tools and normative protocols that may well supersede conventional bureaucratically organized and regulated design and planning institutions. As such, some rigour in laying the theoretical ground of the study will be beneficial.

Let us proceed by considering how architecture itself may be considered a cognitive phenomenon.

36 For a synoptic assessment of the paradigmatic status of the notion of symbolic form in the cognitive sciences—what, in the field of Artificial Intelligence, has been described as the "physical symbol system" paradigm in computing—see A. Newell, "Physical Symbol Systems", Cognitive Science 4 (1980): 125-183. Newell observes that the notion of symbol has permeated thinking about mind well beyond attempts at scientific understanding—in philosophy, linguistics, literature, and the arts. The Kantian notion of "symbolic form" was introduced to art historical scholarship in the work of Ernst Cassirer. Erwin Panofsky's Perspective As Symbolic Form (first published in German in 1927, translated and introduced by Christopher S. Wood. Cambridge Mass.: Zone Books/MIT Press, 1991), is a seminal exemplar of the cognitively grounded interpretation of artistic vision and invention which Cassirer's circle of colleagues at the Warburg Institute began to develop early in this century.
An architecture of cognition:

Architecture is a form of knowledge—a meaningful organization of information concerning the projected form, the intended operations, and the anticipated performance of a building. From this perspective, architectural design can be considered as a process of knowledge engineering—a generally practical, sometimes innovative re-working of such architectural knowledge to meet the particular formal, operational and performance criteria of a given building design problem. This concept of knowledge-engineering may appear to be an intuitively obvious notion, in the sense that the act of "designing" is understood to be a "mental" act involving knowledge. But one does not generally "build" a design—as one may eventually erect it—of individual elements and materials. Rather, designers tend to begin with quite complete "ideas" of what their buildings could be. An architectural professional will have expert historical knowledge of possible precedents, but even an untutored lay designer will have sufficient common sense knowledge of buildings and habitable spaces with which to "imagine" possible solutions. Creative designers tend to be those who are more capable than others of critically discerning and disassembling such pre-supposed constructs—served spontaneously from social, historical, expert and experiential knowledge—to synthesize novel solutions from the more basic elements and concepts underlying them. But the truly innovative reformulation of design problems is rare, let alone the decisive resolution of such.

In these respects my earlier comparison of architectural design reasoning with management reasoning will perhaps now be more understandable. We could say that Architectural design is a knowledge-based mode of reasoning which is predominantly "critical" and "decision-making", in normal practice, rather than problem-solving. An

37 This tri-partite definition of architecture as a relationship between the structure (form), the uses to which that structure is put (operation), and the anticipated and actual behaviour or performance of a building is developed in A. Zandi-nia, Topgene: an artificial intelligence approach to a design process, (Delft, 1992), 2-7 to 2-15. See also, A. Itonis, and J.L. Heintz, Frames, Plans, Representations, (forthcoming, 1995).

38 that is, in the sense of the "knowledge-seeking" mode of
example may help to further clarify these notions. Marx happens to have penned a particularly memorable description of the architect's reasoning, which may serve this purpose eloquently:

The spider carries out operations reminiscent of a weaver, and the boxes which bees build in the sky could disgrace the work of many architects. But even the worst architect differs from the most able bee from the very outset in that before he builds a box out of boards, he has already constructed it in his head. At the end of the work process he obtains a result which already existed in his mind before he began to build. The architect not only changes the form given to him by nature within the constraints imposed by nature, but he also carries out a purpose of his own which defines the means and the character of the activity to which he must subordinate his will.

For our purposes, this passage can stand on its own, and we need not delve into the complex economic argument that it was invoked to support. The essential point, we may deduce, is that the world of Man is of his own making. Man's behaviour cannot be explained mechanistically (as could that of physical systems and simpler biological organisms) as an equilibrium-seeking relationship with Nature and the natural environment, as such. Rather, it is Man's unique capacity and compulsion to conceive of his own more perfect world, and to strive to subordinate the perceived investigation from first principles distinguished in Toulemon, Rieke and Janik, Introduction to Reasoning, 287. Of course, "problem-solving" has been defined in substantially different terms, by others. In Newell and Simon's classic formulation, design thinking is a quintessential example of "problem solving" where the latter distinguishes reasoning about theoretically indeterminate, complex and fuzzy problems from the better defined, information dependent problems studied in decision theory.


40 Marx's own purpose in this comparison, in the immediate framework of his critique of Capital, was to challenge the naive notion of materialism that underscored the economic thought of his day. The intentions of the architect were evidently interpreted as a didactic metaphor for conveying his notion of man's "historical" compulsion to re-design the world as he knew it. For a dependable philosophical reckoning of Marx's theory of History, on which the present comments rely, see; G.A. Cohen, Karl Marx's Theory of History: A Defence, (Princeton: Princeton University Press, 1978).
environment to that plan. The basic cognitive insights that we might derive from this very partial reading of the above passage are as follows:

- There is a natural world of which we are a part and of which we have certain a priori knowledge (like any other organism).
- However, our cognitive capacity to perceive ourselves in relation to that given world—that is to "reflect"—allows us to imagine how that relationship might be different.
- The possible worlds we posit and to which we "subordinate our will" and actions are a structural basis for our social relations, usually in the form of collective beliefs on which "higher" institutions of social organization and control may be structured and legitimized.
- Cognition is "historical"; a dynamic relationship in time, between the beliefs we have of the world as it is, of how the world ought to be, and of how the world works—i.e., its social relations of production—as a function of this unresolved process of world-changing.

We might therefore describe the design cognition of Marx's hypothetical architect, as depicted in the following figure (2.1), as a tripartite relation between his normative precepts of the design problem (historically, conventionally, and institutionally determined if, for instance, he is a trained and registered member of a professional organization); his (ostensibly objective) perceptions of the actual design problem, its program and constraints; and, in between, what we might call the cognitive agency of the architect, that is their beliefs about "how" things are the way they are believed to be, and how an

41 It was Marx's view, I might add, that "History", and the unequal structure of social relations at any given time, are phenomena of this unresolving, dialectical process. Ibid.

42 The notion of "possible worlds" has been employed by different philosophers for a variety of quite disparate purposes, over the years. I use it here in its most obvious, auxiliary sense; i.e., the "idealized" state of affairs, ideological or simply preferred, to which we plausibly aspire.
intentional agent might alter the state of things, within the effective social and cognitive constraints on the problem-solving process.

**NORMATIVE FRAMEWORKS OF KNOWLEDGE**
(beliefs about what "ought" to be)

**COGNITIVE AGENCY**
(beliefs about how things happen)

**NATURAL STATES/OBJECTS**
(beliefs about what "is")

*Fig. 2.1. Cognitive Agency.*

Historians, and theorists of History such as the Marx of the above passage, speak of processes and relations. Sociologists, and social epistemologists try to frame such phenomena in terms of structures and categories. Alvin Goldman\(^\text{43}\) offers an alternative epistemological description of the cognitive relations between individuals and social context, which Marx theorizes, in the form of the following taxonomy of factors that can influence beliefs:

- Nomological regulations
- Institutional rules and structures
- Patterns of communicational behaviour
- Social belief-forming methods
- Nonsocial belief-forming methods
- Basic cognitive processes
- Environmental objects and events

*Fig. 2.2. Factors that can influence beliefs.*

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We will group these taxa as indicated to articulate the possible content of the tripartite hierarchy of cognitive-historical relations between Objects, Agency and Norms proposed in the preceding diagram. For our purposes a simpler set of categories will be sufficient in the end. But an overview of Goldman's definitions and distinctions will prove useful.

"Environmental objects and events" are perceptual stimuli which give rise to belief via perceptual processes. These are prime causal factors in the determination of belief, but have an "external" relationship to cognition. It is through the "basic cognitive processes" of the human mind that such external phenomena can become actual objects of cognition. These include processes of perception, memory, attention, concept formation, problem solving, learning and reasoning. These processes comprise the basic constraints with which cognition is bounded and ordered. They are "basic" in that they may be considered natural or "pre-wired" aspects of human cognition; the human counterpart of the instinctive knowledge of other species.

We can correlate Goldman's middle group of methods and processes with what we have referred to as cognitive agency, that is the "internal" or intentional category of cognitive frameworks and principles which may be said to be knowledge-producing. By contrast to the given or "natural" constraints of the basic cognitive processes, these and all higher categories of cognitive frameworks and principles are forms of received or "nurtured" knowledge. It is through these, and particularly the higher social processes of cognition, that what we call human "consciousness" evidently distinguishes itself from the mental processes of most or all other species. The belief forming methods of Goldman's middle two categories are defined as learnable algorithms, heuristics, procedures, or techniques for arriving at beliefs. These may be very general in their applicability, as in proof-techniques in Logic, or highly domain specific techniques. Social belief forming methods are a further category of such learnable methods, distinguishable by the fact that their inputs are opinions or communicational acts of other people, or the cognizer's doxastic responses to such.

The higher categories of factors influencing beliefs, in this taxonomy, can be regarded as what we have called "normative frameworks".
These consist of conventional patterns, protocols, "styles", "institutions", and institutional frameworks for defining, and regulating the flow of information in social knowledge relations. Goldman defines "Nomological regulations" as the laws governing the causal network by which the lower factors in this hierarchy are linked with beliefs. 44 Between these highest standing controlling elements of reasoning—which effectively legislate the terms of the legitimacy of the power to which norms, beliefs and actions are attributed in a particular historical situation 45—and the lower belief forming methods, these successive modes of reasoning evolve by stages from knowledge-producing practices, to practice-enabling constraints, to knowledge-controlling institutions. The contractual commitments and "tradition" of esprit de corps of the Public Works engineers of British India; the departmental standards, protocols, and procedures, they devised; and their overriding belief (in consort with other colonial civil servants) in the justice and utility of their development efforts in India, were each examples of such normative frameworks. As we shall examine in the case study, these were generally perceived as "external" factors, relative to individual intention.

Goldman's classification and precisions distinguish possible from inapplicable objects for study under the particular analytical criteria of what he calls "social epistemics". 46 However, the essentially descriptive and explanatory concerns of the present study are not so exacting and fall across most of Goldman's categories, including historical factors (i.e. "events"). Our investigation will consist in explaining the historical emergence and evolution of what we will call "conceptual systems", as such may be discerned through an examination of

44 Ibid., 197-199.
45 With these we should include the epistemic norms that control conditions of acceptable knowledge in reasoning processes, and axiomatizing norms which control their logical form. See: A. Tzonis, R. Berwick and M. Freeman, "Discourse Analysis and the Logic of Design", Harvard GSD Publication Series in Architecture (1978), 12-13.
46 hence, Goldman's distinction between "social" and "non-social" belief forming methods. He is also concerned that such objects be amenable to truth value analysis, and therefore excludes environmental and historical factors from consideration. Goldman, Liaisons..., see in particular, Chapter 10: "Foundations of Social Epistemcs".
47 or what, in Goldman's terminology, are called "belief profiles".
the varying significance of these intentional and institutional factors in belief formation, over time.

A basic model of cognition:

Let us now enhance our original triad of cognitive relations with the essential categories and properties of cognitive processes indicated in the preceding taxonomy. Our emerging cognitive model can be depicted schematically as follows:

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NORMATIVE FRAMEWORKS
   (institutions / "external")
   (modes of reasoning)
CONCEPTUAL FRAMEWORKS
   (intentionality / "internal")
   (conceptual systems)
COGNITIVE CONSTRAINTS
   (intrinsic knowledge / "pre-wired")
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Fig. 2.3. The structural hierarchy of cognition (and alternative classifications / characterizations of knowledge types)

As we have discerned, there is a fundamental distinction, among cognitive phenomena, between intrinsic or what we have referred to as "pre-wired" forms of knowledge, and that which is learned or "constructed" through perception and experience. The former we will call "cognitive constraints". These may be characterized—to use the analogy of the computer—as the essential representation of the "architecture" of the machine's hardware in the structures and properties of the software designed to run the system. Typical cognitive constraints in architectural design reasoning (though not exclusive to such reasoning) are shape preference rule systems, and typologies of artifacts and space arrangements. It is through such constraints that design artifacts are recognized, compared, classified, memorized, conceived, and evaluated.

Ibid., 179.
The broad category of learned and constructed cognitive phenomena are referred to, over-all, as "conceptual frameworks", in our model. It is these "internal" frameworks which define "consciousness" and support what we have been referring to as "intentionality". In the computer analogy such "constructs" are instantiated in the software of the machine as a whole, and in any of the many forms and applications of software. But the actual conceptual frameworks are the programming languages, practices, routines, heuristics, and paradigmatic programming strategies through which such software is conceived. Examples of conceptual frameworks in architectural design cognition are the typologies and conventions accumulated through history in the theory, methodologies, and pervasive structures of belief or "conceptual systems" through which design reasoning is enabled and informed.

The computer analogy will help—once again—in clarifying the distinction between conceptual frameworks and the higher, ostensibly "external" category of knowledge frameworks affecting reasoning which are called "normative frameworks" in our cognitive model. If a programming language or a software tool for writing programs may be regarded as conceptual frameworks in the computer analogy, in terms of their generic knowledge-engineering operations, a commercially marketed software tool of that sort may become a normative framework if it enjoys any general success. An example would be the popular "tool-kit", "Norton Utilities". More profoundly pervasive normative frameworks, in the domain of computer

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48 According to Searle, "...what philosophers and psychologists call "intentionality", [is] the feature by which our mental states are directed at, or about, or refer to, or are of objects and states of affairs in the world other than themselves. "Intentionality", by the way, doesn’t just refer to intentions, but also to beliefs, desires, hopes, fears, love, hate, lust, disgust, shame, pride, irritation, amusement, and all of those mental states (whether conscious or unconscious) that refer to, or are about the world apart from the mind." John Searle, Minds, Brains, and Signs. (Cambridge Mass.: Harvard University Press, 1984), 16.

Among philosophers there are fundamental debates as to the utility, or indeed the necessity of the concept of intentionality. Although I side with the view that such is a substantive phenomenon, the present work makes no philosophical claims in that regard. "Intentionality" is employed here as a useful global term which accounts for the various conceptual phenomena Searle describes—not least "beliefs" and "intentions", with which we will be more particularly concerned in our cognitive historical case study of design reasoning.
software, are the basic operating systems such as MSDOS and WINDOWS on which whole families of software are dependent. Conceived as one-off solutions to the basic problem of interfacing with the hardware of the machine, practical adoption of such systems by other programmers with different problems to resolve, has led in time to their adoption industry-wide as de facto standards. The normative power of such frameworks in the world of computing is ultimately an almost entirely commercial matter of vested interest. In this sense we may characterize such frameworks as "external" in their relation to productive conceptual processes and as "institutional" in terms of the socially implicated forms of knowledge they become, even though such may continue to have a profound influence on knowledge organizing and processing practices, and hence the formation of beliefs. In the case of architectural design, as this study examines, basic conceptual frameworks of design such as the vernacular building practices of a certain local culture may become normative frameworks when such frameworks of "practice" are defined and such descriptions then become the object of externally imposed controls--institutional or otherwise--which attach those frameworks to primarily social rather than cognitive purposes.

The distinction between these two upper categories of "constructed" knowledge frameworks, in our cognitive model, could be characterized broadly--with respect to their essential cognitive operations and "interests"--as "process" versus "procedure". A fundamental point argued here, however, is that this differentiation--between conceptual process and normative procedure, individual intention and social institution, internal and external compulsions, bottom-up and top-down approaches to the description of problems and the respective production or prescription of solutions--is a dynamic phenomenon which works both ways. The designing of a building, or a computer programme, is a structured process which results in a structured product. That design product may then serve as a tool with which to address future design problems, as a precedent solution, or as a mode of reasoning about the problem.

This dialogical relationship between intentional process and heuristic procedure is the nature of the internal reasoning practices supported and enabled by the conceptual frameworks of cognition. As indicated in fig. 2.3, we will distinguish two essential sub-types of
conceptual framework, in this category. What we have been calling "modes of reasoning" are the very large category of possible approaches, techniques, styles of description and analysis, methods of proof, etc., with which an act or practice of reasoning may be structured. These include what Goldman calls belief forming methods—i.e. learnable algorithms, heuristics, procedures, or techniques for arriving at beliefs. Modes of reasoning specific to architectural design would be the use of canons of spatial composition, program stereotypes, and design routines, as heuristics in the development of design hypotheses. In later chapters of this study we will examine the modes of reasoning of the British Indian engineers with respect to their use of standard plans as a design tool.

"Conceptual systems" may be regarded as the "content" accrued by such structured modes of reasoning in context-specific practice. In concept forming practices such as architectural design, when a certain pattern of reasoning emerges and is maintained with some stability over time, we may refer to this as a "point of view", or a "design perspective". These are what we call conceptual systems. These frameworks differ from modes of reasoning—that is, from the mere procedural structure of the reasoning practice in which they arise—in that they constitute a particular and recurring pattern or profile of beliefs, and of norms and facts that may link such to corresponding patterns of behaviour in particular historical contexts. Conceptual systems can be of different degrees of generality, in this respect. A conceptual system may relate exclusively to a very specific activity, as, for example, when an architect develops a specific "point of view" concerning the design of religious buildings but holds to a very different set of beliefs, norms and design practices concerning hospital planning.

In such practice or indeed object specific respects, what we call conceptual systems have been described alternatively as "patterns of

49 This could be sub-divided in various ways depending on analytical point of view. Goldman’s distinctions between social and nonsocial belief-forming methods are one other possibility. See above.

intention".\footnote{M. Baxandall, \textit{Patterns of Intention...}, 41-42. Baxandall insists, however, that the "intentionality" he seeks to discern and describe through his method of inferential criticism "...is not a reconstituted historical state of mind, but a relation between the object [artifact] and its circumstances." Ibid., 42.}

When we consider the development of idiosyncratic conceptual systems in architectural design, or in painting as another obvious instance, we can see how such frameworks may in time become less creatively intentional and more procedural or even institutional in character. A reflective artist or architect might come consciously to externalize their own conceptual system and then re-deploy it as a self-critical mode of reasoning toward the formation of new concepts, or a whole new conceptual system, with respect to the design problems they address.\footnote{Donald Schon's thoughts on "reflective practice" and "professional reflection-in-action" are suggestive in this regard. See: D.A. Schon, \textit{The Reflective Practitioner: How Professionals Think in Action} (New York: Basic Books, 1983).}

In this sense we can appreciate how cognition is a dialogical process of both intentional and normative operations at the level of the conceptual frameworks of cognition, which can be fundamentally creative.

In my view, this notion of an interactive relationship between specific modes of reasoning and specific conceptual systems is not incompatible with the strong argument in certain recent writing about "culture" and cognition that the burden of explanation for the intentional behaviour of historically or culturally distant groups rests in their conventionally defined reasoning "practices" rather than in any distinct structures of belief ascribed to a particular cultural group as a whole.\footnote{A principal exponent of this skeptical view is G.E.R. Lloyd, \textit{Deweyzifying Mentalities}, (Cambridge: Cambridge University Press, 1990).}

But, I don't see that it is necessary to reject that notion of "mentalities" out of hand. A mentality is simply a conceptual system of a more general and pervasive order in the reasoning of a social group.

The notion of "mentalities" has been used extensively, by historians in particular, to describe and explain historical cultures and their internal coherence over time.\footnote{An "histoire de mentalite" has long been a compelling methodological project of historians--predominantly French
generally not been well defined and hence has been liable to obfuscation. Lloyd criticizes that there are simply too many problems with this notion for it to be useful. For one there is too much evidence

medievalists--aligned with the journal Les Annales Economiques et Sociales. Among these were the founders of Les Annales, Marc Bloch and Lucien Febvre. Active exponents today include Michele Vovelle, Pierre Mandrou, Georges Duby, and Jaques Le Goff. For an in depth study of the historical problematic of "mentality" and its methodological issues, see in particular, M. Vovelle, Ideologies et Mentalites (Paris: Francois Maspero, 1982).

The English social historian, Peter Burke--a sympathetic critic of the genre--distinguishes three general features of the mentalities approach: "There are (1) the focus on the ideas or beliefs of collectivities rather than those of individuals, (2) the inclusion, as important data, of unconscious as well as conscious assumptions, and (3) the focus on the structure of beliefs and their interrelations, as opposed to individual beliefs taken in isolation." P. Burke, "Strengths and weaknesses of the history of mentalities", History of European Ideas 7 (1986): 439-451. as related in Lloyd, Demystifying Mentalities, 4. For a more recent assessment of the contribution of the "mentalities" perspective to the New History in general, see P. Burke, New Perspectives on Historical Writing, (Cambridge: Polity Press, 1991).

55 The word "mentality" was first brought into modern usage by English philosophers of the 17th century. In this original sense of "the particular way of thinking and feeling of a people or a group of persons", the application was narrowly technical. But the subsequent usage of the word in French has been more affective than cognitive in connotation. Marcel Proust's literary excavations of memory and mentalite in his introspective psychological investigation of fin de siecle Parisian culture and society re-presented the word to the French language in the sense it retains today --- the popular successor to the german weltanschaung or world-view, a mental universe at once stereotypical and chaotic. J. Le Goff, "Les Mentalites; Une Histoire Ambigue", in Faire l'Histoire, vol. 3 (Paris: Gallimard, 1974), 82. But the notion of "collective conscience", attributed to Emile Durkheim, is the specific connotation with which the term was originally employed in the history of mentalites -- itself a direct offshoot of Durkheim's sociology. G. Duby, "Histoire Des Mentalites", in Histoire et ses Methodes, ed. C. Samaran, (Paris: Pleiade, 1961), 940.

The antecedents of the history of mentalites are found in the emerging social sciences at the end of the 19th century, in which the historian's focus was shifting from the genius of remarkable individuals to the actions of the group. The influences of both Marx and Durkheim were instrumental, but it was Durkheim's comparative study of the structures of consciousness of different civilizations that proved to be particularly fecund -- with respect to the history of mentalites, as well as many of the themes that dominated phenomenological sociology in America, cognitive sociology in England, and structural anthropology in France until relatively recently. Brown and Lyman, Structure, Consciousness, and History, 106.
in general of a multiplicity of inconsistent beliefs and norms held simultaneously within social groups, or even within individuals, to easily establish on what grounds groups or individuals may be said to actually share and sustain deeper, pervasive belief systems. If such collective mentalities do arise; on the other hand, he sees that it is equally problematical on the part of historians who study them to presume that such deep set patterns of belief, once acquired can ever be modified.\(^{56}\) Furthermore, Lloyd argues from a methodological perspective that seeking only to describe an underlying pattern of intention, we risk denying or bracketing a great deal of...mental activity on the part of the specific actor or group observed, of possibly great significance in explaining actual practice. To explain the reasoning--of individuals, societies or groups within societies--a more certain tack, in his view, is to begin by appreciating the diverse modes of reasoning used to express thought, belief, arguments, justifications, and the quite disparate domains of discourse, theoretical and practical, in which such may be employed: "It is...modes of reasoning that provide the locus of investigation," he concludes, "...not the reasoners themselves nor their supposed mentalities."\(^{57}\)

Lloyd's rather global sense of "modes of reasoning" appears to account for both the modes of reasoning and the conceptual systems we have described. With our view of the dialogical relations between the two, however, one may indeed speak of both mentality and modes of reasoning in the same explanation of historical shifts or cultural differences in thinking.

The principle of the conceptual system is not limited to the local context and specifics of a particular practice, in our view, although such are certainly a common circumstance in which a conspicuous pattern of beliefs and intention may arise. Such patterns may also arise on the broader level of social groups or even well defined societies as what we

\(^{56}\) G.E.R. Lloyd, De-Mystifying Mentalities..., 138-139.

\(^{57}\) Ibid., 145. For a less critically motivated articulation of an essentially similar argument and theory concerning the varieties of reasoning, and the significance—in the analysis of such—of the social and practical context or "forum" of reasoning, see Toulmin, Rieke and Janik, *An Introduction to Reasoning*.
might call a "general belief system". It is such collective systems of belief which we may understand as "mentalities". However, for the sake of clarity, we can avoid that problematic label.

The general belief system of a social group is a kind of conceptual system which is particularly pervasive and influential as it configures the highest controlling elements of reasoning which, as explained earlier, consist of those norms on which the political, legal and fundamental epistemic authority of a social system relies. In architectural debates, as in other historical discourses, these nomological elements are usually questioned only during periods of major conceptual reorientation at the social level. 58

Whether such general belief systems are, in fact, "deeper" structures than the dialogically interacting conceptual systems and modes of reasoning that sustain normal discourse and practice, is not an issue we can or need to resolve here. It will be contended, however, that beliefs and values do have sufficient continuity in "normal" behaviour to be regarded as systematic. This study demonstrates that changes in modes of reasoning in practices such as architectural design may have a significant relationship with change in beliefs or values, at the level of general social belief systems as well as in the immediately pertinent professional conceptual systems of the designers concerned.

Conceptual Systems: structure and components

We have said that a conceptual system is a particular pattern or framework of beliefs, norms and facts which may explain a corresponding pattern of decision-making in a particular historical context. Let us now consider the basic components and structural principles of such frameworks and how these we may be discerned from a methodological standpoint.

This study employs a theory of conceptual systems in design reasoning developed and applied previously in a paradigm of research on "discourse", in design and other domains, employing methods of textual

58 Itonis, Berwick and Freeman, "Discourse Analysis and the Logic of Design", 12.
analysis. However, apart from the enumeration of the essential elements of that method that follows, we will only be concerned with the theoretical point of view and the more general principles of inquiry indicated by that earlier research, rather than a rigorous application of its specific techniques for design discourse analysis.

This line of research holds to an essentially mentalist position in the spirit of Chomskian linguistics: "To understand the external form of sentences,"—in our case, written or graphically stated utterances of design reasoning—it is contended that "...one must know rules—internal representations—by which they are produced." On this view, a theory of the design reasoning process must contain a representation of design decisions (a mentalistic construction) in explicit form. It follows that methods of analysis must make these rules explicit.  

Design reasoning may be represented explicitly, in this view, from a bottom-up perspective beginning with a basic kernel of reasoning structure. In design, and in any other discourse, reasoning is a combination (sometimes very complex) of very basic statements. Such statements are instances of this basic kernel—a generic structure in which the relative factual or directive nature of a statement is determined.

Factual statements describe states. These are classified as "descriptions", and may be evaluated from the point of view of truth.

Directive statements prescribe actions to bring about states. These are classified as "prescriptions", and evaluated in terms of validity rather than truth.

As was identified in our preliminary discussion of the problematical ambiguities explored in this study—that is, between defining and describing operations in the rationalization of design knowledge and the directive implications of such codified knowledge in institutionalized design practices—the distinction between descriptive and prescriptive forms of reasoning is not necessarily explicit at the level of basic


statements. In design statements—an architectural plan being an obvious instance—the distinction between the possible factual (i.e. "descriptive") or directive (i.e. "prescriptive") nature of such a statement is often impossible to discern unless specified by a label or by the context of the plan’s use.

Prescriptive statements may actually be regarded as compound descriptions consisting of two essential components: 1) a design state, and 2) a component that indicates whether this state is prescribed or not. These may be represented by two corresponding sub-structures or branches, "factual" and "deontic", the combination of which comprises a basic kernel of reasoning.

The deontic branch of this kernel is represented in terms of the logic of commands. It consists of two ends and a middle:

```
Norm       N
Fact       F
Directive  D
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*Fig. 2.4. The deontic components of reasoning.*

- The upper component is the design norm (N), a prescriptive statement itself, which we may think of as the "goal."
- The bottom component is a further prescriptive statement, the directive (D), an action to be produced or justified.
- The middle component is a connecting node between norms and directives. This consists of a descriptive statement (F) providing factual support for the reasoning that links a more general design state prescribed in the norm with a particular design state aimed for in the directive.

The factual branch of the basic kernel meets the deontic branch at

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node (F). This is comprised of further descriptive statements which support the claims of statement (F). This branch has two possible components or extensions. The Backing (B) provides a first level explanation for the truth of (F). A Base (Base) may be invoked in some arguments requiring higher standing support for the truth value of (B). The factual branch of this kernel may thus be regarded, alternatively, as its belief component.

Here is a schematic diagram of the deontic and factual branches combined. This represents the basic kernel of reasoning:

```
      N
     /  \
Base—B—F
     |  |
     D
```

*Figure 2.5. The basic kernel of reasoning structures.*

Actual statements are rarely so simple or unencumbered by contextually dependent pre-suppositions that they could be represented in this simplest of possible configurations. The analogical notion of "branches" of operations employed in the above description is appropriate for appreciating how these may ramify in the construction of more complex arguments or decision-acts. There may be multiple norms (N1, N2, ...Nn) warranting a single directive. Similarly one may attribute a variety of different actions (D1, D2, ...Dn) to a single norm/goal (N). Springing from node (F), the factual branch that represents an especially "thick" description, for example, may consist of a comparably "bushy" array of

62 With the fundamental addition, in our view, of the deontic "normative" component of reasoning, this kernel derives from the principle of claims and warrants of Stephen Toulmin's basic model of argumentation. See S. Toulmin, *The Uses of Argument* (Cambridge: Cambridge University Press, 1958). In his later work on "reasoning", as briefly discussed at an earlier point in this chapter, Toulmin has himself enhanced and modified that model to describe the varied kinds of practice-specific reasoning to which he has proposed it may be applied as an analytical tool. See Toulmin, Rieke and Janik, *Reasoning...*
multiple fact components each supported by its own dense array of backings and bases.

Single kernels of reasoning may, in turn, be compounded sequentially in "reasoning chains". For example, a directive (1D), resolved upon in consideration of general norm (1N), becomes the secondary norm or goal (2N) which more specific actions (2D1, 2D2, ...2Dn) are taken to achieve.

When we consider the combinatorial implications of such "chaining" with the ramification of deontic and factual components at each stage, it is evident that very complex reasoning structures can arise from the basic rules and components we have described.

What this cursory digression on the rudimentary structure of reasoning has hopefully established is an understanding of the explicit basis on which we speak of "conceptual frameworks" in this study. Represented in this basic kernel of reasoning are fundamental rules of composition by which these various components may be assembled in the construction or defence of the specific "reasons", the basic "rationale", the "conceptual system", or indeed the "general belief system" that underscores any instance or process of reasoning, in individual or social context.

In the following case study we will not actually be so concerned with the precise structure of conceptual systems. But an understanding of such implicit structural relations will enable us to make better sense of their content, and to articulate the various discrete components of which such may be comprised. Let us therefore consider, finally, how such content may be discerned and interpreted historically.

**Historiographic considerations:**

For the historian of design reasoning conceptual systems may be discerned through a diachronic analysis of changes in their content, interpreted in terms of changing belief-profile and norm-bias. The generic model of reasoning components guides the historian to look more particularly for changes in the kinds of directives, norms, facts, backings, bases, and higher standing nomological regulations contained in the historical
design discourse which they analyze. However, such changes are not constant nor necessarily even common. The general stability of norms, beliefs and values in "normal" circumstances is, after all, the very basis of what we call a conceptual system. And the more stable such a system is, the less consciously articulated its components may be.

Consciousness—that is, explicit and innovative reasoning—is only occasionally prevalent. The greater part of the time we fall back on "routines" of thinking through which we re-cognize and efficiently repeat to a large degree previously reasoned responses to familiar problems or situations. In such routine reasoning, the conceptual content is largely or wholly pre-supposed.

The analysis of conceptual content may, by contrast, be most felicitous in historical moments of crisis. At such junctures, it may be observed, mere routines may come to be perceived and defended as doctrines, and those pre-suppositions that informed the former may harden into increasingly manifest prejudice—a form of ossified conceptual system. Such brittle structures may temporarily be the only basis of order to hold onto in periods of change and uncertainty. As with scientific paradigms, however, crises may serve alternately as catalysts for conceptual change for it is at such moments in history when prevailing conceptual frameworks tend to become exceptionally explicit. Bared and vulnerable, their weaknesses are eventually revealed, and so in time alternative norms and beliefs more suited to the evolving historical circumstances may arise to transform them.

Methodologically, the felicity of historical crises is their effect in provoking the generation and documentation of articulate argumentation concerning the critical issues of the moment or their implications. Texts and other documents in which viewpoints, norms, and beliefs generally left implicit in the inconsequential traces of routine activity, are cogently voiced in defence of or support of "contested" practices in the historical debate.

In the case study, into which we will enter presently, we will begin

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64 Ibid., 15.
by considering the particular set of historical crises between which it was framed. Seeking keys in those crises to the differing states of belief that prevailed at the beginning and the end of that period, the investigation will attempt to explain a shifting pattern of intention and the evident conceptual changes that may be discerned beneath.

Meanwhile, we conclude this methodological chapter with the following notes on the nature and sources of the primary historical data investigated in the case study. 65

3. DATA AND SOURCES

This historical case study has entailed substantial primary research in relevant archives in India and England, as well as an extensive photographic field survey of the colonial settlement planning and architecture under study. Much of the latter survives in greater or lesser states of repair, in many cases accommodating much the same official functions or appropriate grades of government employees for which they were originally designed.

The research—archival and physical survey—was initially organized and directed according to the following sub themes and objectives:

1. Survey and analysis of the buildings and built environments created by the PWD from the mid-nineteenth century to the mid twentieth century as the physical "traces" of the conceptual object in question.

2. Analysis of drawings and intra-departmental proceedings as a record of practice, protocol, and the economy of information and expert knowledge within the PWD system.

65 With respect to secondary sources, there is a large and steadily growing scholarly literature concerning the different political, technological, and social facets of modern Indian history during the era of British colonial rule. This case study of planning and architectural design reasoning in that historical context is obviously not proposed as a definitive reading of any of those other facets of the literature with which it necessarily overlaps. References and bibliographical commentary regarding key secondary sources pertinent to this case are provided in the footnotes.
3. Analysis of the curriculum and institutions comprising the educational foundations of the Indian PWD—Royal Indian Engineering College, Cooper's Hill (the civil engineering college established in Britain for the superior executive cadre of the Indian Engineering Service); Chatham and Addiscombe (the two military academies from which the cadre of Royal Engineers comprising the initial P.W.D. were drawn); Thomason Civil Engineering College, Roorkee (the principal Indian engineering college founded in 1849 to produce the "subordinate" cadre of skilled overseers required to carry out and replicate the works and buildings of the Department); the engineering colleges at Sibpur, Poona, and Madras (the three "local" counterparts of the Roorkee school).

4. Compilation and analysis of the corpus of "standard plans" for widely replicated building types designed and constructed by the PWD and its various branches (Military, Railways, Buildings and Roads, Judicial, etc.) as archetypical projections of the conceptual system of the typical PWD engineer/architect and, hence, of the more general "mentality" of technocratic rationalism ascribed to the project of colonial development.

5. Examination of the formation and contest of professional ideologies surrounding the PWD establishment and the increasingly autonomous architectural profession that emerged in the twentieth century to compete for dominance in government works over the professional hegemony and conceptual system of the departmental engineers (survey of professional journals, reports to Indian Inst. of Architects, interviews, etc.).

6. Survey of literature, criticism and other cultural output (both "high" and "low") gauging the perception and popular representations of the "official space" (typical government buildings and residential quarters, and built environments such
as cantonments and railway colonies) conceived by the PWD engineers. Through this ultimately curtailed facet of the investigation evidence was sought as to how that architecture was acculturated into the general belief system of the greater colonial community and, subsequently, that of post-colonial Indian society.

The majority of the data were gathered on two separate research trips to India. A preliminary survey of historical material in the library and drawing archives of the present day Central Public Works Department (CPWD) in New Delhi did not reveal as much useful documentation as had been hoped. Much of the original library collection has evidently been lost over the years or distributed among

66 The Central Public Works Department was the successor to the Public Works Department in the Government of India, which originally had its secretariat in the former colonial capital, Calcutta. The present day Public Works system is, however, further decentralized than it was under the colonial system of "Supreme" and "Provincial" or "local" government departments. The Central Public Works Department came into being to undertake the construction of the new imperial capital at Delhi in the 1920's and has largely retained that more limited mandate to maintain and develop central government buildings and services in the capital region of Delhi and in federal jurisdictions at other specific points in the country. Local government works departments at the state and municipal level carry out the great bulk of mundane public works with relative autonomy from central government control. Further autonomous authorities for the planning and maintenance of airports, railway buildings and infrastructure, post and telegraph buildings and transmitters, etc., have devolved from the technical branches of the former PWD in the Government of India. Established conventions are strong, however, and design standards and departmental protocol are still closely modeled, in most cases, on the original PWD Code and manuals of the 19th century. Hence, a general homogeneity to the norms, practices and design production of the various different governmental works organizations of modern India is still quite prevalent. See for example: Government of India. Central Public Works Department. C.P.W.D. Code, amended compilation of revised edition of 1959. Delhi: Controller of Publications, 1984; Government of India. Central Public Works Department. C.P.W.D. Manual, 1986 ed. Vol.1, Staff, Establishment, Organization and Office Procedure. Delhi: Controller of Publications, 1989; Government of India. Central Public Works Department. C.P.W.D. Manual, 1988 ed. Vol.2, Works, Accounts, Contracts, Stores, Budget and Audit. Delhi: Controller of Publications, 1990; Government of India. Central Public Works Department. Specifications 1977: C.P.W.D., New Delhi. Delhi: Controller of Publications, 1977.

67 The peripatetic PWD Secretariat, which migrated semi-annually
the various regional branches of the CPWD or local government works departments. Architectural drawings were to have been a primary object of the historical inquiry, but these also proved to be very difficult to locate. Trial inquiries in local Public Works offices in Bombay and Madras were similarly unpromising.

Among other factors, these shortfalls in the preliminary research served to alter considerably the original scope of the research, which was to have encompassed the full 140 year history of the Indian Public Works Department with the object of explaining the long term continuity of departmental modes of reasoning—i.e. the "PWD mentality" as such is often labelled, disapprovingly, by present day Indian architects—from the colonial period through to the present. Although compelling observations and considerable historical material pertinent to the development of the Indian PWD system in this century were gathered in the field research, it was ultimately necessary to exclude that data from the dissertation in its final, more concise and selectively focused form.

The bulk of the primary historical data interpreted in this study were culled, finally, from colonial government records preserved in the

between Calcutta and the summer capital at Simla, had a respectable collection of canonical theoretical works on architecture, encyclopedia, pattern books, and practical manuals, of the 18th and 19th centuries. See: Government of India. Public Works Department. Catalogue of Books in the Library of the Public Works Department Secretariat. Calcutta: Superintendent of Government Printing, 1886. The possible role of such published design precedent knowledge in the design reasoning of the PWD engineers is discussed in Chapter 8.

The CPWD Secretariat in New Delhi does, in fact, possess a potentially very valuable collection of thousands of design documents—including original construction drawings, tracings and rendered presentation drawings by the watercolorist, William Wolcott—for the design and city-planning of Imperial Delhi, for which Edwin Lutyens and Herbert Baker were the principal architectural consultants. Previous scholars have sampled this material and brought some of it to light in publications; notably Robert Grant Irving in his comprehensive study of the building of New Delhi, Indian Summer: Lutyens, Baker, and Imperial Delhi. New Haven and London: Yale University Press, 1981. However, it has until very recently been stored in very poor environmental conditions in a state of near indecipherable disarray. While hope of making a methodical investigation of that trove was abandoned early on in the present research, it is encouraging to note that the CPWD, under the initiative of Senior Architect, Jeevan Kothari, has subsequently begun to recatalogue and re-house their archives in a new facility planned for the use of scholars.
National Archives of India, in New Delhi. An in-depth survey of those "supreme" government records was complemented by more time-constrained samplings of equivalent "local" government records of public works activity at the provincial level, in the State archives of the former Bombay Presidency (Maharashtra State, today) and the Madras Presidency (State of Tamil Nadu). A third point of view, with regard to the official record of Public Works in British India, was investigated through the India Office Records collection in London.  

Having limited the search to these standard archival sources, in the end, the sheer mass of potentially relevant material to access and analyze presented a further challenge. A good understanding of the institutional phenomenon which forms the object of this study was gathered directly from the idiosyncratic structure of the almost overwhelming repository of information which the colonial bureaucracy—in the Department of Public Works as in all other departments—methodically amassed in its day to day affairs. Making sense of that archival structure—identifying its conventions of nomenclature and classification, and the successive changes in these recording practices with efforts to improve the efficiency and consistency of the departmental system—took far more time than one might reasonably have anticipated. Although much of interest, and hopefully of scholarly value, was unearthed in that research, the study that follows is a product in part of what was not found, and what was learned by that frustration.

In the National Archives of India the research focused principally on the monthly volumes of the Proceedings of the Government of India in the Department of Public Works. The separately compiled volumes of Public Works Department Circulars were a somewhat more fruitful source of actual architectural drawings.  

69 The India Office was the "Home" end of the colonial administrative system, which prepared, managed, and duly recorded all out-going and in-coming correspondence between the British Parliament and the Government of India in Calcutta. With the demise of British India the records of the India Office were bequeathed to the British Library which has more recently combined these with its Oriental Collections.

70 The search for drawings was a frustrating and largely unsuccessful quest in general. The reason—-it is telling to note—-was that drawings were usually classified as "enclosures" to official correspondence; that is, as supporting documents for whatever textual document that may have
State Archives in Bombay proved to be the richest source of architectural drawings pertinent to Indian Public Works that I came upon in my research. However, these related in large part to the rather particular case of railway buildings and have therefore been a less generalizable source of evidence than one would have wished. In the Tamil Nadu State Archives the Proceedings of the Government of Madras in the Public Works Department were specifically examined with a view to the design reasoning and actions of PWD engineers at the "local government" level. At Roorkee University, formerly the Thomason College of Engineering where many of the Indian born members of the PWD establishment gained their training, original course manuals, college calendars and prospectuses, library catalogues, and other material indicative of the curriculum of the former college, were the objects of inquiry.

Substantial additional data and observations were gathered through subsequent archival research in London. In the India Office Records Collection (IOR) I continued to search for original or published architectural drawings pertaining to the Department's corpus of "standard plans", however with little further success. Alternatively, the European Manuscripts Collection of the IOR furnished pertinent material from the collected papers of actual individual members of the PWD, which has enabled a more personalized understanding of the departmental engineers and their reasoning than can be deduced from the official departmental proceedings alone. Other special collections of the IOR pertaining to departmental recruitment, the Royal Engineers in India and their disputes with the Civil Engineering profession, departmental reorganization and, finally, the various engineering colleges created to supply the PWD with its personnel, have proved to be especially useful contributions to the

accompanied them, even when—as was often the case—such was only a covering letter for the enclosure itself. According to the standing regulations concerning the recording and filing of Government documents, (see, for example: Government of India Public Works Department, Code of Regulations for the Public Works Department with Rules for the guidance of the Barrack Department. 2nd ed., revised and corrected to Jan.1, 1866, (Calcutta: Office of the Superintendent of Government Printing, 1868), Chapter VI, "Recording".), "enclosures" along with "matters of routine" were systematically discarded when the monthly proceedings were compiled and sent for printing. Text was evidently regarded as the only legitimate form of archival record.
research. In addition to the India Office Collection, the British Library itself was a source for historic engineering journals of particular importance to the study. Among others sampled, the Professional Papers on Indian Engineering (Roorkee) were surveyed exhaustively. Also in London, the library and the prints and drawings collection of the Royal Institute of British Architects furnished considerable data concerning the accomplishments of British architects in India, although that material has ultimately been excluded from the final dissertation.

Finally, some of the most intensive and consequential work with period sources was conducted in the author's own home institution (McGill University), where an exhaustive survey of The Builder, from the mid to late 19th century, was undertaken.

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Summary: In this methodological chapter we have established the theoretical premises on which the following case study is conducted. We first distinguished our "cognitive" historical perspective on design reasoning in a brief review of other "contextual" and "cultural" approaches to the problematical issues of technocratic rationalism and control, in recent architectural, urban, and planning history. A cognitive model was discerned and various key terms were defined. The basic building blocks of the intentional reasoning structures we call "conceptual systems" were described and their structural rules of relation were explained. Such structures, we argued, are the basis on which individual or socially specific states of belief, norms and actions tend to be sustained in consistent relation to each other over time, and on which we may speak of historically specific "patterns of intention", or "local" or "limited" rationalities. We then briefly discussed methodological considerations relevant to the detection and analysis of conceptual systems in historical design documentation. The chapter closed with a description of the primary sources of historical data on which the case study was conducted, and practical aspects and limitations of the field work and archival research.
PART TWO

INSTITUTIONALIZED DESIGN REASONING
the CASE of
THE BRITISH INDIAN DEPARTMENT OF PUBLIC WORKS
Fig. 3.1. The British Indian Empire, (c.1900). Source: The Imperial Gazetteer Atlas of India, Vol. XXVI, Atlas, 1931, plate 21.
CHAPTER 3

IMPERIAL PROGRESS
INTRODUCTION TO THE CASE

Introduction: With this first chapter of Part II we enter the case study. We begin by establishing the historical parameters of the case in the broad change in the pattern of intention of the British Indian colonizers observed between the early and late 19th century. This is followed by a chronological overview of the historical content of the case, the principal events and developments to be examined, and the cognitive historical interpretation of these advanced in later chapters.

Metaphor was a favorite medium of colonial apologists. For the engineers of British India and their champions, the vocabulary that sprung from the notion of "empire building" had an obvious appeal and utility in winning recognition for their particular contribution to the colonial cause. However, as the grand political and economic construct of the British Indian Empire began inevitably to come apart in the early decades of this century, the metaphorical framework on which it had been supported attained an increasingly mythic significance.

The official historian of the Royal Engineers in India summed up the achievement of the Corps as follows:

The consolidation of India has been, in no small measure, the work of engineers. Deprived of roads, railways and canals, the country would even now revert to savagery. After British soldiers had dug the foundations in sweat and blood, British engineers raised, as it were, a steel framework for the expansion of the civil administration.¹

In the end the technical skeleton which the engineers had wrought was among the few tangible artifacts of empire of which the retiring colonizers could remain unreservedly proud. The means had supplanted the supposed object of the colonial enterprise, the metaphor made concrete—but it no longer carried meaning.

In the 1860's and 70's, the heyday of colonial development in British India, the vision of Empire had not yet become so confused with

its trappings. Charles Trevelyan, an elder statesman of British Indian administration long committed to the Liberal ideal of colonization as a civilizing mission, could look back with admiration and a sense of national pride on the work of the British in India over the course of his own half century of service to the cause. In 1873 it was nevertheless clear in his mind that the sophisticated technocratic framework they had assembled to administer their vast Indian territory "...was but a provisional temporary arrangement", "...a sort of scaffolding which had been erected until the edifice of our Indian Empire is completed, and as it is completed, that scaffolding should be taken down."²

Trevelyan's metaphorical use of the builder's vocabulary is telling. For imperial policy makers of his Liberal persuasion the real "project" of colonial development was not a technical matter of bricks and mortar, it was a far more grand scheme which envisioned no less than the cognitive reformation of India as a modern society. Behind the "scaffolding"--the institutional framework and the necessary infrastructure for the logistical support of the community of European colonial servants--these idealistic empire-builders perceived that they were building anew the fundamental conceptual framework of Indian society, its belief-systems and values, on the transcendent new lines prescribed by their own Enlightenment ideals of rationality and liberty, order and justice.

As a young Secretary to the Government of India in the 1830's, Trevelyan had been party to the most radical attempts to implement such a project of conceptual restructuring--through educational and judicial reform--that the British were to venture in their two centuries of dominance in the Indian subcontinent.³ Despite their condescension with


³ William Bentinck, Governor-General of British India from 1828-1835, was an ardent Benthamite who believed knowledge to be the "universal cure" by which India could be brought out of the state of poverty and degradation in which the Liberal and Evangelical Christian reformers of the day perceived it to be mired. Trevelyan's brother-in-law, T.B. Macaulay, a member of the Governor-General's Council, was responsible for putting Bentinck's belief in general
respect to the subject society they sought to transform, and the shortcomings of the alternative conceptual system they prescribed, the early 19th century colonial reformers' notion of development through knowledge and conceptual change had been not only the most radical but potentially the most emancipating of development strategies that the colonial authorities could have pursued. An India made "modern"—that is, conceptually compatible with its European conquerors in its collective beliefs and normative modes of reasoning—could be expected to assume responsibility for its own government once again, and take its place in the British Empire as an active agent and beneficiary of imperial progress.

But, whereas the predominantly white settler colonies of the British Empire were presently to achieve such autonomy as self-governing dominions, India was ultimately denied that course of development. By contrast to the idealistic faith in the universal human potential for progress through reason which underscored the reforming ambitions of Trevelyan's generation of colonial policy-makers, the technocrats of the mature British Indian administration that emerged in the second half of the 19th century were to resort by stages to a comparatively cynical policy which was manifested in an increasing obsession with the ostensive technological and organizational tools of British progress and power. This normative technocracy came to serve as both the mechanism and the legitimization for a discriminatory and paradoxically conservative scheme of imperial progress. Behind that "scaffolding", and the facade of authority and system which it assisted the colonial authorities to conserve, the underlying conceptual edifice of the colonizing society had begun to show cracks under the escalating strain of economic competition.

education as "a panacea for the regeneration of India" into policy with his Minute on Education of 1835—a pivotal document which was to entrench English in India as the language of power and of political thought from that point forward. Meanwhile, Macaulay devoted his energies to his principal mandate, the framing of a Criminal Code for India.

and social complexity in a world that was coming to perceive that there were ultimate limits to growth. 4

In India, where the challenge of competition and limited resources were not yet keenly felt, the colonizers could still convince themselves that they were in firm control of the situation. But this was to depend on a more and more wilful belief in the profound difference—the special case—of India relative to the "modern" world of industrializing Europe. This enabled a different kind of rationality to be applied in British Indian policy and planning—a "limited rationality"5 premised on the conviction that in India, at least, things didn't change. 6 The successful conquerors came to believe that they no longer had to think strategically. Proven solutions for known problems would suffice.

Nevertheless, underlying certainties were eroding. As established beliefs about progress and the libertarian values with which such had been promoted proved less and less tenable, conceptual systems fell into flux and institutions were relied on to sustain continuity and guide action—an increasingly conspicuous pattern of paradigm saving behaviour. Resisting impending obsolescence, the forms and conventions that the colonizers had devised and institutionalized over the years in developing their colonial polity were to be employed more and more rigidly, as doctrines to which adherence was strictly prescribed.

4 For the purposes of this historical study of design reasoning, I will adopt Hobsbawm's economic explanation for the "scramble for empire" of the late 19th and early 20th century, which climaxed with the First World War. See: E.J. Hobsbawm, The Age of Empire, 1875-1914, (New York: Vintage, 1989). Our interest rests in the conceptual ramifications of that crisis and how these affected the evolution of design and planning thought in Colonial India. See Chapter 9 below.

5 The notion of "limited rationality" has been employed by political scientists to describe issue or context specific cognitive orientations in voting behaviour. It is employed here in the sense of what decision theorists describe as "sub-intentional causality". As Elster explains: "One may in fact choose one's desires, through 'character planning', which then provokes an intentional explanation of why the desires are what they are... Similarly,...it may be possible to choose one's beliefs, in the sense of deliberately adopting certain beliefs because it is useful to hold them, quite independently of whether the agent believes them to be true." Elster, Explaining Technical Change, 85.

This ossification of the institutional structures of British India found one of its more explicit manifestations in the increasingly dogmatic attitudes concerning building and architecture that affected the practices of the British Indian Public Works Department in the final decades preceding the demise of that colonial administration. This was the end-state of the process of rationalization, standardization and control of design and planning practices within that departmental framework, of which the idealism of the reformers of the early 19th century was the preamble. It is the sequence of changes between these different states or patterns of intention in colonial policy—from rationalist determinism, on the one hand, to institutional determinism on the other—that we will try to chart in this study. The aim is to explain the basic productivity of the institutionalized design practices of the Public Works Department engineers in that intervening period; to describe their modes of reasoning, and to discern the relations between that reasoning and the various normative knowledge systems—architectural, professional, technological, bureaucratic, social—in which it operated, which might explain the particular problems and historical changes observed in those practices. More generally, the case provides an indication of the role of cognitive and conceptual factors in the structure of social practices such as design.

This chapter presents a concise historical overview of the case, principal issues and arguments. Subsequent chapters will offer more detailed readings of the content of the case and specific portions of the narrative, from particular points of view.

**IMPERIAL PROGRESS, 1850-1900**

Empire building in the Victorian "Raj": barracks, railways and sewers

The decision to create a Department of Public Works in the Government of India in 1855,\footnote{The historical background to that decision and its immediate implications are discussed in Chapter 5, below.} was among the more telling indications of the important conceptual change that came about in the middle years of the
19th century, with respect to colonial policy and practices, generally. The monopolistic trading interest of the East India Company—through which the British Indian Empire had been assembled—had long been revoked. However, the role that the Company regime had come to play, alternatively, as the administrative organ for a vast, geographically, politically, and ethnically complex assemblage of territories had not, to that point, been inspired by a collectively compelling ideal of government on an imperial scale, nor had the responsibilities which that entailed been fully accepted. The commitment to the construction of irrigation canals, railways, and other works of public improvement—which the new department was mandated to plan and execute—was the first important step along the path of limited and pragmatic but forward looking technical development that the colonial administration was to pursue in the subsequent two decades.

The volume and range of the Public Works Department's building achievement in the second half of the nineteenth century was impressive. In its various technically specialized branches it undertook the development of a vast network of roads, railways and irrigation canals which substantially transfigured the economic and cultural geography of the subcontinent. Those audacious technical feats tended to overshadow the architectural output of the departmental engineers, but they were no less prodigious in that vein. The PWD undertook the planning and construction of the basic accommodations for virtually every facet of the colonial administration's residential and working needs. This included all government offices; all civil buildings and institutions such as courthouses, police stations and jails; all military works and buildings; public service buildings such as post offices and railway stations; and a wide array of residential "quarters" and "bungalows" to house the growing ranks of meticulously graded and categorized government servants, European and Indian.

The work was carried out by a small cadre of engineers and

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8 With respect to technology transfer and its role in the colonial conquest and transformation of India, the incisive, relatively recent studies of Daniel Headrick will serve as our prime secondary source. See: D.R. Headrick, Tools of Empire, (New York: Oxford University Press, 1981); ----, Tentacles of Progress (New York: Oxford University Press, 1988).
semi-skilled subordinates, many of whom were officers and soldiers deputed to the FWD for peace-time duty from British Sappers and Miners Regiments of the Indian Army. Before any aesthetic considerations, this massive construction mandate was approached as a matter of military logistics. Hence it was hardly surprising that the typical buildings produced by the department had a “barrack-like” utility and uniformity of design.

For its detractors the standardized idiom of the FWD epitomized the most deplorable implications of modern building processes. This colonial off-shoot of the phenomenon was redoubled in its mediocrity, they felt, by contrast with the variety and riches of traditional Indian architecture. "There are hundreds of such buildings in India," lamented one such critic, "where, cut up into longer or shorter lengths, they serve for law courts, schools, municipal halls, dak bungalows, barracks, post offices and other needs of our high civilization." 9 This architecture was anything but "high" culture the commentator implied sarcastically; it was a mean and pedestrian abomination of the European architectural canon which "enlightened native gentlemen" were, tragically, only too ready to emulate in their eagerness to appear progressive. 10

9 J.L. Kipling. “Indian Architecture Today.” The Journal of Indian Art 1, 3 (1886): 1-5; quoted in G.H.R. Tillotson, The Tradition of Indian Architecture: Continuity, Controversy and Change Since 1850. (New Haven and London: Yale, 1989), 99. (My emphasis.) John Lockwood Kipling—the father of Rudyard Kipling—was an ardent apologist for the principles of the Arts and Crafts Movement in his capacity as principal of the Mayo School of art in Lahore. His efforts to find patronage for the traditional architectural sculptors and stone masons of India in modern public buildings were repeatedly frustrated by official adherence to the unornamental functionalist standards of the FWD.

10 The derogatory inference went deeper than a mere patronizing concern for the authenticity of "native" building traditions, I would argue. The FWD was regarded as one of the "lower services" of the colonial administrative system. Its military subordinates, along with their counterparts in the British rank and file of the Army, could expect little but scorn and condescension from the rest of the British sub-culture in India for they represented the working classes of Victorian Britain. For the uppity civil servants of more genteel social backgrounds who bled the middle and upper ranks of that tiny and grossly distorted social microcosm of 19th century Britain, it was perhaps especially galling to be subjected to the plebeian utilitarianism of the FWD builders. The drab monotony of the standardized designs had
Nevertheless, the majority of European colonial servants in India endured this banal but versatile built environment with a stoic disregard. Their accommodation merely reflected the general sobriety and workmanlike pragmatism of the colonial culture at large during the second half of the nineteenth century. Not until the final years of Queen Victoria's long and remarkable reign did the British really transcend the tentative, calculated attitude to the colonization of India with which that fundamentally commercial venture had begun two centuries earlier. Colonialism was an investment, a long term investment to be sure, but the objective had always been to realize a profit and, eventually, to withdraw. The buildings constructed by the PWD were short term means towards that end. Exigency was their purpose, the immediacy and variability of which demanded only appropriate, temporary solutions. Outside the colonial metropolises, the only self-consciously "architectural" designs regularly produced by the PWD were minor churches and funereal monuments. These buildings were culturally specific to the tiny community of British colonial servants, civil and military--reminders of the moral superiority it assumed with respect to its colonized subjects, and of the martyrdom the British had compelled themselves to undergo in India for the seemingly interchangeable causes of "Progress" and "Empire".

The unaffected utilitarian designs of the PWD spoke for this collective ideal of temporary sacrifice for the greater future good. As long as that progressive ethos sustained the colonial culture its official building needs continued to be satisfied by the government engineers and their straightforward, practical norms. The Raj of the mid Victorian era was not yet driven by the millenarian ambitions and consequent obsession with architectural representation to which it would resort in the beginning of this century when the specter of the demise of the Empire had become apparent. Self-conscious monuments to the British Indian Empire were built in earnest at that stage, the only moment in the colonial era that professionally certified architects were empowered with substantial official authority to pursue the cherished ideals of their affinities to nothing in the Victorian Englishman's experience so much as the dreary rows upon rows of standardized workers' housing in the industrial towns of the British midlands.
profession—that a work of Architecture is a product of craftsmanship, of cultural and historical value and, above all, of permanence.

The colonial technocracy:

The marked shift in the pattern of intention which we may infer from official building efforts in colonial India after 1900 reflected broader changes in the conceptual framework of the British colonialists that had come about over the course of the Victorian era.

The Liberal and Evangelical reformers of the early nineteenth century had imbued the colonial engagement of the British in India with the ideology of a "civilizing mission". By the latter part of the century, however, the naivete and the essential optimism of that notion had eroded significantly. While British dominance in India had been firmly consolidated and a process of social change substantially advanced—not least the anglicization of an urban middle class—a politically expedient new belief in unbridgeable differences between the conquering and subject societies had superseded the earlier reformers' faith in an evolutionary process of social "improvement". The turning point in this regard had been the bloody popular revolt of 1857-58 which swept much of northern India.

Memorialized infamously in imperial historiography as the "Great Mutiny", this sensational affront to the British colonial endeavour was explained to the indignant public and parliamentarians back in England as a rejection of the gift of English civilization by the people of India. The colonial mandate was not then perceived to be in any serious jeopardy itself, but colonial administrative and cultural policies would necessarily be reconsidered. While a wedge of contempt and mistrust had lodged itself between the colonizers and the colonized, the seemingly irreversible incorporation of India into the world economic system of the British Empire would be formally recognized at that point by sweeping administrative and military reforms which put it on an altogether new footing as a "crown" colony directly responsible to the "Home" government.

11 Stokes, Utilitarians; Metcalf, Aftermath of Revolt.

12 Hutchins, Illusion of Permanence.
of Britain.\(^{13}\)

This intimate new relationship with the political centre of the British Empire would be enormously enhanced in the following decade by the dramatic acceleration of communications with India brought about by the completion of a submarine telegraph link from London to Bombay in 1865, followed four years later by the opening of the Suez Canal. The sudden compression of the time and distance that separated the imperial metropolis from its Indian Empire compelled bureaucrats and politicians of the Home government to become much more closely concerned with the detail of colonial administration and, reciprocally, to demand a greater degree of information and accountability from the local and district echelons of the administrative system in India. Concurrently, this tightening of the reins of political control compelled the accelerated development of internal communications within the vast but disjointed array of territories under the aegis of British India.\(^{14}\) The construction of this extensive infrastructure of roads, railways and telegraph wires was the principal mandate of the Public Works Department in its first years of operation.

As the flow of correspondence and telegraphic communiques increased, so did the bureaucracy required to produce and process it. Through the latter half of the nineteenth century the steady expansion of the colonial government would be characterized by a marked tendency toward centralization, on the one hand, and specialization of functions, on the other. These tendencies were manifested expressly in the creation of a series of new technical departments and government services including the post office and the telegraph department, the Indian Medical Service, and an augmented and reorganized Department of Public Works—which had only just begun to be established on an autonomous departmental footing two years before the Mutiny. These new agencies added significantly to the ranks of colonial government servants, an increasing number of whom were

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\(^{13}\) A standard work on the Mutiny and its consequences, on which I will rely in the main in this account is T.R. Metcalf, *The Aftermath of Revolt: India 1857–1875*, (New Delhi: Manohar, 1990). That crucial event, and its implications for the technical development of India are treated at length in Chapter 5 and Chapter 7, below.

to be recruited in India.

Meanwhile the complex and inter-twining revenue and judicial systems of the colonial administration, which had evolved under the long tenure of the British East India Company, were to undergo reforms to bring that idiosyncratic inheritance more closely into line with the more rationalized and consolidated corporate hierarchy of the post-Mutiny regime. But this was not to be an easy exercise. After more than a century of semi-autonomous development, a binding consensus between the various provincial and presidential governments of British India on a common system of administration could never be fully achieved. The inertia of ingrained practices and entrenched establishments sustained a resistance to reform which embodied the deeper-set intransigence of opposing political philosophies—the Whig Liberalism and Tory paternalism of the English parliamentarians of the early nineteenth century who had battled to frame the moral and legal grounds for colonial rule during the crucial developmental phase of British control in India. Under the unbridled administration of the East India Company, the personal styles and political convictions of the more charismatic or stubborn individuals who had first represented the foreign rulers in each newly subjugated territory, had been embodied in their self-styled administrations. These had been grafted in turn on local indigenous systems of government, which furthered their idiosyncrasies. Hence, political expediency and the heuristics of local administrative practice would conspire to discount most reform measures. The so-called "regulation system" would only be adhered to with reasonable conformity in Bengal and was always somewhat of an enigma. 15

A Call to Order: Rationalization and Professionalization in the aftermath of the Mutiny

The post-Mutiny reforms eliminated most of the residual autonomy—real or

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15 The presidency of Bengal was geographically and historically bound to the authority of the "supreme government" in Calcutta. For a now classic study of the political and philosophical contrasts that prevailed in the development of the administration during the tenure of the Company, see: Eric Stokes, *The English Utilitarians and India*, (Oxford: Clarendon, 1959). See also Chapter 5 below.
imagined—that the British colonial administration in India had retained under the regime of the East India Company. Economic and political incorporation brought with them the corollary of cultural peripheralization. Under this new regime (what came to be called the British Raj), colonial society in all spheres became far more rigidly classified and divided than previously—by official standing, professional function, social class, and gender in the case of the British sub-culture, and categorically by race, language, and religion in the case of the indigenous population. Defined and ranked as such, the social order was expected to remain unchanged. Indian society and culture was left to its own traditional practices; socially and spatially segregated from the European colonial population, and largely excluded from the limited and selective scheme of modernization pursued in subsequent colonial policy. 17

For the poor, illiterate rural masses of India this effective incarceration in their traditional mold had little perceived consequence. It was the wealthy elite and educated urban middle class who aspired to join a more worldly modern society but were, with increasing intransigence, denied the right to change. The vain attempt of the colonial regime to control its indigenous subjects by containing them within its fixed and largely fictitious idealization of the "real India" eventually compelled these small but powerful factions to take up the anti-imperial cause of Indian nationalism.

In the middle years of the 19th century, meanwhile, British India had become an outlet for the surplus of the prodigious economy of newly industrialized Britain. This included capital, manufactures, technical know-how and professional labour. In the domain of engineering India was perceived for a time as a forum for diffusing "progress" and thereby sustaining the growth of a profession which, with the end of the British


17 This is the central argument of Francis Hutchins' important ideological study of British Indian social history and culture. See F. Hutchins, The Illusion of Permanence: British Imperialism in India. (New York: Princeton, 1967). See also Stokes, English Utilitarians in India, and Metcalf, Aftermath of Revolt.
railway boom in the 1840's, had begun to outstretch its domestic market.

The arrival of the civil engineering profession on the colonial Indian scene was marked dramatically by India's own railway construction boom, in the 1860's. Carried out largely by private railway companies under the direction of independently contracted consulting civil engineers, the latter were encouraged to believe that they had sustained their place in the vanguard of British enterprise and technological progress; a position they hoped to exploit more generally in India. However, the global economic malaise of the 1870's threw colonial development policy into another gear. Railway development was thereafter to be far more tightly controlled by Government, under the direct planning and superintendence of the PWD. To secure any professional turf in India, civil engineers were compelled to confront and ultimately conform to the bureaucratic methods and modes of reasoning of the military engineers who had created that department and with whom they now had to join ranks as colonial civil servants.

The competition between civil and military engineers within the Public Works Department was to provoke a heightened consciousness of their respective professional identities and values. This reinforced the military engineers' predilection for authority and system, at the expense of the civil engineers' privileged individualism, and underscored an increasing concern for standards, rules and regulations.

Standardization:

After the comparatively short spurt of new development in the 1860's and early 1870's, largely focused on the construction and consolidation of a transportation and communications infrastructure, there was to be little further technical change of any general nature in British India, up to the very end of the regime some 75 years later. Rather, the colonial engineers hastened to standardize explicitly the architectural conventions they had developed over years of building in the subcontinent, along with the various formal and technical improvements they had most recently devised in their effort to rationalize a built environment in which the European colonial community could thrive effectively in the enervating climate of India and carry out its
administrative functions with efficiency and system. Design standardization served to parameterize both the architectural product and the processes by which it was conceived and executed; it confirmed expectation, certainty, familiarity; it simplified design decision-making, if not excluding it altogether; it enabled relatively few engineers to exercise control of many projects widely distributed over a large territory.

However, this seemingly willful abstention from further innovation was not necessarily an optimal strategy from the point of view of economic rationality. This strong-armed option for standards had more to do with control than with efficiency.

A bias for equilibrium is of course hardly remarkable. Technical change is not routine economic behaviour. It is a general case of innovation, which does not tend to be continuous; a phenomenon of disequilibrium involving possible static inefficiency. 18 The emergence of tacit standards is to be expected in the normal course of development. But the resort to such explicit design standards as were developed in Victorian India, on the one hand, and the general willingness of the colonial community, on the other hand, to adhere to that utilitarian architectural vision even where not specifically prescribed by standard plans, was indeed exceptional.

I will argue that this behaviour may be explained, at least in part, by the practice specific modes of reasoning through which these buildings and design standards came into being in the day to day operations of the Department of Public Works. But, the development and institutionalization of that methodology, and the departmental organization in which it operated, cannot be properly understood without a broader historical consideration of the conceptual framework in which they evolved; specifically the condition of cognitive dissonance 19 and change in the metropolitan social context of the second half of the 19th century, from which colonial service offered some respite.

18 Shumpeter emphasized the essentially random intentionality of the innovating individual entrepreneur, in this regard. See Jon Elster, Explaining Technical Change, 112–130.
19 Elster, Explaining Technical Change, 86.
Engineered stasis; the colonial paradigm of control:

Engineers, along with other colonial servants in Victorian India, came by stages to share a belief that the Indian civilization they controlled was a radically peculiar object, tradition bound and timeless by nature, hence set apart from the increasingly competitive and tumultuous metropolitan world of Progress.

At a moment when the established economic paradigm of social progress was experiencing some of the first disconcerting indications of its fragility and the unforeseen complexities and constraints to which that model would have to be adjusted in future, colonial development presented a seemingly uncomplicated and imminently manageable task by comparison. That such could be perceived to be so simple belied the parametric rationality which underscored the policy and practices of a colonial regime that had captured power in India with relative ease. The British perceived no significant competition from an indigenous society they believed to be bound by Nature to its own traditional hence predictable patterns of behaviour, according to prevalent notions of European racial and cultural prowess. 20

But this seemingly ideal condition of dominance presented a paradox. To exploit the situation, with the full force of their technological know-how, would have inevitably entailed significant changes for a society they preferred to believe was destined to languish in a medieval state of development. This would not have been a parametrically rational course of action. A technologically transformed society would potentially present a whole new ball game, a transformation of the prevailing

20 The contemporary metropolitan understanding of the notion of "modernity", according to authors such as Foucault and Rabinow, was historical; the era when "Man" himself finally appeared as an object of knowledge, and as a knowing subject who sought to know the social world and its human actors as social beings capable of reform. P. Rabinow, French Modern: Norms and Forms of the Social Environment, (Cambridge Mass.: M.I.T. Press, 1989), 18-19. By the later years of the 19th century, however, the distinction between "modern" and "traditional" social orders had ceased to be a question of historical development, for colonial policy makers, but rather a discrimination between those believed to be predisposed to reform, and those thought to be incapable of self-reflection hence self-improvement and change.
parameters, a society no longer controllable under the assumed rules of colonial dependency. It was in the "interest" of the British in India, therefore, to engineer a state of suspended progress. Set apart from a volatile, changing world of competition, and uncertainty, they endeavoured to "construct" and maintain a space of calm, reassuring uniformity, of certainty and control.

The possibility of a permanent British Indian empire had begun to impress itself upon the consciousness of the colonial authorities, once the imperial conquest of India had been consolidated through the technical rationalization of the subcontinent. By the 1870's, the throttle of the technical development process could be pulled back to idle, with momentum conserved thereafter through the framework of codified rules, regulations and standards that the PWD had devised. Behind this sober facade, however, an increasingly fantastic ideology of imperial destiny and glory had been developing. As the contest of Britain with the other imperial powers of Europe intensified dramatically in the last quarter of the 19th century, this ideology became creatively explicit. After decades of near total eclipse by the utilitarian forms and mechanistic norms of an engineering vision of building, "Architecture" was finally to find a place in the scheme of colonial cultural construction.

Modernization in the colonial periphery:

Late in the development of modern European society, and the distinctive conceptual system of "mechanization" from which the nascent modern architecture of the 19th century had sprung, the expansion of European civilization into dependent colonies such as India created a new stage for the reenactment in microcosm of much the same pattern of conflicts

21 Lefaivre and Tzonis ascribe the emergence of "modern" architecture and engineering reasoning to the pervasive conceptual system of "mechanization" in Western European social development. This is characterized, essentially, by the higher standing norm of efficiency; a way of thinking which they trace back to the advent of capitalist economic practices, in Italian Renaissance. L. Lefaivre and A. Tzonis, "The mechanization of Architecture and the birth of Functionalism", Via 7 (1984): 121-144.
and resolutions that had attended the original process of modernization in European culture. However, the cultural production of European imperialism was, in various ways, a mirror of metropolitan society rather than just a simple extension. As in a mirror image the colonial pattern had a symmetrical but opposing, retrograde relationship to the original. Foregoing the "universe of precision"\textsuperscript{22} into which British engineers had originally sought to incorporate India, as they had England over the preceding century, the buildings they designed conformed increasingly to the criteria of convention rather than context; conceived less as "tools" for environmental amelioration and change than as representations of an established spatial and social order which they served to define and conserve.

If this "middling modernism"\textsuperscript{23} was not intentionally repressive, it embodied a paradoxical notion of development bereft of any prospect for significant change.

This "reflexive" colonial experience of modernization in the architectural development of Victorian India was, in interesting ways, a preview of the crises of modern architecture and modern culture a century later. The challenge posed by the conspicuous aestheticism and representational intent of the flamboyant imperialistic architecture which architects and engineers began to design in the final decades of the British Indian regime, to the institutionalized norms of utilitarian building they had previously championed, begs comparison with the demise of the Modernist orthodoxy in architectural design practice in the final quarter of this century.

Colonial history has much to tell us about the social complexities, institutions, and conceptual systems to which European expansion gave

\textsuperscript{22} Picon invokes Alexandre Koyre's famous formula—"from the 'approximate world' to the 'universe of precision'"—to summarize the conceptual change he describes in his study of French engineering thought and practice, from the 18th to the early 19th century. By the middle of the latter an inherent paradox in the quest for technical optimization had become apparent to the French as well. Picon, French Architects and Engineers, 312.

\textsuperscript{23} Rabinow, French Modern..., 358. I borrow Rabinow's opposite characterization of the technocratic mode of conservative social engineering undertaken by the French in their own colonial planning and building endeavours.
rise, but which were to return "Home" in the twentieth century following the breakup of the empires, to complicate the increasingly universal, cosmopolitan culture of the "globalized" social order of in the late 20th century. As the European colonies and dependencies once functioned as workshops and as laboratories for the remote dissipation of structural pressures in the evolving metropolitan societies of modern Europe, so historical inquiry into that phenomenon provides pertinent insight toward the more comprehensive and critical understanding of modernity and its problems with which we are at present so preoccupied.

The inquiry into the problematical issues of rationality, design standardization, and environmental and social control in the modern architectural experience, pursued here, can be viewed in a particularly relevant light. I would propose, as a cautionary tale concerning the "sustainability" of a design practice and its supporting conceptual system. For all their shortcomings, the norms if not the forms of the British Indian Public Works Department have indeed prevailed in the public sector building practices of the ex-colonial countries of the Indian subcontinent, to this day.

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Summary: In this introductory chapter to the case study we have surveyed the principal historical developments to be analyzed in later chapters, and outlined a preliminary cognitive historical interpretation of the relations between the increasingly institutionalized design practices of the British Indian engineers in the second half of the 19th century, and changes in the respective general belief systems of the colonial and metropolitan societies.

In Part III this interpretation is substantiated and developed in detail through close readings of the historical design documentation in which the interplay and conflicts between the conceptual and normative frameworks of design reasoning of the PWD engineers can be discerned. The following three chapters of Part II establish the preliminary grounds for that interpretation through further, detailed description of the design content and historical issues surrounding the case. We consider, respectively, the buildings and culturally specific built environment produced by the PWD engineers; the development of the "normative" social and institutional frameworks in which those engineers operated; and, thirdly, the basis of their conceptual frameworks in the ideologies, pedagogies and "traditions" of the rival civil and military engineering professions of mid-19th century Britain.
CHAPTER 4

CIVILIZATION OF THE BRICK BUNGALOWS AND BOUGAINVILLEA SORT
THE TYPICAL BUILT ENVIRONMENT OF BRITISH INDIA

Introduction: In this and the following two chapters we develop a multi-faceted preliminary description of the contents and contexts of the case on which the cognitive historical interpretation of the institutionalized design reasoning of the PWD engineers, developed in Part III, will depend. We begin with the most "external" and ostensibly explicit facet: the built artifacts of that design reasoning process. The general range and character of the peculiar proto-modern built environment built by the PWD for the British Indian colonial community is described; and working hypotheses are established concerning its formal development, its operational criteria, and ostensive utility in the historical context in which it was developed, and the qualitative criteria by which its users judged its performance.

We proceed first to develop a comprehensive preliminary description of this architecture, both of its general spatial order at the level of the individual "compound" and in colonial settlement planning, and of its generic elements and forms. In later sections we consider the historical derivation of this Anglo-Indian building practice, the apparent rationale behind its particular forms and styles, and the "logic" of design implicit in that building practice which the engineer-builders of the Indian PWD evidently exercised in their development of the colonial built environment.

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The anomy of the planned environment: an initial impression

A distinctive colonial building vernacular was already well evolved in India by the middle of the 19th century, where our present historical investigation begins. The following disconsolate description of "Anglo-Indian architecture", in the 1860's, would suggest that the familiarity of the British colonial community with this standardized built environment was so intimate it verged on contempt:

Who does not know the sense of desolation that comes over one at first sight of some of our Indian cantonments, the straight and dusty roads, the rows of glaring white rectangular barracks, the barn-like church, differing only from a barrack in the presence of a square tower and classical (!) portico; the Roman Catholic chapel ditto, only smaller and with bright green doors all round.

Then the houses, evidently built after the model of the barracks...High bare white-washed walls, a barn-like roof, with
perhaps a dirty ceiling cloth shaking in the wind; a dilapidated plaster floor, and square holes cut in the walls doing duty as doors and windows. One exception alone is there to this puritanical simplicity, in the fire-place, which is evidently an offspring of the genius of the native mason, and consists of a grotesque mass of ornaments which would perhaps be more effective if unblackened by the smoke from the ill-constructed chimney.\(^1\)

The typical "modern" buildings of British India were puritanical in the austerity of their simple volumes and stark white-washed finish. Regardless of variations in arrangement and proportion, and the range of different functions for which they were designated, they confronted their occupants and observers with the numbing monotony of a homogeneous, absolutely predictable built environment in which each building was derived from the same generic prototype. A Spartan ethic of discipline and simplicity seemingly proscribed innovation and individuality. Settlements were hardly distinguishable one to the next, the same cartesian grid of civil and military "lines" laid out again and again, with only incidental variation, on the tabula rasa of the Indian plains.

The vocabulary with which this standardized colonial landscape of the 1860s was described, we might note, could easily have served the critique of functionalist Modern Architecture and planning of a hundred years later. The desolation experienced by the colonial officer in his planned and standardized built environment was evidently not unlike the anomie attributed to the mass-produced "Alphavilles" and "Levittowns" of post World War II Europe and America.

1. THE SPACE OF THE COLONIAL COMMUNITY

The characteristic building types designed by the Indian PWD were rarely built in isolation. They were the elemental components of an equally canonical class of artifacts deposited in the Indian landscape by the colonial builders: the "civil lines" and military "cantonment" which together comprised the so-called "station", the characteristic settlement type of the European colonial community.

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Fig. 4.1. "Our Station". The typical Anglo-Indian civil station, as depicted in G. Atkinson, *Curry and Rice*, 1859.
Fig. 4.4. Lahore and Environs. Source: The Imperial Gazetteer Atlas of India. Oxford: Clarendon Press. 1931.
The Anglo-Indian station was that peculiar collection of dusty red- and white-washed buildings swallowed up in the shimmering heat and somnolence of the mofussil (provincial India) which furnished the physical setting and cultural-cum-conceptual framework for the Anglo-Indian fiction of Kipling, Forster, Flora Annie Steel and others. With its spacious array of bungalows, its modest public offices, courthouse and church; and the clutch of topi-sporting English men and ladies, their Indian servants, and the strange ballet of race, class and gender prejudiced rituals they performed within that exclusive settlement space; the Anglo-Indian station was the cradle of the unique sub-culture of the ruling elite of colonial India.  

In the scheme of colonial administration, the station was the local seat of government for the particular political jurisdiction in which it presided, as well as the residential enclave and cultural preserve of the British officials and other Europeans engaged in private business in that locality. Minor stations (the large majority) were essentially civilian settlements—"civil stations"—which supported the elementary machinery of the district level administration—revenue collection and the courts—on which the day to day operation of the Empire depended. Stations of greater political or strategic importance, such as regional and provincial headquarters and those adjoining the larger Indian towns and cities, were usually military stations as well, partitioned accordingly into distinct civilian and military sectors.

The latter so-called "cantonments" were essentially permanent army camps in which military personnel, and their various civilian "followers", resided and conducted their routine peace-time training.

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2 Anthony King's study of Colonial Urban Development (London: Routledge, 1976) remains the most rigorous and dependable sociological description of that colonial sub-culture, with respect to its relationship with its built environment—in the paradigmatic case of the North Indian "stations" and "cantonments". Colonial settlement planning in other regions of the Indian Empire, and had local peculiarities which sometimes differed significantly from King's model.

Among the many publications of a more popular nature, on that theme, the oral history of the everyday life and manners of the British in early 20th century India, compiled by Charles Allen, Plain Tales from the Raj (London: Andre Deutsch and B.B.C., 1975), and the companion volume, Raj: A scrapbook of British India, 1877-1947, (Harmondsworth: Penguin, 1979), are both useful and entertaining.
activities. However, they were not secured by any defensive works, in the
general case, and were often directly encompassed within the greater
settlement area of the European station as, for example, at Allahabad or
Benares (figs. 4.2, 4.3). Alternatively, they were laid out as virtually
autonomous settlements, much like modern day military bases, several
miles removed from the principal settlement areas of the "native" city
and adjacent civil lines (fig. 4.4).

A third distinctive residential-cum-occupational sector of the
larger stations, that emerged in the second half of the 19th century with
the development of the Indian railways, was the so-called "railway
colony". Straddling the railway lines--as these typically cleaved their
way between the old town core and the verdant expanse of the suburban
European station—the orderly, hierarchically graded quarters of the
racially heterogeneous pool of railway workers negotiated the spatial,
cultural, and racial gaps that separated the higher status European
officials and military officers from the Indian populace.

By contrast to the dense congestion of typical Indian urban
development, the exclusive civil lines and cantonments of the British
were exceptionally expansive, though rarely did the average station
actually accommodate more than a few scores of European officials, their
dependents and Indian servants. The quintessential building type of the
station was the bungalow, of which more later. But it was the
comparatively vast multi-acre garden "compounds" in which each such
dwelling and official building was set, the tree-lined avenues, and the
general orderliness and propriety overall, that figure most prominently
in impressions of the station environment. Charles Allen, a "Raj"
chronicler who began life in British India towards the end of the
colonial period, offers the following description:

Beyond the railway station there might be an area of no man's
land, perhaps a maidan (open public ground) partially enclosed
by European-style offices and public buildings. From here a
broad mall would lead into the civil lines, with carefully
laid-out roads, neat, shady verges and very often a 'Company
bagh' (public garden) complete with bandstand. Nearby would be
the church (C of E), the station club and most of the senior
officials' bungalows. Further down the mall there might be the
police lines and beyond that again the military cantonment,
with its own lines, its garrison church, its bazaars and parade
ground. 3

In the especially exclusive space of the cantonment, where planning along with public decorum were strictly governed by a special military code of regulations, 4 the sense of order and propriety was all the more expressed. For the novelist, Mulk Raj Anand—in his autobiographical recollection of life in the Punjabi cantonment of Mian Mir (Mean Meer) at the beginning of this century, as the young son of a non-commissioned "native" officer—the overwhelming greenery of the cantonment had a connotation very different from the comforting nostalgia for the bucolic charms of English country lanes and gardens that it evidently fostered for the homesick British. To the Indian subaltern, it was perceived as an inviolable barrier between the British officers and the Indian soldiers they commanded; emblematic of the rigidly classified social hierarchy that the alien environmental norms and design standards of the Europeans served to impose on the colonized population as a whole:

[T]he whole atmosphere of the cantonment was dominated by the superior, exalted white sahibs, who lived rich lives in sequestered bungalows, curtained off and protected from the dust, the flies, the native by tall privet hedges... 5

On one side of our house are the straight barracks, where soldiers live, on the other side are the bungalows of the Sahibs, with their gardens, white-washed and still, and hazy with their mysteries before my eyes. Dividing the barracks and the bungalows is the road lined with casuarina trees, which

3 Allen, Raj..., 57.

4 The Cantonment Code (first enacted by the Government of India in 1864) spelled out the rules and regulations for cantonment planning, construction norms and specifications, etc., as well as for day-to-day operations, administration, and public order within such jurisdictions. The authority of this Code was later reinforced with a more comprehensive legal regime instated with the Cantonment Act of 1889. This was created to establish and clarify the paramountcy of military considerations in settlements primarily intended for the occupation of troops and, in the interest of the soldier—who was subject at all times to military law—to maintain a special form of municipal level law that would also bring the civilian to a certain extent under the same regime of discipline and control. H.W.C. Carnduff, Military and Cantonment Law in India, (Calcutta: S.K. Lahiri & Co., 1904), 463-549.

stretches from end to end of the horizon.  

Cantonments were the most distinctive instances of the colonial settlement pattern; the most extreme contrast to the spatial order of traditional Indian urban development. (See fig. 4.4, plan of Lahore: city, civil lines, and cantonment). The development of that military settlement type was, moreover, a telling indicator of the strategic and political rationale that the British brought to bear in their colonial administration of India. But, despite the role it came to play in shaping the European colonial sub-culture in isolation from the indigenous society it existed to control—both spatially and conceptually, as the above reminiscences imply—the original concept of the Anglo-Indian cantonment appears to have evolved, in fact, from the practices of the indigenous regime the British superseded. Let us pause for a moment to consider how this came about.

The development and diffusion of the cantonment as a general settlement pattern:  

Consistent with institutions developed by the British in many other areas of colonial practice and policy, the Anglo-Indian cantonment was the product of an expedient adaptation of an established indigenous precedent to the changing requirements of the European rulers.

By the end of the 18th century the colonial regime then administered by the British East Indian Company had come (by guile, and opportunism, and relatively limited military campaigning) to preside over a large portion of the Indian subcontinent.  However, it was then faced with the challenge of maintaining effective control of that territory, which began to surpass the scale of even the greatest of the earlier dynastic empires of India; this with the aid of only a fraction of the soldiers that the

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6 Ibid., 7.
7 Unless otherwise indicated, the following sub-section is a synopsis of equivalent accounts in Davies, Splendours...; King, Bungalow..., Colonial Urban Development...; and Nilsson, European Architecture in India...
8 A more detailed historical sketch of pertinent developments in the mid-19th century, is developed in Chapter 5.
Mughals had mustered for their imperial armies, and only a small number of British officers to command them. In these circumstances it had become apparent that the mobility of the army—its readiness for rapid deployment wherever trouble dictated—was the key to sustaining effective potency. It was therefore expedient to keep the majority of the troops permanently mobilized "in camp", as it were. The impressive historical legacy of urban fortresses and fortifications of both Indian and European design, which had previously served as strongpoints and stepping stones in the incremental process of European conquest, were henceforward occupied merely to neutralize their potential tactical and symbolic utility in the event of indigenous revolt. In the protracted process of imperial consolidation and control that preoccupied the British Indian administration in the 19th century, military power—and increasingly, civilian political authority as well—was vested in the comparatively ephemeral preserve of the suburban cantonments.

The earliest Anglo-Indian cantonments were evidently little other than "standing camps". Such were initially pitched under canvas or other indigenous forms of temporary shelter, and generally laid out on a classic military grid pattern according to straightforward functional and hierarchical criteria. These were gradually converted to more permanent construction, usually beginning with brick bungalows for the officers, the native sepoys (soldiers) building their own huts of mud or sundried brick, thatch and other semi-permanent materials.

In the 1780's such permanent camps were already described as town-like in their proportions and features, and by the middle decades of the following century the architecture of key cantonment buildings such as barracks and military hospitals had become quite substantial indeed, as rationalized and up-graded throughout the country according the design standards developed by the PWD (as will be discussed in later

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9 The word "cantonment" is a proper technical term in the English language for a "standing camp". However, constant use in British India, and so little elsewhere, caused it to be virtually appropriated as an exclusive Anglo-Indian concept by the end of the 19th century. Hobson-Jobson: A Glossary of Colloquial Anglo-Indian Words and Phrases. Yule, H. and A.C. Burnell, eds. (London: John Murray, 1903), s.v. "cantonment".

10 Ibid.
chapters). But despite the growth and architectural evolution of this settlement type, the expansive, regimented spatial order of the original "camp" concept generally survived as the most distinctive and universal characteristic of the cantonment environment.

Whilst this cartesian regularity of the typical cantonment plan had obvious generic affinities with the army camps of other military states going all the way back to the Romans, more immediate Indian precedents have been suggested. According to Davies, the concept of the cantonment arose from the Mughal practice of governing peripatetically from a roving royal camp; a precedent which could seemingly explain the direct historical relevance of the camp-like settlement pattern of later colonial urban development, for both the civil and the military factions of the colonial community.

The camp of the touring Mughal court was a veritable tent city, according to a description from the early 17th century. The camp covered an area of some twenty square miles and was organized like a town, topographically and socially, with every member and servant of the imperial entourage, high and low, allotted his proper place in the scheme. As the British gradually usurped the power of the declining Mughal regime in the following century, and with that the responsibility for the government of the country, they were pragmatic in their opportunism and initially sought to assimilate as much as was efficacious to the established order. The existing legal and administrative systems, and many of their traditional institutions, were simply taken over by the British including—as Davies suggests—the institution of the touring government camp.

At the local level of the administrative districts, the British did in fact adopt the practice of peripatetic government. But the rationale was nothing but practical it would appear; their pretensions to represent authority extremely modest by comparison to the great camps of the

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11 Sastri proposes the Vijayanagar empire of South India. K.A. Nilikanta Sastri, A history of South India (Madras, 1955), 296. As cited in S. Nilsson, European Architecture in India..., 77.

12 P. Davies, Splendours..., 77.

13 Account of Thomas Roe (1616), one of the first British emissaries to the Mughal Court, as cited in ibid, 77.
Mughals, and the spectacular "imperial assemblages" and "durbars" which were staged in the later Victorian era to revive the awe and splendour of that imperial tradition on behalf of Britain's mounting delusion of grandeur as a global imperial power. In the day-to-day business of district administration, the civilian colonial bureaucracy—imbued with the political economy that pervaded the Whig-Libertarian paradigm in British policy in the first half the 19th century—had much the same concern as the military to optimize the distribution of limited instruments and agents of European authority. Consequently, the principal officials at the local and regional levels of the administration—the district heads or so-called "collectors", circuit judges, executive and superintending engineers, Inspectors-general of jails, etc.,—were obliged to tour their respective jurisdictions on a regular basis; receiving petitions, gathering information and revenues, and directly administering judgments and directives, as they went along.

In the case of the collectors and those other officials who were required to tour the smaller towns and villages of the districts, a travelling camp (albeit of very modest size) was the actual seat of government for several months each year. In the general case, however, the government camp, like the military camp with which it so naturally elided, became a permanent settlement in the form of the generic district station, with or without an actual military cantonment adjacent. The local officials continued to tour their districts "under canvas" in the appropriate season, but the increasing number of higher ranking officials such as circuit judges and superintending officers of one department or another, and their military equivalents, would expect to camp, as it were, in more solid digs at each successive station on the tour of their respective "circles" or "divisions". Thus, whilst the officialdom themselves maintained the tradition of peripatetic government, the parallel institution of the "camp" was rationalized for the requirements.

14 B.S. Cohn, "Representing Authority in Vistorian India," in Hobsbawm, E. and T. Ranger, eds. The Invention of Tradition, Cambridge: Cambridge University Press, 1983. See the further discussion of this theme in Chapter 8.

15 We will consider the implications of this political and ethical background for the development of the British Indian polity, in the next chapter.
of a modernizing regime, increasingly dependent on the ease, efficiency and consistency of communications. The familiar spatial order and essential facilities of the "camp" were institutionalized accordingly in a standardized built environment which was more or less reproduced at every station.

We have now considered the historical and practical relationships between the common settlement pattern of the cantonment and civil station, and the perennial mobility of the colonial officialdom. However, this does not necessarily explain the conspicuous separation of the European community from the native towns and cities to which such stations were almost invariably attached. Nor does it fully explain the peculiar affinity of the British for a settlement pattern that so clearly expressed the hierarchical order of their own colonial community; in which the discrimination between the different "castes" of European colonial servants was almost as consequential as the gulf between the races.

Davies proposes that the cantonment "...represented the first stage in the physical separation of the rulers and the ruled which characterized the Raj; a phenomenon which at its best promoted an aloof incorruptible government and at its worst, arrogant ideas of racial superiority."\(^\text{16}\) Although, as we have seen, the cantonment concept was specifically adopted by colonial military planners to deal with the evolving logistic and strategic criteria that they began to face in the late 18th century, the self-contained, hierarchically explicit, neatly zoned and distributed spatial order of the cantonment, and the acutely self-conscious social order it engendered, were to have a broad and profound impact on colonial urban development in India generally, in the final century of British rule, from a sociological as well as an urbanistic point of view.

The social and political histories of British India from the middle of the 19th century forward were significantly influenced by the delusions and conflicts that derived from this spatial/conceptual schism. However, the role that this social environment may have played in

\(^{16}\) Philip Davies, *Splendours of the Raj*, 77.
representing such divisions, or indeed in driving the historical processes these exacerbated, is not perhaps as obvious as one might assume. As we will observe in later chapters, the actual builders had little prescience—at least initially—as to the post-hoc interpretations their actions might inspire. Nor is it surprising, perhaps, that they had no clearly overriding object to their design efforts. The increasingly explicit assimilation of the colonial built environment to the planning norms of the military cantonments, over the course of the 19th century, is most effectively explained, it would appear, in terms of multi-functionality.\(^\text{17}\)

The pragmatics of maintaining control over the colonized society were surely considered in the planning of the colonial environment. There was no mistaking the fact that the majority of the troops and resources of the British Indian Army at any one time lay languishing in cantonments far from the frontiers of the subcontinent and the largely imaginary aggressors presumed to threaten the sovereignty of the Empire. The real enemy from which the colonial rulers recoiled in their suburban enclaves, were their own Indian subjects, on whom the guns and British troops in the cantonments were constantly at the ready to contain and subdue.

But whether the colonial builders had such a clear idea of their object in articulating the social hierarchy and divisions of their own community so clearly, is not so certain. Indirectly, design policy-makers may have acted in part to protect the vested interests of the colonial authorities in formal prestige and spatial exclusivity, over fellow countrymen of lesser status. But the more explicit intentions appear to lie generally in more mundane matters of utility which can be discerned only through closer scrutiny of the parameters and objects that the

\(^{17}\) In this multi-functional sense, we might concur cautiously with Markus' notion of spatial planning as an analog of a conceptual system. See, in particular, T.A. Markus, "Buildings as Classifying Devices," Environment and Planning B: Planning and Design 14 (1987): 467-484. The military cantonment—like the multi-norm conceptual system of authority and system which came to frame the design reasoning of the PWD engineers more and more rigidly in later years—was a settlement planning model that answered to a variety of functional criteria. The relative significance of racial segregation or uniformity of appearances as planning norms, versus the security and efficiency of proximity to communications, among other advantages of the cantonment, varied with the general state of belief and concerns of the colonial community.
engineers and policy-makers responsible for the design of these environments actually addressed. At that level what we may call the "cognitive utility" of their design reasoning is revealed.

The case of the cantonment, which we have begun to examine in preceding few pages, is a significant starting point for this line of inquiry. The original development of that military settlement pattern, and its subsequent adoption as the norm for civilian colonial settlements, are indicative, respectively, of a design reasoning that was essentially opportunistic, and a colonial sub-culture for which the values and norms upheld in the corporate conceptual system of the military were evidently reassuring. These two tendencies—an essentially heuristic design reasoning, and the convergence of civilian and military conceptual systems in the institutions and norms developed by the colonial community—will be encountered repeatedly in this study.

The ubiquity of the standardized station environment:

As a class of settlements, the Anglo-Indian station was limitless, in a sense, for the ubiquity and redundancy of the standard buildings and layouts of such settlements throughout the subcontinent, engendered a continuity and familiarity from one station to another that could scarcely be escaped by any member of the small, socially isolated and highly self-conscious community of British colonial servants for whom "the station"—wherever that might be—was home.

The standard building types and planning conventions of the station were a generally unquestioned fact of the colonial life-style of the British in India; instantly familiar in any corner of the sub-continent to old hands and novices alike. So little was surprise anticipated, nor indeed desired, that regulations were even introduced at one point to standardize the labelling of all buildings and streets on an identical numerical scheme such that any cantonment in India might be immediately familiar and negotiable to any military personnel, at any place in the country. Even far beyond India, in fact, the imperial tourist of the

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18 PWD (Mly Wks) Circular No. 100 of 1862; PWD (Mly Wks) Circular No. 20 of 1865; PWD (mly wks), Fort William, April 7, 1863, re. "Numbering of Streets in Military Cantonments." [NAI]. The experiment was fairly
late Victorian era, like the globe-trotting patrons of MacDonald Restaurants' "golden arches" a century later, could expect much the same mundane but dependable comforts of a travellers' bungalow and "the club" in virtually every corner of the tropical world as the tried and true pattern of the Anglo-Indian station was reproduced by British and other European administrations in their colonies and protectorates in Africa, Asia and the Caribbean.

In his account of a long and mesmerizing journey on the Upper Nile, as one example, Rudyard Kipling could not disguise his paradoxical sense of both disappointment and pride when, deep in the heart of the "Dark Continent", he alighted from his boat at an all too familiar outpost of "...civilization of the brick bungalows and bougainvillea sort."¹⁹ With his worldly readership of servants and celebrants of Victoria's far-flung empire, Kipling could confidently employ this cursory word-image of the typical colonial station as a mnemonic shorthand capable of evoking the whole colonial sub-culture, and the steady march of British imperial progress throughout the tropical world.

However, not all were convinced that such a homely representation of British civilization was worthy of its greatness. Bartle Frere, the Governor of Bombay from 1862 to 1867 and a vociferous campaigner for a modern architecture of metropolitan sophistication for India, was particularly disparaging of the artless utilitarianism on which the building tradition of British India had resolved. In was his opinion that "...an ordinary Indian station is as nearly as possible like a nightmare of umbrellas in bricks and mortar. Be the materials bricks, stone, or timber, they are put together so as to afford shade and shelter, and

short-lived, however. In 1865 the officers of the PWD were petitioned as to the success of the new system of nomenclature (see: PWD Circular No.29, March 29, 1865). A further Circular (No.96, Oct. 5, 1865) later that year communicated the collective conclusion that the standardized system was "...generally considered inconvenient, and not readily intelligible." The PWD Secretary was therefore instructed to order its discontinuation and to direct a return to the familiar old system of naming key roads after their directions (eg. Delhi Rd., Kanpur Rd., etc.) and others after men of esteem or heroism.

¹⁹ Rudyard Kipling, "The Riddle of Empire", in Letters of Travel, 1892-1913 (New York: Doubleday, 1925), 255.
nothing else."^{20}

On home turf in India, Kipling himself was less charitable in his estimation of this ubiquitous built environment than he had been in Africa (and even more succinct); in a word, it was "bungalowsome".^{21}

To Victorian sophisticates, with their eclectic aesthetic sensibility, the redundancy of this standardized architecture and its flawed functionalism were surely perceived as oppressive and banal. But few could bring themselves to be so sincerely concerned with the deficiencies of this dowdy vernacular as were those few with a professional stake in its design such as the Royal Engineer, Major Medley, with whose morose observations we began. By contrast, popular commentators among the colonial community tended to make light of the mediocrity with which modern times and their higher "civilizing mission" in India obliged them to make do. As the following passage illustrates, veteran "civilians" were even inclined to entertain themselves by penning self-mocking introductions to their motley little burghs for the benefit of the uninitiated:

...that square white-washed edifice, with an excrescence at one end, looking for all the world like an extinguisher on a three-dozen chest!—what is it? You may well ask. It is the church! a regular protestant building! protesting against everything architectural, aesthetic, ornamental, or useful; designed and built according to a Government prescription. Next to it is our assembly-room and theatre; just beyond you see the hospitals; then comes the racket-court, and to the left is the well-stocked burial-ground. This is the course, where the live splendour of [the station] resort when shades of evening close upon us. There is the bandstand, and this is the station bath. On the extreme right are the barracks, for you must know that Europeans man the guns of our battery that is quartered here. That is the artillery-mess, and opposite lives Stickerdoss, who sells Europe-goods, and can accommodate you with anything, from a baby's bottle to a bolster.^22

^{20} From a talk presented by Bartle Frere at the Architectural Museum in London in 1870, as reported in Building News, (June 7, 1870). Quoted in T. Roger Smith, "Architectural Art in India", JSA (March 7, 1873): 283.


^{22} as quoted in Michael Edwardes, Bound to Exile: The Victorians in India (London: Sidgwick and Jackson, 1969), 64.
Like any caricature, this satirical sketch of the typical station environment of the mid 19th century errs perhaps in its exaggeration. But the essential fidelity of the description is corroborated by the various other impressions we have considered in the preceding pages (see fig. 4.1, above); so too the curious sense of ambivalence of the colonial community with regard to this infinitely predictable planned environment. For all the blandness and redundancy of that "prescribed" architecture, however, this last colourful description indicates a certain diversity at the level of the functional, if not the formal, make-up of the typical colonial settlement.

Let us now move inside that space and examine the architecture of these mundane buildings of the Anglo-Indian station at closer range.

2. ANGLO-INDIAN BUILDING PRACTICE: ELEMENTS, AND CONVENTIONS

Apart from certain grand public buildings erected in the exceptional cases of the presidency towns of Bombay, Madras and Calcutta, the civil buildings of British India rarely incurred more than a minimal outlay on design, construction and maintenance. The principal explanation most readily offered by apologists and critics alike was the temporary nature of the typical colonial servant's commitment to life and service in India. "No Englishman is a settler in India", insisted one India-returned practitioner in an address to the Royal Society of Arts in 1873 concerning "Architectural Art in India". "We do not transport ourselves, our houses, and our modes of life to that country. We only go there for a term of years, and consequently, looking upon the whole thing as temporary, we put up with that which in a real colony would soon be superseded." The buildings that did get erected were "motley...modern (and made) no pretension to architectural character."23

Construction norms of the generic Anglo-Indian building:

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The architecture produced by the public works engineers was indeed a "modern" intrusion on the cultural landscape of India. The ranks and ranges of new PWD designed offices, public buildings and staff quarters were spare in detail, austere in their volumes and symmetries, clone-like in their standardized replication.

This paucity of architectural diversity and character was regarded as an unavoidable outcome of the particular limitations that prevailed in British India on the means, both material and cognitive, with which these buildings were produced, and of the basic technical constraints such were obliged to address. Much as metropolitan architects admonished the principle, it was one of those peculiar facts of the colonial Indian situation, as Major Medley explained, that "...the Architect and Engineer are generally one, and he also is the constructor as well as the designer." 24 The climatic parameters of building in India posed the principal technical challenge:

The requirements of climate necessitate modes of construction differing from those in England, but until lately we have not managed to combine coolness and ventilation with much Architectural beauty. A reform in this respect is however in progress. We are at least erecting handsomer buildings, and attention is being directed towards cooling them effectually. The difficulties are great, for what does for the moist heat of the Lower Provinces will not answer for the fierce dry heat of Upper India... 25

Medley described this evolving utilitarian tradition of building that the British had devised in India over the years, in a short list of basic attributes. The typical building had no upper-storey; its roof was either thatched or tiled, or else flat and covered with brick and lime plaster; in the former case the heavy timber members of the roof structure were left exposed to monitor vermin such as white ants or termites; walls were rarely papered, generally plastered and white-washed; floors were paved with lime plaster or brick on end, instead of perishable wood; doors were numerous and invariably double.


25 Ibid.
Finally (though Medley was not convinced himself) verandahs fully
enveloping each such building were generally considered to be
"indispensable".  

Expanded, contracted, extruded, compounded, and variously
partitioned, blocked-in or opened out, the relatively versatile building
system implicit in these simple specifications was used to generate
virtually all of the typical buildings described above. However, if there
was a generic "building type" from which that general range of buildings
and these basic principles of construction could be said to have derived,
it was the Anglo-Indian bungalow. To appreciate the origin of this
peculiar building tradition, and the various technical and cultural
innovations it came to embody over the years, we need to look closely at
this most ubiquitous and representative of Anglo-Indian architectural
inventions.

The bungalow: the generic Anglo-Indian building type

In a generally inadequately studied domain, the Anglo-Indian bungalow has
been the object of considerable popular and scholarly interest over the
years. In the most recent and thorough study of that building type, King
explains that this quintessential symbol of European colonial enterprise
in the tropics was actually far from European in its architectural
pedigree; "...a product of cultures in contact, an indigenous mode of
shelter adopted and adapted for Europeans living in India."  

26 Ibid. Medley later rationalized his objection to verandahs, along
with certain other conventions of Anglo-Indian buildings, in his proposal
for a technologically more appropriate and environmentally effective new
prototype barrack for the Indian Army, in the hot dry plains of North
India. See the discussion of Medley's design reasoning in this regard in
Chapter 7, below.

27 The reader is referred to the seminal studies of Anthony King: The
Bungalow: the production of a global culture, (London: Routledge, 1984);
and Colonial Urban Development: Culture, Social Power and Environment,
(London: Routledge, 1976). King draws on numerous historical sources
including F. Buchanan The History, Antiquities, Topography and statistics
of East India, 3 vols. (London: W.H. Allen, 1838); Grant, Anglo-Indian
Domestic Life (1849); and J.L. Kipling, "The origin of the bungalow",
Country Life in America, 19, 8 (1911): 308-310.

28 King, Bungalow..., 14.
The term "bungalow" has been in common usage in the English language since the middle of the last century to refer, broadly, to any house or villa of a single floor. By the beginning of the present century that generic definition extended very broadly indeed to refer not only to the typical dwellings occupied by Europeans residing in India and other tropical countries, but to the ubiquitous suburban detached house type of Britain, North America and Australia (among other industrialized societies) which—by a complex dialectic between colonial and metropolitan cultures, that King documents and analyses at length in his study—had been diffused worldwide through the international market economy that emerged in part from the wealth generated through the British Empire. Nevertheless the narrower class of building to which the word "bungalow" originally referred, had been derived through long and continuous usage by British and other European colonists in South Asia, from a traditional indigenous dwelling type which is widely constructed in rural areas of Bengal even to this day.

The derivation of the Anglo-Indian bungalow from indigenous norms:

What the earliest European traders learned to refer to as a "bangla"—according to the proper Indian word for the common hut of the Bengal peasant—was generally a very modest structure constructed of impermanent materials such as mud, bamboo and thatch. In the particular style of construction peculiar to Bengal, the predominant feature of such dwellings was their characteristic roof form, described in an early 19th century account as "...a pent roof constructed of two sloping sides which meet in a ridge forming the segment of a circle so that it has a resemblance to a boat when overturned..."29

The traders and soldiers who established the initial footholds of the European powers in India built their principal coastal settlements in a manner as closely allied to contemporary metropolitan norms of design as local resources and the architectural knowledge and building skills they brought with them from Europe would permit. In their more

29 Francis Buchanan in 1810, in F. Buchanan The History, Antiquities, Topography and statistics of East India, as quoted in King, Bungalow, 18.
provisional building efforts "up-country", however, they were compelled to improvise and make use of whatever local norms prevailed. Beginning with mere temporary "pavilions" for ceremonial functions erected in a "bangla"-like fashion with bamboo and thatch, the inland building tradition of the colonial Europeans sprung quite naturally from the indigenous tradition, it appears, simply for the sake of expediency. The itinerant traders and political agents who first travelled upstream to represent European interests did little more than camp in the ephemeral structures their "native" followers threw up for their temporary shelter. As the colonial purpose of the Europeans in India became by degrees more concerted and long ranging in its prospects, however, their building practices became accordingly more permanent and culturally differentiated from the indigenous norms.

By the middle of the nineteenth century—the historical departure point for the present study—distinctions had clearly emerged between the traditional and the evolving European traditions of bungalow construction (fig. 4.5). The typical Anglo-Indian bungalow developed for the use of the European servants of the East India Company was a more substantial structure by comparison to its humble Bengali precedent, of more solid construction—usually sun-dried brick, plastered and white-washed with lime. The roof was still the predominant feature, but the Anglo-Indian type tended to be crowned by a disproportionately large pyramidal or hipped-gable roof, thatched for the most part in earlier years; a material that later gave way to ceramic tile following the implementation of fire-prevention regulations by the PWD. The eaves of the roof extended well beyond the low walls of the single storeyed structure, and were supported at its extremities by a colonnade of wooden posts, in the general case, or simple square or cylindrical columns of plaster-faced masonry in the more conspicuously classicized variants of the building.

30 King, The Bungalow, 36-37.
31 As per a directive circulated in the PWD in 1863, all "well-constructed" buildings, civil and military were to be built, or re-roofed if existing, with a suitably inflammable material, in lieu of thatch. This specification was not required but recommended for kutch (semi-permanent) buildings as well. See: Governor-General's Circular No.41 of 1863: Proceedings of the Right Honourable the Governor-General of India (PWD-Military), Simla, Aug.28, 1863. [NAI]
type. The semi-contained space between this outer colonnade and the solid
inner walls was the all-important "verandah". In addition to its role as
the principal living space of tropical European architecture—a form of
passive air-conditioner—this space could also be partially blocked-in or
partitioned to contain a variety of more mundane activities and services.

In the most basic exemplar of the Anglo-Indian bungalow, the
interior of the building consisted of one central room or hall. The
surrounding verandah space was often enclosed at the corners for use as
private bathing rooms, in the front; storerooms or dressing rooms in the
rear; the residual lateral spaces closed-in, similarly, to serve as
bedrooms. More elaborate buildings could have separate living and dining
rooms under the main roof, as well as larger bedrooms or similar spaces
designated for use as the office of the inhabitant. Such structures could
be quite substantial. For instance, the plinth area of typical bungalows
constructed in the Punjab in the first half of the 19th century was as
much as 7,000 square feet (84 x 84). Verandas were generally ten to
fifteen feet deep, and the dining room in one such bungalow was described
in a contemporary account as no less than 28 by 40 feet. Even in the
larger, multi-roomed versions of the type, however, the layout was
usually quite simple. Internal corridors and service spaces were not
generally required, as all rooms opened out onto, and thereby
communicated through, the ubiquitous verandah.

Interior spaces were lofty, rising high into the barn-like cavity of
the roof structure but for a thin screen of (usually) white-washed coarse
cotton fabric stretched taught across the space from the cornice of the
walls. This screened the inhabitants from the dust and vermin that
filtered down from the thatch whilst simulating (sometimes quite
convincingly, historical accounts suggest) a more refined interior.
Before articulated roofs became the norm later in the nineteenth century,
allowing for clerestory windows and ventilators in the upper walls, light

32 Although overhanging eves and stoops were a formal feature of the
most likely Bengali prototype for the Anglo-Indian bungalow, King
suggests that the name and the institution of the verandah in the
architecture of tropical Asia were probably of 15th century Portuguese
origin. Ibid., 30.
33 Ibid., 31-34.
Fig. 4.5. The derivation of the Anglo-Indian Bungalow from the indigenous "chauyari" and the curvilinear-roofed 'banggolo', of Bengal. According to Grant, Anglo-Indian Domestic Life. 1849. Source: Anthony D. King, The Bungalow, 1984.
Fig. 4.6. The bungalow 'classicized'. (c. 1845). Proposal for a Canal Officer's Bungalow at Roorkee. One of several sketch proposals for a 'pukka' bungalow of decidedly grand pretensions, by the Executive Engineer of the Ganges Canal Headworks, at Roorkee, Richard Strachey. Strachery was later to serve as chief Engineer and Secretary to the Government of India for the P.W.D. Source: private correspondence of Richard Strachey, IOR: MSS EurF127/296.
and air were admitted only indirectly, through doors and windows opening on to the verandahs. Interior spaces were therefore quite dark in general. 34

The mature Anglo-Indian bungalow of the mid 19th century was sufficiently distinctive in its apparent independence both from European prototypes and from any immediately obvious Indian precedent, to provoke several different Victorian writers to posit theories as to the "true" origins of the type. Some, such as J.L. Kipling (the art-teacher father of the famous author), were not convinced that the Anglo-Indian bungalow had actually descended from the indigenous dwelling type at all. To Kipling—no fan of the engineer-builders of British India, and what he saw as their philistine utilitarianism with regard to the Indian building crafts—the essential form and concept of the Anglo-Indian bungalow suggested nothing so much as a permanent, thatch and brick version of the standard "service tents" in which the early European residents of India had made their homes for much of the year as they engaged in their "nomadic" military, administrative or trading duties. The only connection with the indigenous building tradition that Kipling accepted was the probable practice early on of covering the canvas of such tents with sun-proof thatch or "bangla" (as he chose to interpret the term)—"...the name and the thatch were all we took," he argued. 35

On the basis of the documentary evidence in contemporary drawings and descriptions, and consideration of the political economy of the case, however, King sides with the more widely held theory that the Europeans in India appropriated and gradually modified the norms of indigenous dwelling-house construction to their needs. Kipling's explanation credited the British with more autonomy than they evidently had as builders in India. In view of the fact that they were almost entirely dependent on the labour, building knowledge and resources of the indigenous population—whatever cultural models of architecture the British carried out to India in their heads, or indeed whatever circumstantial innovations they might have conceived of (such as Kipling

34 Ibid., 30-34.
surmised)—they could hardly have avoided the "native idea" permeating the design and execution of the buildings they caused to be erected.  

The bungalow and the evolving colonial polity in the 19th century:

With hindsight the appropriation of the bungalow by the European sub-culture is seen by some as one of the more obvious indicators of the deep structural changes in the economy and society of India that the colonial expansion of Europe had instigated. Unlike the traditional dwelling type from which it had evolved—or, for that matter, the dwellings of early European emigrants in other colonial contexts such as the Americas, or Australia—the Anglo-Indian bungalow was never associated with basic farming activity, despite the multi-acre compounds by which they were generally surrounded (on which several families of indigenous cultivators might easily have subsisted). Those who resided in the spacious bungalows of the colonial sub-culture—the civil and military authorities, along with the wealthy "planters" of cash crops such as tea and indigo—were a class of managers whose dwellings usually performed the dual operation of residence and administrative workplace. "In the later colonial bungalows," King observes, "this function of political economy was reflected in the 'office', an institution in the plan which remained long after colonial rule. It is the office which, for Marxists, would symbolize the appropriation of surplus value."  

It is perhaps no surprise, however, that Victorian professional observers of Anglo-Indian building practices remained naively impervious to the political economy of the colonial context. The contextual parameters of the building design problem were perceived almost exclusively in physical terms; the challenge of accommodating Europeans comfortably and productively in the enervating environment of the tropics. Bolstered by the growing authority of medical science, and what

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36 Ibid., 28-30.
37 Ibid., 36-47. For an outline to a more general material historical critique of modern tropical architecture and its colonial antecedents, see: Shanti Jayawardene, "Reflections on Design in the Context of Development", Himal, 27 (March 1988): 70-75.
38 King, Bungalow..., 36.
was alternately revered and denigrated as a virtual cult of pragmatism in the English approach to problem solving (themes we shall discuss at length in later chapters), the inordinately capacious, single-storey layout of the standard Anglo-Indian bungalow was rationalized at the time as a strictly practical, indeed necessary technical solution to the living requirements of the British in India.\textsuperscript{39}

The classicization of the bungalow vernacular:

The paradigmatic form and specifications of the Anglo-Indian bungalow, as described so far, had fully evolved by the beginning of the 19th century. With minor technical improvements, buildings of this type were constructed up to the end of the British Indian administration, and after. As a broader class of buildings, however, the bungalow continued to evolve in that period. The most conspicuous development in this regard was the emergence of a distinctly classicized variant of the type. With the consolidation of the military and administrative control of the East India Company over the greater part of the Indian subcontinent, in the first half of the 19th century, a more self-consciously "European" architecture began to be diffused in-land. Generally, this did not approach the scale or pretensions of the neo-classical town houses and suburban villas of the wealthy traders and officials residing in the principal colonial port cities of Madras and Calcutta. (Bombay only emerged as a major port in the 1860's; an era marked by the new architectural fashion of the Gothic revival.) But, the bungalows built in particular for the European officialdom in up-country stations, were increasingly to dispense with the great hipped roof of the standard type in favour of the distinctive terraced roof and arceduated verandah of a "pukka"\textsuperscript{40} classical variant.

Initially, the spatial planning of pukka bungalows was very similar

\textsuperscript{39} Ibid., 46-47. See also King, Colonial Urban Development.

\textsuperscript{40} From the Hindi word "pakka", meaning: ripe, or well-cooked; and hence, substantial. Habituially contrasted with the word "cutcha"—i.e., impermanent—one of the most common uses in which the word became specific in Anglo-Indian usage was that of a building of brick and mortar, in contradistinction to one of inferior material such as mud or thatch. Hobson-Jobson, s.v. "pucka".
to the thatched variety. With time, however, liberation from the particular geometrical and structural constraints imposed by the heavy timber roof structure of the more traditional type, allowed the colonial builders to apply more directly the familiar canon of European classicism, and its compositional conventions. (fig. 4.6).

King draws attention to the subtle but significant conceptual change indicated by this formal transformation. Whereas, previously, the term "bungalow" had minimally referred to a cutcha building of the form we have described—a technical criterion which did not necessarily discern between European or Indian users—the term in later years was applied indiscriminately to flat-roofed brick structures as to the thatched or tiled roof standard type. According to contemporary dictionary entries, the essential definition of a bungalow had by then evolved to connote "the most usual class of house occupied by Europeans in the interior of India." Formal attributes were now only a secondary consideration. As King points out, "...the major criteria of definition are [no longer] related to what it is but rather, who it is for... [A]s a result of the colonial process, the ownership of the term has been transferred." 41

A more directly significant implication of this changing idea of the bungalow, and its diversifying form, from the point of view of our present concern with the evolving norms of colonial building in Victorian India, was an increasing concern with permanence. The hard-edged solidity of the pukka bungalow can be seen to have reflected the ideal of a permanent colonial polity that the British in India came to envisage with increasing conviction through the course of the 19th century, as their political and military control of the sub-continent was more and more firmly secured. But it would be too simplistic, I believe, to interpret the pukka bungalow as a forthright representation of the millenarian intentionality of the mature British Raj. Rather, the development of that variant of the type may be more accurately explained as a by-product of the increasingly concerted efforts of the colonial administration to consolidate the formal means and procedures through which it could assume direct responsibility for the provision of the ever growing number of buildings it required to accommodate its expanding operations.

41 ibid., 37.
Through the long period of conquest and consolidation of the British Indian empire, under the administration of the East India Company, responsibility for government works and buildings had been delegated to the engineer-officers of the Company's Army. With workmanlike practicality, they had further developed the assimilated bungalow type through countless instantiations, confirming its status as the accommodation norm for both military and civil officials. In this latter regard, we may surmise that the application of a classical gloss to such buildings was motivated quite simply by its utility in identifying official status and, by comparative degree of elaboration, in distinguishing the relative rank of the occupant.

In the final years of the Company regime and thereafter, the employment of such norms and devices in the building efforts of the government engineers became more conspicuously rigorous and methodical. The reorganization in 1854-55 of all official works and building activity under the single agency of the Department of Public Works was the most conspicuous factor. But the overall reorganization of the colonial regime that followed just three years later considerably augmented the mandate of the new department and, circumstantially, the pressures under which it operated. Above all, it marked a sea-change in the mentality of the entire community of British colonial servants in India. The ideal of imperial glory, and (more immediately) the attendant notions of duty and collective discipline such appeared to induce, had further significant consequences for the evolving "vernacular" of the engineer-builders of British India.

In the next chapter I will develop these points more adequately in a more thorough examination of the developments and controversies that surrounded the political watershed of the Indian Mutiny of 1857 and subsequent imposition of crown rule.

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42 King claims that this distinctive "vernacular" developed by the army engineers under the aegis of the Military Boards (the military agency mandated with responsibility for managing all official works and building projects, under the regime of the East India Company) came to be known widely (and reviled by some) as the "Military Board Style", Ibid., 38. However, I have not found any contemporary references to such in those terms.
The notion of an imperial architecture:

In the decades following the Mutiny the mandate of the British to rule and to develop India as they saw fit (from their presumed position of cultural and technical superiority) was asserted with a marked new degree of confidence and self-consciousness. The model and the image of imperial Rome were never far from mind. 43

From the point of view of the metropolitan based architectural profession in the 1860's (which had so far been all but excluded from the possibility of practicing in colonial India), it was high time for imperial Britain to begin building a a genuine architecture in India worthy of its greatness. But how might art and an appropriate monumentality be instilled in a tradition that, to that point, had condoned the building of merely serviceable structures derived from the local vernacular? An answer to this rhetorical question was offered in an address to the Royal Institute of British Architects in 1868. "The solution", the speaker proposed,

lies first in the adoption of a type essentially European; and secondly, in the retention, and blending with it of such admissible features as are to be found in the best styles of architecture that have been elaborated already in tropical climates.

Had we a distinctive modern English style, we ought, unquestionably, to use it in our colonies, as the Roman did in his colonies, with such changes as local circumstances made necessary. But though this is, unhappily, denied us, there are in existence distinctive European styles... [A]s our administration exhibits European justice, order, love and law, energy and honour, so our buildings ought to hold up a high standard of European art. They ought to be European, both as a rallying point for ourselves, and as raising a distinctive mark of our presence, always to be beheld by the natives of the country. 44

This was not the first time that such sentiments had been expressed, and


certainly not the last. It was not until the turn of the twentieth century, however, that the notion of rallying the will of the colonizers through an architecture consciously representative of imperial power, would actually be pursued as a matter of colonial government policy. In the 1860's it remained an unrequited aspiration of the architectural profession in particular; articulated, notably, in counterpoint to the more pragmatic design ethics of the engineering establishment in India, whose power over the physical development of the country was then at its peak.

The methodical building tradition that the military engineers had derived—epitomized by the pukka bungalow, but which applied to almost all the conventional civil and military building types erected for the colonial sub-culture in India was precisely what the architectural profession sought to transcend; the inverse of what it envisaged as a principled imperial architecture. It was a "type" essentially Indian, in which the most practical generic features had been retained and enhanced while admissible features of European classicism had been blended in. It not only failed to speak for European architectural culture with authenticity, but (a more basic failing) it represented the fundamental misconception of architectural design of which Victorian architects accused their engineer colleagues; the notion, that is, that one could simply "put architecture" to construction—what engineers were inclined to regard as the more essential aspect of building, and the exclusive product of their own professional labours. 45

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45 The latter complaint was articulated more explicitly in a further critique of contemporary building efforts in British India delivered to the R.I.B.A. in 1874. The speaker in this instance was among the first Fellows of that institute to have actually gained experience in professional service in India in the employ of the colonial administration. "There is a peculiar notion," he explained, "which has taken possession of many engineers—not in India alone—respecting the work of an architect. During my employment under the Chief Engineer of Bengal, I was sometimes ordered to 'put architecture' to engineering work; and I think you will hear me out in saying—as I told the Chief—that if his "engineering" did not contain the essence of architecture no power on earth could ultimately add it. I have had occasion, more than once, to hear that constructive details, such as girders, stone lintels, brick walls and arches, are engineering specialties, and that the architect's work is limited to the coat of cement with which the facades of buildings are sometimes dressed. This
In later chapters of this study we will consider more thoroughly the case for the aestheticization of British colonial building norms, and the aspects of cognitive change in the colonial society, and among the particular professional groups concerned, which eventually made way for the architectural profession to play a more direct role in British India. For the present, however, my object in introducing the issue of architectural aesthetics at this point has been to emphasize, by contrast, the distinctly utilitarian mentality that appears to have prevailed in the energetic building efforts of the colonial administration in the crucial middle decades of the 19th century.

The formal conventions of the Anglo-Indian building vernacular:

Let us, now, leave the specific case of the bungalow and return to consider the essential characteristics and compositional conventions of the Anglo-Indian building "vernacular" that the departmental engineers distilled from that generic building type.

As a generic solution to the climatic and technical parameters of building in India, the mature prototype of the bungalow served as a formal and conceptual framework for virtually all of the smaller building types developed by the PWD. The stepped section of the prototypical bungalow, with its low verandah and peripheral rooms (if any) and its lofty central space, recurred constantly. Expanded and extruded lengthwise, the same section was also the basic generator for larger buildings such as barracks and hospital wards. (fig. 4.7).

While the British accommodated themselves considerably to the climatic exigencies of building in both the ferocious dry heat of the Indian plains and the excessive humidity of the tropical coasts, the basic spatial conception of their buildings remained quite alien to the traditions of Indian dwelling and settlement planning. Modeled on the formal and climatological configuration of the bungalow, the large majority of colonial buildings were detached, outward-looking structures

fallacy is probably the origin of the many extraneous horrors with which engineers are often pleased to spoil their works. William H. White, "On government architecture in Bengal", Transactions of the R.I.B.A. (1873–74): 150.
Fig. 4.7. Hospital for a regiment of native infantry. (c.1830). Source: BA-Map No. 3350.

commanding large surrounding compounds of empty space, and indeed requiring such to insure adequate ventilation through the deep verandahs with which they were almost invariably ringed.

The majority of the indigenous building types of India had evolved in a diametrically opposite manner, spatially, and in terms of social operation. In these an essential inward-looking conception of the built environment tended to place a void in the form of a courtyard or atrium at the centre with more enclosed chambers and opaque walls containing and defining it. Through their internal porosity and openness to the sky, these indigenous buildings were quite bearable climatically, while obviously far more efficient in space use. Above all they engendered privacy and security for their occupants, which the conventional European dwellings could not insure without the benefit of constant surveillance and spatial isolation.

Various explanations may be offered for this differentiation. Among these the political imperative of distinguishing between rulers and ruled
is obvious. Even the most modest Anglo-Indian bungalows shared with the most grandiose residencies and government houses the same fundamental relationship in the colonial social environment. Regardless of the diverse functions these buildings served, each represented, in a collective and fundamental sense, the authority of the ruling elite. The colonial polity automatically vested authority in the British occupants of such buildings by virtue of their innate membership in the ruling culture. A technical rationale concerning salubrity and physical comfort may have reinforced the cultural preference of the English men and women in India for living arrangements that reproduced to some degree the familiar and spiritually comforting ideal of a house in a garden, as conscious determinants in the planning of European settlements in colonial India. But the political character of the bungalow configuration was inherent in the particular variation of the type that satisfied both practical and nostalgic prerogatives.

The building traditions of India furnish many examples of building types of comparably authoritative connotation: the forts and palaces of princely rulers, the havellis of wealthy urban merchants, the compounds of zamindars (land owners) amidst their fields and rice paddies. However these are conventionally inward-looking; a void within a solid. The adoption of the outward looking variation of the type by the British in India was indicative, it would appear, of their distance as a sub-culture from the Indian masses they ruled.

The matter of "style" in the Anglo-Indian building tradition:

Suburban, if not entirely rural in their typical settings, volumetrically simple with only spare, economically rendered gestures of classical detail, the PWD produced buildings of the British-Indian colonial stations had a particular affinity to designs of the late eighteenth century and Regency period for mundane rustic building types -- cottages, barns and stables -- and the colloquial gate lodges and out-buildings of the country-houses of the English gentry. Numerous pattern-books of plans and views of idyllic prototypes for such structures were published by aspiring English and American architects, draftsmen and builders in this period. Several of these publications were sent out to India over the
course of the nineteenth century and found their way into the libraries of the PWD Secretariat and of the Thomason Civil Engineering College at Roorkee.

As the principal (and for several years the only) engineering school in India, the Thomason College was responsible for producing a large proportion of the subordinate technical staff of the various provincial Public Works Departments of British India. Numerous draftsmen in the PWD drawing offices were Roorkee graduates. We can only speculate on the potential influence of these rustic designs on the impressionable young men of Roorkee. But at least seven different published folios of designs for simple cottages and rural buildings alone (in addition to several other folios of designs for more aristocratic rural villas and "country seats") had been acquired by the college library by the beginning of this century. 46

Departmental records and proceedings offer no explicit evidence of direct borrowings from such published sources. However, the generic affinity of whole ranges of typical PWD building efforts with certain of the simpler designs, and more particularly still, certain characteristic principles of composition and detailing developed in the diminutive rustic fantasies of J.C. Loudon or T.D.W. Dearn, for instance, encourage further speculation as to why. Certain of J.M. Gandy’s 47 simplest designs have considerable affinity with buildings of similar purpose, or elements of larger compounds, built by the PWD in British India throughout the 19th c. 48 One is reminded in particular of the most rudimentary third


47 Better known as the gifted draftsman responsible for most of John Soane’s evocative drawings.

48 In 1805, J.M Gandy published a particularly intriguing folio of plans entitled Designs for Cottages, Cottage Farms and other Rural
class railway station buildings-cum-station master's quarters and of the basic units combined in "lines" and compounds of lines-man's quarters on some of the western Indian railway lines. (See comparative illustrations in chapter 8, below). There was a certain logic, it appears, to the accommodation of the "native" and menial Eurasian and European employees of the colonial system, particularly its technical services, on the same standards as British farm labourers. However, as far as I have ascertained, Gandy's publications were not among the several such pattern books of designs for rural buildings, cottages etc., that the department kept in its library or, perhaps more importantly, that were kept in the library at Roorkee.

Most of Gandy's competing peers in the business of compiling collections of designs for cottages, etc., aimed their efforts at precisely the class of ne'er-do-well Englishman who might have been recruited for the Company's civil service in India. While the aristocracy built their great country houses with the services of the greatest architects, lesser aspirants to modest professional fortune if not fame targeted the fantasies of the rising middle class for a little piece of the country and/or a small but elegant retirement nest. The parallels are obvious between the many and varied palladian and occasional Gothic designs proposed for this market, and the minor palaces and villas erected by prosperous Anglo-Indian nabobs in India and upon their retirement to England. Certainly some of these books did make their way out to the colony, and may well have provided direct models for what was built by official or private agency, in various individual cases. But


Fig. 4.8. A Dwelling of one story, for a man and his wife with a family of children; having a cow-house and pigsty attached. Source: J. C. Loudon. *An Encyclopedia of Cottage, Farm, and Villa Architecture*. London: 1842.
**Fig. 4.9.** Proposed Assistant Engineer's Bungalow at Rutlam, on the G.R.N.R. Bombay PWD (Railway Branch), 1898. A 'modern' pukka bungalow of the late 19th century. Note the use of iron in the "jack arch" roof construction, the increased use of glass, and general degree of enclosure in such later Anglo-Indian buildings obliged the increased use of 'chajjas', the traditional Indian sun-shade. The Source: B.A. Map No. 8005.
Fig. 4.10. Section details of quarters for native Clerks at Hotgi Junction, (upper) and Quarters for Eurasians and Parsees at Bhosawal Station. Source: Bombay PWD (Railway branch), 1884.
the more general affinity with the paradigm of 18th neo-classicism in English architecture is certainly sufficient to explain the same, regardless of the diffusion of any particular publications. What is most interesting about such patterns books is what they tell us about the later phases of neo-classicism—a period when social change and professional economics appear to have driven architectural designers and speculators to stretch, distill, and compress, the palladian classical canon to its limits in the invention of new and more marketable building types. Again it is in the most rudimentary examples of such that we see the clearest affinities with the spartan manner of building developed by the Military Boards and PWD in India. Once the flab and ornament of the full-blown idiom were boiled away, essential principles of taxis, symmetry and the simple blocky forms that remained could begin to be re-composed in a methodical and more pedestrian manner.

A preliminary observation on the prescriptive mode of design reasoning of the British Indian builders:

The quantity and seemingly excessive specificity of the designated building types for which standard plans were duly produced are noteworthy, particularly when we consider the narrow similarities between so many of these. The motivating factor for such a plethora of marginal variations on the same simple themes was quite certainly not an investigation of subtle architectural nuance. With few exceptions, one would be hard put to discern any well articulated aesthetic intentions in these standard designs. It was, rather, the relentless logic of classification in the highly stratified social order of colonial India that obviated the allocation of a precisely and proportionately graded set of residential and work spaces for each "scheduled" employee of the government. "Within the hierarchy everybody knew exactly where they stood. Every rank was set out in order of seniority in an official Warrant or Order of Precedence and the exact position of every single military and civil officer in the country — together with details of his pay — could be found by glancing through the appropriate Civil or
Military Lists." Past a point -- particularly for the droves of lower
grade, low-salaried Indian and Anglo-Indian employees of the colonial
bureaucracy and its para-governmental services such as the State
Railways, and the Post and Telegraph Department, whose dwellings were
usually no more than a room or two in a linear terrace of contiguous
units -- the all-important status differentiation from one type plan to
another could be determined as much by a small variation in the quality
of the specified building materials as by any formal or dimensional
differences.

When, for instance, it got down to differentiating between "native"
 railway clerk's dwellings and those constructed for the slightly higher
status Parsee clerical class, according to the standards regulated by the
Railway Branch of the PWD, the distinction could be emphasized with a
subtle but galling specification for a mere earthen floor rather than a
more "pucka", and sanitary, surface of chunum. (fig. 4.10). Nonetheless,
complete sets of standard plans for each of such nominally identical
dwelling types were methodically drawn up and reproduced.

Such nit-picking distinctions were arrived at quite naturally, it
appears, when the parameters of the problem are more fully considered.
The first order of concern in determining a standard for a particular
office or dwelling type was the budget. All matters of status, class,
caste and race could in fact be neatly codified in a simple scale of
cost. If one occupied an official dwelling unit, no matter what type, one
rented it at a fixed percentage of their salary. The fixed scale of
salaries fixed the corresponding rate at which each specific rank and
category of government servant was scheduled to pay for his
accommodation. Amortized over a set period of time, and depreciated
accordingly, the maximum recoverable cost for any such employment grade
determined dwelling type could be calculated precisely. Using such
figures as a datum, a so-called "schedule of accommodation" could be
worked out. The highest grade officer or employee, as the case pertained,

51 Charles Allen, Raj: A Scrapbook of British India, 1877-1947,
(Harmondsworth: Penguin, 1979), 45. King provides a selective sampling
from the "Warrant of Precedence" showing, for example, divisional
engineers of the PWD on a par with college principals and the librarian
of the Imperial Library in Calcutta. A.D. King, Colonial Urban
was the starting point. The pre-determined budget for their dwelling type was broken down into a further set of quantities which struck a rough compromise between a maximum number of rooms and/or floor area and a higher standard of architectural material and finishes. Within the narrow limitations of what experience had already provided as a model for a desirable and respectable "modern" dwelling in the tropics, a minimal listing of such quantities and prescribed building materials amounted, in effect, to the actual programme for the standard dwelling type in question.

For each step lower in the schedule of accommodation the quantities and quantified qualities were systematically reduced, the corresponding brief made leaner and meaner at each step. But, as the scale of salaries diminished, and so the corresponding budgets, the differences from one to the next became less substantial and thus more difficult to translate equitably into a readily legible gradation of status in spatial terms. One imagines this acted to narrow down still further the possibility for variation or deviation from the core of spatial norms as it was always easier to eliminate something more at each stage, while simply replicating what still remained of the working norm—to proscribe what could not be afforded rather than prescribe an alternative design that might not be so easily accountable.

*Summary: In this chapter we have taken stock of the general corpus of "typical" buildings constructed by the British in India, in the Victorian heyday of their colonial administration. We began by considering the historical and practical relationships of that distinctive built environment with the evolving colonial community. We then discussed the basic repertory of elements and spatial configurations to which that architecture broadly conformed. Here the discussion focused on the Anglo-Indian "bungalow", the essential prototype from which this building tradition derived. In a brief historical analysis, we considered the appropriation of the indigenous "bangla" and its gradual transformation into the quintessential dwelling type of the expatriate Europeans in India, with a view to the cognitive praxis of that historical process of inter-cultural design innovation. The bungalow had already substantially evolved its classic configuration by the mid 19th century, when the present historical study begins. The increasing range and scale of institutional and residential building types developed by the PWD in subsequent decades owed much to this generic building type. This can be explained by the development of the repertory of Anglo-Indian building norms from the implicit rules of composition, and the rationalizations of
building construction and performance, embodied in the mature design of the bungalow.

The further rationalization of that Anglo-Indian building tradition and its institutionalization in the design practices and standards of the PWD in the second half of the 19th century, will be examined from various perspectives in chapters 7, 8 and 9. Meanwhile, we must discern and describe the historical, social and conceptual parameters that constrained those operations. In the next chapter we examine the development of the normative frameworks--social, political and institutional--in which the technical development of Victorian India was prosecuted.
CHAPTER 5

UTILITYAN TECHNOCRACY
ON THE EMERGENCE OF THE INSTITUTIONAL FRAMEWORK OF COLONIAL DEVELOPMENT IN EARLY VICTORIAN INDIA

Introduction: From the design product of the colonial builders, and the spatial framework which that built environment defined, we turn now to examine the historical factors and related social and political consequences which instigated the development of the normative institutional framework of the Public Works Department, through which the technical development of Victorian India was undertaken. The pivotal event in this regard, for the colonial administration as a whole, was the Revolt of 1857. We begin by considering the causes and conceptual implications of that conflagration.

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1. CRISIS AND CONCEPTUAL CHANGE: THE CONSEQUENCES OF THE MUTINY

In the early summer of 1857 the colonial enterprise of the British in India was deeply shaken when the isolated revolt of a Sepoy regiment at Meerut ramified with lightning speed into a mutiny by the majority of the native troops of the Bengal Army. Within weeks the civilian population of much of northern India had also risen up, some taking arms in league with the mutineers, the majority succumbing to the general state of anarchy as the besieged and unprotected civilian representatives of the colonial administration fled their posts. The British did not regain complete control until the end of 1858, and only after a long and ruthless campaign in which horrendous bloodshed was perpetrated on both sides. The British Indian empire emerged from this conflagration physically whole but morally scarred having lost the naive self-assurance with which it had been so casually assembled, and the ardent idealism with which an earlier generation of reformers had sought to "improve" it on their own alien model. The repercussions of the "Mutiny" were profoundly felt throughout India as the victors endeavored in the following decade to consolidate their manifestly fragile hold on their most prized imperial possession.

The call to order occasioned by the Mutiny was instrumental in clarifying the policy of the colonial administration toward the technical development of India. It also brought about a restructuring of the
institutional framework in which this was to be carried out. In a later chapter we will examine specific products of this rationalized planning assault on the colonial built environment in the aftermath of the revolt. Here we will attempt a preliminary explanation of the conceptual parameters of those actions by tracing the evolution of technical development policy in the larger framework of the conceptual and attendant institutional changes in the British Indian administration in the years leading up to the traumatic events of 1857. A brief look at the issues that precipitated the Mutiny and how these were explained by the politicians and pundits of the day will give us some initial bearings.

The circumstances and repercussions of the revolt:

The oft recounted incident at Meerut on the 10th of May 1857 was an outbreak of passion over an issue which had been simmering in the "native" ranks of the Company's armies since the introduction earlier that year of the new Enfield rifle. The special cartridges delivered by the manufacturer for use with these rifles had been smeared with pig fat it was learned when angry rumors among the Hindu and Muslim soldiers, who feared ritual "pollution" from this offensive animal fat, provoked an inquiry. The cartridges were hastily withdrawn. Following a long history of insensitivity to the religious beliefs of the Indian soldiers in the Company's service, however, the incident had excited the fear and suspicion of the troops that their English officers had conspired, by the insidious device of these "polluted" cartridges, to rob them of their caste. New cartridges were subsequently issued which the soldiers were instructed to grease themselves with alternative lubricants, but the sense of mistrust was not so simply alleviated. When, at Meerut on the 9th of May 1857 the new cartridges were distributed to the troops at that station, 85 men refused to accept them. By what was later repented as a rash and ignominious demonstration of stern military justice, these objectors were summarily placed in irons and sentenced to ten years imprisonment each for insubordination. The following day their comrades revolted, freeing the prisoners and setting the station on fire before fleeing to Delhi forty miles distant. There they ensconced themselves in the city fortress of the deposed Mughal emperor establishing a
temporarily secure and symbolically potent base from which the message of revolt was issued across the plains of the north.  

The military uprising was widespread but by no means universal. The sepoys rebelled at all the major stations in the North-Western Provinces and Oudh, where none of the "European" regiments of the Indian Army happened to be stationed at the time. But the loyalty of the Indian troops in the Punjab on the north-west frontier of British India, in Bengal in the east, and of both the Bombay and Madras armies in the west and south, was instrumental in containing the revolt and eventually suppressing it, along side the British regiments of the Indian Army and additional royal troops sent out from England in the crisis.

The civil revolt which followed in the wake of the mutinous sepoys was a more complex and puzzling phenomenon which recent scholarship has described as a pattern of semi-autonomous and variously motivated uprisings triggered by the temporary collapse of the unifying regime of law and order maintained by the colonial administration. The rebels found their most "popular" following among the disaffected populations of Oudh and several smaller princely states of central India which had recently been annexed to British India by a zealous colonial administration impatient for a geographically more coherent hegemony over the sub-continent. In Oudh especially, indignation over the deposing of the Nawab and the imposition of the uninvited British regime with its impertinent and impatient reforms was sufficiently fresh a year after the coup to excite broad based support for the restorationist cause adopted by the Sepoy mutineers, the majority of whom were high caste natives of Oudh itself. In other regions, however, where the legal and agrarian reforms imposed by British rule had been in place for some time, there was no such broad solidarity to the revolt. Civilian implication in the up-rising, and the particular objects of hostility varied widely, determined by complex combinations of social and micro-economic factors such as caste and clan allegiances and local variations in the ecology of the vast riverine tract of northern India. Stokes' later studies have demonstrated that the relative fertility of the land, on which the Indian

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peasants were compelled to pay taxes under the land tenure reforms of the colonial regime, correlated significantly with the pattern of revolt. Cultivators in well watered districts—which were often the fruit of the ambitious irrigation works of British engineers—were generally loyal in their prosperity where their counterparts in more arid regions were ripe for revolt against a regime whose heavy revenue demands they could not sustain. \(^2\) Hostility in such cases was directed as much at the money-lenders to whom the poor peasants were indebted and the new class of absentee landlords to whom their lands were auctioned in consequence of arrears, as at the colonial officials themselves. As such the revolt has been interpreted in terms of "class war". At the same time, however, vertical allegiances of peasants and elites in Indian society, through caste and clan structures and traditional feudal hierarchies, caused entire agrarian communities to stand behind their "natural" leaders. Where such magnates had benefited from British rule, even at the cost of change to traditional holdings and status, they tended to carry their people in support of the regime. Alternatively, the familiarity and stasis of the traditional interdependence between tenant farmers and landed classes had a nostalgic and reassuring appeal for those unsettled by the policies of the colonial administration. In numerous instances aggrieved aristocracy, dispossessed of their lands by their own tenants under the land tenure reforms of the British, successfully inspired these same farmers to revolt against a system that had burdened them with personal ownership and responsibility for the land and the onerous and inflexible demands of the tax collector that came with it. \(^3\)

This portrait of disparate, contrasting responses to the crisis of 1857, described in recent scholarship, has displaced the opposing, politically self-serving theories of the revolt which were maintained through to the end of the British era by imperialist historians and their nationalist counterparts. In both official and popular British accounts of the crisis, the "Great Mutiny" was consistently chronicled as an epic episode in the military history of the Empire while popular involvement

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in the revolt was largely ignored. Polemicists and revisionist historians of the nationalist movement for India's independence naturally emphasized the opposite, portraying the uprising as India's first patriotic war of independence. But the form of the revolt was fragmentary, its climate nostalgic rather than forward looking. Such that there was any unified pattern of revolt between the military mutiny and its various repercussions among the different factions, classes and regional groupings of the civilian population of northern India, historians in the post-colonial era have broadly concurred in the view of the rebellion as a last ditch defense of the old order by those who had most to lose in the new.

Contemporary perceptions of the revolt:

Indian society had been undergoing important changes for many years before the events of 1857-58. These were a function not only of the colonial conquest and the various reforms the British had attempted to impose subsequently, but derived also from the continuing development of social power structures inherited from the earlier Mughal polity. A third factor of change, which has often been understated or ignored in historical studies of this period, was the long history of smaller scale rebellions that, in fact, permeated the century of conquest and consolidation preceding the Mutiny. Resistance to the progress of European imperialism in the developmental stages of British rule was far from a hopeless cause, as it would later be viewed from the supremely self-assured vantage point of the Victorian Raj. Pressure and rebellion operating at all levels of political power within the subcontinent had had a significant impact on the course of development by consistently blunting and deflecting the forces of change which derived from the military and financial needs of the colonial state. The transitional

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4 P. Spear, A history of India, from the sixteenth century to the twentieth century. (Harmondsworth: Penguin, 1978), 143.
5 Metcalf, Aftermath of Revolt, xiii, 62.
colonial society that was emerging was thus a curious palimpsest of both the old order and the new. The administrative apparatus that the Company regime had evolved to govern it was similarly hybrid, less of a "system" than it was a heuristic patch-work of borrowed institutional forms and transferred political ideals compromised in application by countless concessions to local particularities and resistance. The complexity of the up-rising in 1857 was a reflection of the complexity and contradictions inherent in this process of social change under colonial rule. The mutineers and rebel magnates reacted against the uncertainty and dislocation such change had caused. By resorting in their struggle to the symbols and reassurances of a more familiar traditional social order, they were above all, it would appear, seeking to restore social coherency and stability. In their counter-attack the British also sought to make sense of the confused state of affairs, and once control was regained they resolved to put their system back in order.

By virtue of the scale of the uprising, and the temporary military threat it posed to the security of the British in northern India, the revolt of 1857-58 was perceived at the time as a unique event. Sensationalization of the particular tended to discount correlation with the longer term pattern of resistance, and possible "deeper" structural explanations for the revolt. Another wishful contention was that it was merely an opportunistic melee of factional conflicts that posed only a circumstantial threat to the colonial administration. Together, these perceptions tended to contain the apparent crisis within defined and potentially manageable parameters which, above all, cast no serious doubt upon the validity and soundness of the colonial enterprise itself.\footnote{Ibid., 169-170.} For the colonial administrators embroiled in the heat of the conflict and its aftermath, this described a problem for which particular causes could be identified and specific "correctives" administered. For the conservative minded opponents of the predominantly liberal policies of the Indian Government of the preceding three decades, the chaos wreaked by the Revolt was interpreted as a resounding indictment of the administration's radical tampering with the traditional social order of India.

In the British Houses of Parliament the usually tepid interest in
imperial matters (in this period) warmed considerably with news of the Mutiny as the Conservative opposition rose to the fore to challenge Palmerston's incumbent Liberal Government for its handling of Indian affairs. The prevalent theories as to what had precipitated the Revolt clustered around two poles of explanation. On the one hand the Government and its supporters were eager to contain the significance of the incident and attendant recriminations against their radical policies—which had been prosecuted with particular zeal over the course of the preceding decade by ardent reformers in the Indian administration, in several of the regions afflicted by the revolt—within the understanding that it had been a "mutiny", an exclusively military breach of order. The disaffection of the army and a few aggrieved princes should not, they insisted, be misconstrued as a popular rejection of the moral and religious improvement which British public opinion had so irresistibly pressured the Government to pursue in India.

The Opposition lead by the redoubtable Tory whip, Benjamin Disraeli, had a broader and surer plank to spar from, especially as further news of the full extent of the Revolt reached London. The Conservatives, ironically, were the original authors of the "nationalist" theory of the uprising. It was clearly a "national" revolt as they saw it from their almost empathetic perspective of the beleaguered landed classes of 19th century England. The military incident was the pretext but hardly the substance of the rebellion, Disraeli reasoned in his first speech to the Commons on the issue. "The decline and fall of Empires are not affairs of greased cartridges. Such results are occasioned by adequate causes." The real causes, he argued, were the arrogant and intolerant reform measures in both social and religious spheres that the proselytizing Government of India had perpetrated over the previous twenty-five years. The excessive zeal for change had controverted all the original principles on which British rule in India was founded: the respect for traditional laws and customs, and the "principle of Nationality". "Native authority" had been destroyed, and traditional concepts of property had, with religion, been grievously tampered with. The Indian administration

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8 A three-hour harangue delivered on July 27, 1857 upon receipt of the earliest news of the Mutiny. Metcalf, Aftermath of Revolt, 73.
had succeeded only in alienating all the influential classes, who would now have to be wooed back into submission by a return to a policy of respect and conciliation.  

In the Parliamentary debates, and in the subsequent policies of the Indian Government, the thesis of the limited military nature of the revolt, and the evident failures in judgment and communication that had triggered it, was never officially abandoned. The ensuing onslaught of internal reforms to the military and civil arms of the colonial administration bore this out. But most Englishmen, and particularly those in India who spoke from experience rather than partisan viewpoint, acted implicitly as if the Mutiny had been the result of popular dissatisfaction with the British administrative system. The reformers were as widely disillusioned as the conservatives, and in numerous instances drew back from the measures—of land tenure reform in particular—that they had previously advocated. Even while military justice was still being satisfied by the hanging and blowing from canons of several tens of thousands of captured rebels and mutineers, the Governor-General, Lord Canning, (1856–62, later dubbed "Clemency Canning") had set to the more pacific business of pardoning the less heinous of malefactors and retroverting his predecessor’s most resented reforms. Canning directly brought the war to an end in Oudh by buying off the Talukdars, the traditional landed aristocracy dispossessed in the Summary Settlement of 1856, with the promise that they would regain control of their villages and secure a much lighter land-tax assessment.  

The consolidation of a new Raj:

The lessons of the Mutiny, as it was interpreted at the time, were expressed in three resolutions. There was to be closer touch in future with Indian opinion for misunderstanding had proved too expensive. Secondly, the traditional elites were to be identified (or invented) and

9 Ibid.  
10 Ibid., 78–79.  
actively enlisted in the imperial cause through preferential treatment. Finally, great caution was to be exercised in dealing with religion and the traditional customs and institutions of Indian culture.\(^\text{12}\) In short, Indian society was to be defined and preserved as such in the new Raj so the government would be able to get around it more efficiently in pursuit of further imperial development and profits.

The Mutiny served as a catharsis for the British Government, bracing it to proceed with several aggressive reforms to the whole civil and military apparatus of colonial rule in India which had in part been contemplated for some time. The East India Company itself was the first casualty of this campaign, followed by many of its more contentious reforms of the immediate pre-Mutiny period. The Company’s manifest failure to gauge Indian opinion concerning its administrative policy, and the inconsistencies with which such had been carried out in the first place, were held to be just cause to abolish it. But Liberal free-traders and Tory hard-liners alike joined the occasion to trounce the enfeebled anachronism which the Company was perceived to have become as the instrument of Britain’s imperial interests in India.

The free-trade lobby in British politics had already succeeded in abolishing the East India Company’s trading monopoly as early as 1813, but it had retained its mandate to govern the rapidly expanding British realm in India and thereby continue to exploit, if not protect, its commercial interests. Forty-five years later, however, the Company’s trading functions had atrophied entirely, and it continued to operate in effect only as a managing agency for the administration of India subject to the British Government’s direction in matters of policy. As Spear suggests, however, this administrative anomaly was also a scapegoat to divert attention from the general "sins of omission" of the conveniently unconcerned British Government of the past. John Stuart Mill—who like his father, James Mill, had devoted his working career to the enlightened management of Indian affairs as a functionary in the Company’s London head-office—raised a not insignificant plea of defense. This corporation had pursued an honourable and rational course of development, he claimed, which had preserved Indian administration from the whirlpool of British

\(^{12}\) Spear, A History of India, 147-148.
politics. Nevertheless, its governing powers were abolished.\textsuperscript{13} Instituted in lieu of the Company, by the Act for the Better Government of India (1858), was the rather euphemistic new concept of "crown rule". Through the gradual elaboration of the royal cult, beginning with Queen Victoria's benevolent proclamation\textsuperscript{14} of religious tolerance, peace and public works, in the final days of the Revolt, and culminating in the Delhi Durbar of 1877 when Victoria was proclaimed Queen-Empress, the imperial venture of the British in India would be brought considerably closer to the consciousness and imagination of both the Indian and the metropolitan societies.\textsuperscript{15} On the more practical levels of authority the government of the "crown colony" of India was henceforward to report directly to the "home" government, which would increasingly be required to debate and legislate on Indian affairs. In London, the Board of Control with which the Court of Directors of the Company had conferred for periodic Government approval of their policies, was dissolved in favour of a Secretary of State for India, and the Honorable Court itself was recast as that minister's India Council. In Calcutta the Governor-General retained his title but gained the honorific of "Viceroy" with its increase of personal prestige. More significantly the Governor-General's council, and those of the subordinate Governors of the Bombay and Madras presidencies, were increased by the addition of non-official European and Indian members. These small advances in the practice of popular representation were a direct response to the recognized need to gauge indigenous public opinion more carefully.

These formal changes in government were to some extent only an eye-wash, for the underlying institutional structure and traditions of the civil service created by the East India Company remained essentially

\textsuperscript{13} Ibid., 148.

\textsuperscript{14} Proclamation by the Queen in Council to the Princes, Chiefs, and People of India, 1st November, 1858. Miscellaneous records, Public Works Department, Government of India, for the years 1881-1909. (FWD Misc., coll. nos. 16, 23, and 24), (NAIL). An excerpt of that seminal statement appears at the head of Chapter 7.

intact. Only now the district officers would, with an increasingly pessimistic conviction, set about re-entrenching the traditional hierarchies and power structures of the indigenous society; the same "barbarisms" of feudal inequality that previous generations of the civil service had so earnestly attempted to "level". The Indian polity of the high Victorian era would still be somewhat of a patch-work of concessions and exceptions to the rule of systematic administration, and increasingly so, as the politics and diplomacy of "Empire" encouraged the Home government and its agents to meddle more and more in the affairs of the colonial state. Yet, such intervention would be enabled as never before, without compromising the over-all coherence of the revamped regime, by the new paradigm of peace and security and the quantum leap in the efficiency of communications which were rapidly achieved in the 1860s through the more profound commitment to reform and progress in the Military and technical departments of the administration.

For obvious reasons the Indian Army was the object of immediate and major reform. Beginning with the execution or imprisonment of the principal mutineers, and the disbanding of the major portion of the original Bengal Army, the traditional composition of the force was completely overhauled. "Native" troops in the three presidential armies were at no time in the future to outnumber the complement of British troops in the subcontinent by more than two to one. The 16,000 "European" troops of the Company Army were paid off or absorbed into the British Army, which thereafter would maintain a much augmented standing contingent of 65,000 troops in India at any time. The formidable artillery of the old army was largely abolished but that which was preserved was placed exclusively in the charge of British troops in well-fortified and segregated cantonments. Each battalion of British soldiers was normally brigaded with two battalions of Indian soldiers, but the two armies were exclusive racially and in virtually all aspects of staff and protocol.

The significance of communal divisions in maintaining the discipline and managing the loyalties of the Indian troops had been well demonstrated in the Mutiny, and recruiting for the revamped army would concentrate on those regions and martial clan groups that had proven most loyal to the British cause. As in all facets of the new Raj, a sense of
race, caste and tribe was carefully fostered. The Brahmin element from
the north central plains of India, the core of the original mutinous
army, was heavily reduced and its place taken by Gurkhas, Sikhs, and
Punjabis (Jats and Rajputs). The officers remained exclusively British,
but the professional rigor and prestige of this corps was significantly
increased over previous norms. And, with a new resolve "to know their
men", these officers now lived in much closer touch with the troops to
the point of regularly visiting the villages from which they were
recruited and cultivating a sincere paternalistic concern for the welfare
of their people. 16

The reorganized military establishment continued to guard and
periodically dispute the natural frontiers of the subcontinent, but its
primary role in future was to contain and control the internal stability
of India. In many ways this strong arm of Peace both engendered and
depended on the ambitious program of public works that constituted
(certainly) the most concrete facet of the post-Mutiny developments and
reforms. The substantially augmented military expenditure in the new era
had several economic effects of note. It brought about a major increase
in Government outlays, in the 1860s particularly, as the military branch
of the Public Works Department scrambled to increase the scale and
quality of accommodation for the greatly augmented contingent of
European troops in India. This necessitated larger imports of bullion and
resulted in a more rapid circulation of money in the interior of the
subcontinent. The altered strategic concerns of the army in the
post-Mutiny era were also a direct and determining impetus for the
development of the Indian railway system which experienced its principal
construction boom in this same period. Similarly, the development of
specific public works schemes, such as the canal colonies of the Punjab,
was encouraged (somewhat less directly) to favour some of the most
important areas of military recruitment. 17

The establishment of the Public Works Department of the Government
of India predated the Mutiny by just two years. But the great rate of
change, and the excessive new demands that were placed on the department

16 Spear, A History of India, 145-146; Bayly, Indian Society..., 194-195.
17 Bayly, op.cit., 195.
with the wave of reconstruction and new development that followed in the
wake of the institutional reforms of 1858, compelled it too to evolve
substantially in these early years of its operation. However, we will
reserve description of those institutional changes, and the origins of
the Public Works Department, for a more detailed discussion in the latter
part of this chapter.

At this point we might summarize the outcome of the post-Mutiny
reforms in the Government of India as a leaner and meaner approach to
imperial rule. The political stratagems of imperialism would be explored
with increasing zeal in the British Parliament. But, meanwhile, the
Indian administration further consolidated itself as a bureaucracy. The
romance and ideals of earlier generations of reformers had waned in
favour of a cool new utility of mind—a tyranny of law and order, and
technical expertise in which public works rather than public morals or
western values was to be the guiding star of progress. 18 The "utility" of
this stripped down framework for colonial development was more than
merely qualitative. The Utilitarian philosophy of the English
Enlightenment had been directly infused into the civil service of the
Company by numerous disciples of the creed, from Governors-General on
down, in the first half of the century. But the inherent despotism in
Bentham's "philosophic" vein of radicalism had never been fully stomached
by the Liberal political establishment. It took the shock of the Revolt
to dispel its "Whiggish" distrust of power and the altruistic ideals of
reform it had subscribed to in the evangelical enthusiasms of Victoria's
early years on the throne.

The variant of the Utilitarian program of reform that finally
revealed itself openly in the institutions and methods of the new Raj
owed more to the fundamental pessimism of Hobbes than it did to the ideal
of progress toward "liberty", which had grown from Bentham's later
development of the philosophy of the "greatest happiness for the greatest
number". Progress of a concrete and practical sort could be pursued
selectively with a new degree of authority and system, but the deeply
conservative convictions of the majority of experience hardened veterans

18 Spear, A History of India, 144.
of colonial service would equally be accommodated in an authoritarian machine of government that firmly retained the tools of power in the hands of an enlightened few, to rule the many "for their own good".

2. THE BRITISH INDIAN POLITY

To understand the nature and implications of this significant conceptual change it will be necessary to take a somewhat longer historical view of the development of the British Indian polity in the 19th century and the conflicting political philosophies that structured it.

Stokes' reconstruction of the intellectual pedigree of Utilitarianism and its devolution in the Indian arena reveals a subtle and complex process of conceptual change, prone to misinterpretation. Historians have commonly associated the Utilitarian creed with the "reformist" camp of Macaulay's Liberalism and the Evangelism of the Clapham Sect, in opposition to the conservatism of lingering eighteenth century colonial policy (which, in the case of the younger and critically revitalized school of paternalistic administrators, derived its intellectual fire-power from the political philosophy of Burke). In temperament and practice, however, the Utilitarian school of policy in India actually incorporated more of the authoritarianism of the latter than is generally imagined, and only a cool and dispassionate distillation of liberal philosophy—its logical and distinctly unsentimental "intellectual" foundations, devoid of altruism. Utilitarianism was, thus, a rather esoteric creed played out through the dialectic of the two more obvious and opposing camps in contemporary British politics. In India the conservative school, as the attitude of "paternalism", held much better purchase than it could in England itself, where progress towards an industrial society had rapidly emptied it of content (the spirit of feudalism and the heritage of the past as still preserved in the immemorial system of traditional Indian society). This tenacity and lingering relevance tended to divide and confuse the aims of Liberal reformers, particularly to dissociate from it the Utilitarian element. 19

19 Eric Stokes. The English Utilitarians and India. (Oxford:...
The Romantics vs. the Whigs: The context of Liberal reform in the first half of the 19th century

The early stages of the contest between conservative and Liberal schools of policy in British India was marked by the shift from the "Oriental" form and principles of the existing Mughal administration, which the East India Company adopted un-critically in its original take-over of the government of Bengal as a windfall of the Battle of Plassey (1757), to what Stokes qualifies as the "defensive anglicization" of the administrative system by Cornwallis (Governor-General, 1786-1793) essentially to shore-up the rights and freedoms of European venturers and servants against the despotic power with which the Company had initially been invested.

Cornwallis' major legacy was the Permanent Settlement of Bengal of 1793, "...a frank attempt to apply the English Whig philosophy of government... (which) had as its central belief the Whig conviction that political power is essentially corrupting and inevitably abused; that power, to be exercised with safety, must be reduced to a minimum, and even then kept divided and counterbalanced....To the Whig mind landed property appeared as the agency which affected the reconciliation of freedom with order. Itself almost a part of the law of nature, there flowed from a system of landed property a natural ordering of society into ranks and classes..." which Cornwallis maintained was nowhere more necessary than in India (Bengal) for preserving order in civil society. 20

The Permanent Settlement was enacted to fix in perpetuity the government revenues to be collected annually from the land in the belief that such unvarying, un-negotiable obligations would effectively divest the executive element of the administration of all discretionary authority and thus the tendency towards corruption and the misuse of power, which would be safeguarded by the rule of law, as framed into formal legislative enactments by the Supreme Government and enforced by a judiciary entirely independent of the ordinary executive authorities. The most revolutionary, and consequently disruptive, aspect of this

Clarendon, 1959), xvi. Unless more specifically noted, the following section draws broadly from this work.
20 Ibid., 5.
Settlement in the context of Indian administration was the determination to introduce private property rights in land ("the kernel of the Whig conception of political society") to a culture which had traditionally held the land collectively at the level of "village communities". In addition to the division and consequent augmentation of administrative functions which this new system entailed at the level of government, it introduced a new instability into the social order by investing the traditional tax collectors, the zamindars, with effective proprietorship of the lands under their traditional jurisdictions. Empowered and obligated by legal tenure to secure the revenue of the land rather than its viability for its traditional peasant tillers, this new "landed" class of middle-men were thus liberated by the system to break up the traditional order where economic expedient or opportunity called; to sell off or expropriate the land and gradually disenfranchise the agrarian base order of the society. Englishmen were also, of course, enabled by the same token to buy up the deeds to "estates" thereby defined and transform them to whatever purpose their individual commercial will or caprice prescribed, regardless of the peasantry instated traditionally on the land.

The Cornwallis reforms were to be both the base-line and the key dynamic in the twists and turns of administrative policy in the expanding territories of British India over the next half century. The trend toward the bureaucratization of government, alienation from traditional cultural patterns and the idealization of individual rights enshrined in the Whig polity of Cornwallis became identified with the political centre and the comparatively metropolitan mentality of Calcutta and its crass "nabob" (and later "boss-wallah") culture of European traders. That little commercial world, with its sights fixed on the external markets of the imperial world economy, was increasingly detached by physical and ideological distance from the the "real India" experienced (and re-invented in the hagiographic mythology of the later "Raj") on the steadily advancing frontiers of the empire. Self-styled patriarchs such as Charles Metcalfe at Delhi, and later the Lawrence brothers in the Punjab, reacted against the principles and institutional product of the Cornwallis system—particularly its dependence on the new bureaucratic class of Bengali "babus"—setting up in its stead their own benevolent
and ostensibly much admired despotisms armed with the still keen threat of the sword but executed with judicious and expeditious strokes of the pen. 21

If the Cornwallis system can be seen as one offshoot of the abstract rationalizing of the Enlightenment in European thought, the counter-reformation that came to be articulated in the alternative ryotwar system of administration pioneered by Thomas Munro in the Madras Presidency, was its "Romantic" antipode and more than coincidentally allied to the sentiment of Wordsworth and the Romantic poets for the "noble peasant". 22

The coterie of younger men nurtured under the wing of Cornwallis' successor, Wellesley (Governor-General, 1798-1805), who would assume key positions of authority in British India in the 1820's after the major conquest of the sub-continent had been achieved—Munro, Malcolm, Elphinstone and Metcalfe—were the principal avatars of the resistance against the anglicizing effacement of the traditional Indian social order. Imbued with a fullness of both intellectual and worldly experience in the passionate epoch of the Napoleonic wars in Europe and the conception and decisive military consummation of the British Empire in India (concluded with the final Mahratta War in 1818), these men found their personal "centres" in their passionate sense of morality rather

21 It was Lord John Lawrence (1811-79), Chief Commissioner of the Punjab, and later Viceroy of India (1864-9), who is purported to have intoned the famous plea for civilization of the bureaucratic sort: "By which will ye be governed—the pen or the sword?" When confronted with the rebellion of several Punjabi chiefs, in 1848, Lawrence issued a proclamation to this effect to the major landowners of the affected district. Forces were subsequently sent out to quell the rebellion and at every halt these forces met the local village representatives. A pen and a sword were placed before the assembled headmen, who were asked to choose the instrument by which they would prefer to be ruled. The chronicles of Empire record that the pen was enthusiastically grabbed and the rebellion thereby aborted. The incident was perceived by Lawrence's contemporaries as an example of his masterly skills of governance, but it always raised the rancour of later nationalists as a glaring illustration of the patronizing condescension of the British toward their Indian subjects. Sidney and Beatrice Webb. Indian Diary. Niraja Bopal Jayal, ed. (Delhi: Oxford University Press, 1987), ff.2, 109.

22 as distinguished, however, from the more primal "noble savage" of the earlier Enlightenment school of thought of Rousseau and the Whig philosophers. E. Stokes. Utilitarians..., 13.
than the intellect, privileging "action" over cool "scientific" expertise; admiring the conviction and bravery of their enemies of the battle-field and reserving their scorn for the grey legislative's of a depersonalized bureaucracy who would clip the wings of their empire-building ambitions. While they were critical in their appraisal of the newly subjugated Indian states they recognized their own fundamental empathy with the paternalistic authority of the Indian princes and the "simple", "natural" order of respect and subservience accorded those rulers by their subjects. Their's was a relativist position, Romantic but firmly rooted in a conscious and realistic consideration of History. In this regard particularly they can be seen to have derived their creed from Burke and his critical attempt to redeem Whig philosophy from its "superficiality and crudeness". As Stokes argues, "[t]hey brought to the Indian problem Burke's notion of history, that conception which regards human society as a continuous community of the past, present, and future. The Bengal System (of Cornwallis) they saw as the denial of this touchstone of history and experience; it was the ignorant application of a priori political ideas without regard to the history and circumstances of Indian society. It rested on the fallacy that a political society could be constructed anew, on the basis of abstract principles wrung from an alien tradition. They did not deny the theoretical value of the rule of law and division of powers, but they denied that these could be introduced unmodified into India."

Bentham's Philosophical Radicalism:

The Utilitarian political philosophy articulated by Jeremy Bentham, which had its first and most direct application to the administration of colonial India during the term of William Bentinck as Governor-General (1827-35), was in origin authoritarian and thus inherently adaptable to the staunchly conservative polity of the Wellesleyan school of paternalistic administration that had gained the upper hand in Indian government by this time—much as it stood to transform many of the customs and institutions these romantic paternalists had sought to

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23 ibid., 15.
preserve.

Bentham's ideas were a product of the century of enlightened despotism. When, later, the philosopher sided with Democracy, it was an authoritarian mode of democracy he promoted; he did not pause to consider the middle ground, that of Anglo-Saxon Liberalism. As Halevy assessed the philosopher's political evolution, "Bentham had never been a liberal; always impatient of philanthropic reforms." 24 His conception of the nature and exercise of political power sprang from Hobbes: ". . . Government was an artifact, a creation and expression of will. Sovereignty was single and indivisible; its instrument was Law speaking the language of command. Rights had no meaning except as they were a creation of Law; liberty was but the absence of restraint, and found place only where the Law was silent."

Bentham addressed the problem of how Hobbes "Leviathan", the great "machine" of government, was to be controlled by humanity and not enslave it. The nature of the machine and its virtues—which were necessarily to be preserved—was its speed, efficiency, economy, regularity and uniformity. The danger of the abuse of such power was not to be averted, however, by redesigning the machine to temper its speed and efficiency, or worse by breaking it up. Rather, it was essential to insure effective control over the "hands" to whom its operation was entrusted. Such control could be substantially engendered in the machine of government itself by further refinement and fortification through a codification of the law. The human balance in the equation could be fostered by compulsion, by confirming and compounding the responsibility and accountability of those few selected to assume the executive roles of society.

Bentham thus disparaged the Whig principle of the division of powers, and logically extended that indictment to censor the concept of "committees", "boards", and "benches" of collective authority which were only "screens" in effect behind which legislators were prone to hide and evade their executive responsibilities. This was resolved into Bentham's "single-seatedness" principle, and supported by slogans such as:

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"Official aptitude maximized, expense minimized"

and

"Minimize confidence, maximize responsibility."²⁵

Agents of Utilitarianism in the British-Indian administration:

Bentham's key propagandists in the Indian governmental system were James Mill, appointed Assistant Examiner to the executive of the Home Government of India in 1819, and his son John Stuart Mill who joined the Native States Department as political correspondent in 1823. James Mill had earned this influential position in the upper echelon of the Company's administration on the authority and temerity of his monumental 6 volume work, *The History of British India*, first published in 1818. The *History* was principally an attempt to make a philosophic analysis of Indian society and assess its place in the "scale of civilization". One of Mill's main purposes was to dispel what he considered the silly, sentimental admiration of oriental despotism which had muddled earlier thinkers of the Enlightenment. An indication of the supreme confidence and conviction in his critical agenda was the fact that Mill had never stepped foot in India, and thus had no empirical experience of the civilization he presumed to describe. This was no deficiency he argued, but, rather, his remote disinterestedness was a guarantee of objectivity. His astonishing arraignment of the entire population of India, and of China to which his arguments extended, demonstrated the fantastic authority he and fellow Utilitarians were prepared to grant to the philosophic intelligence.²⁶

In his capacity as Assistant Examiner through the formative period of the 1820's when the pacification and consolidation under British rule of vast new territories recently conquered or "lapsed" was steadily under way, Mill had the responsibility for reading the great majority of the principal "Home" correspondence in all departments, and personally drafting many of the despatches returned to India in response. These were

²⁵ Ibid., 72-73.
²⁶ Ibid., 53.
formally reviewed by the Court of Directors, the upper-most tier of the executive, but many went on to India little altered and thus carrying the stamp and tenor of Mill’s stern intellect directly into policy and action at all levels of the colonial administration. J.S. Mill later assumed the same post as father with a similar degree of influence until the very end of the Company regime.

Along with the Mills at India House, another Utilitarian apostle of note was Edward Strachey, the elder Mill’s fellow Assistant Examiner, charged with judicial matters. Strachey was described by Carlyle as “a genially abrupt man; Utilitarian and Democratic by creed”.27 He was also a direct link by which Bentham’s ideas reached Bombay through Strachey’s close friendship and correspondence with Mounstuart Elphinstone. Strachey was purported to have actually visited Bentham and procured Elphinstone a present of the philosopher’s works, which was duly conveyed to the Governor in Bombay.28

In the post-Mutiny era, Edward Strachey’s sons John and Richard carried the Benthamite creed of their father’s generation forward in new spheres of influence. Richard, to whom we will return in later chapters, trained as an engineer in the Company’s military seminary, and rose from his initial posting on the Jumna Canal works in 1840 to serve as Secretary to the Government of India for Public Works (1861-65). In this and several other senior offices of the evolving Public Works administration, between 1855 and 1871, he had a significant influence on the formulation of the technical development policy of the post-Mutiny regime, and indeed its major works of infrastructure, notably irrigation and railways.29

John Strachey had, by the 1870’s, become the most powerful influence in the Indian civil service as senior council to the Viceroy, upon whom both Mayo (1869-72) and Lytton (1876-80) relied heavily. In Stokes’ estimation John Strachey embodied the ultimate formulation of the utilitarian creed in India, which could be summed up in the two pregnant

28 ibid., 50.
Bentham himself entertained a long and recurring interest in India and its potential reform. The Mills’ “insider” influence was a singularly important tool for the advancement of his thought, a hand-hold on power that was firmly clenched in 1827 with the appointment of William Bentinck, another devotee, as the Governor-General.

In practice, on the Indian field itself, the deceptive simplicity of the Utilitarian creed, its rigour and sternness were adaptable and adopted by both of the prevailing schools of policy in Indian administration in the first half of the nineteenth century. Its influence was thus divided at first, one stream setting itself upon the project of energizing the Cornwallis system and the rule of Law; the other seeking its fortune in the quasi-military administration of the newer territories of the North-West, or applying its scientific bent to the engine of social and economic transformation then being constructed in the form of the Bombay survey and settlement. But these initially diverging applications of the creed would reconverge in the logic and rigour that informed the reorganization of the Indian administrative system after 1857, when a strong executive harmonized with the rule of law was finally made uniform throughout the “Raj”.

**Benign despotism: the Indian Civil Service**

The new Raj, and the most venerable and tenacious convictions of the old, were embodied equally in the Indian Civil Service (I.C.S.), the newly “professionalized” cadre of executive officers who resumed control of the political and judicial apparatus of the Indian empire in the second half of the nineteenth century. The I.C.S. manned all the executive posts of the civil administration from the Viceroy’s council, to the secretariats, to the collectorships and circuit courts of the districts. These

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30 Stokes, *Utilitarians...*, 293. We will return to the discussion of that paradigm and its spatial and conceptual embodiment in the institutional architecture and settlement planning of the post-Mutiny era, in later chapters.

31 ibid., 80.
"heaven-born", whose elite ranks rarely exceeded a thousand, were almost exclusively Englishmen before reforms in the early twentieth century began to make way for the inevitable transfer of power in 1947. Recruited by competitive examination from Oxford and Cambridge, they represented a select fraternity with an equally select and homogeneous conceptual system which served effectively to coordinate the making and maintenance of policy throughout the corporate colonial regime. However, as the late doyen of British Indian historians, Percival Spear, observed, the I.C.S. was at once the strength and the weakness of the colonial administration at this crucial juncture. Contrary to the progressive purposes of the new technical departments, it remained in the tradition of the paternalistic school of frontier administration under the Company regime, a fundamentally conservative institution which served the needs of a static society with efficiency and devotion, but which was temperamentally unsuited to adapt itself to the demands of a changing society and larger world. This was particularly apparent in the case of district administration, the most coveted domain of the Indian civil service.

Throughout much of British India until the end of the nineteenth century the Collector and his immediate subordinates in the district administration assumed the paternalistic dual role of both judicial and executive authority. District administration was the training ground for the civil service where junior officials learned the ropes of the colonial system, on the "front line" as it were, where ideally they would also gain an intimate knowledge of the people and the land they had been sent out to govern. A sparing economy of human and technical resources at this primary level of government promoted character-building self-reliance bolstered by the heady dose of authority with which even the most junior English "civilians" (i.e. I.C.S. officers) were empowered. The dominant cultural and political premises of the colonial rulers were explicit in the generally remote, rural context of the districts. Seeking legitimacy in the feudal order that was still presumed to prevail in the political mentality of the Indian ryot (peasant), the British opted for a virtual despotism placing all powers in the ostensibly firm but balanced hands of a benevolent patriarch and his

32 Percival Spear, A History of India, 155.
The most positive and politically efficacious aspects of the princely governments of India—their rough natural simplicity, and their "personal" character—were directly emulated in the development of the ryoitwar system of district administration that was propagated throughout much of British India in the early nineteenth century, with the exception of Bengal. These qualities of leadership were thought to provide a focus for the "...ordinary instincts of loyalty and racial sentiment, and satisfied, as British rule never could, the need of peasant society for paternal direction and an easily intelligible form of law and government...To the ryot, government was to be represented simply,...by a single officer, who had powers to inquire, to judge, and to punish, without the delay and the intricacies of Western legal process. This officer was not to be an awful figure, presiding in his cutcherry like a deity in a temple, but a familiar lord visiting and speaking with them of their quarrels and their crops, and looked up to as "ma-bap", father and mother."34

This principled omniscience and autonomy of the district administrators was regarded as the essence of the colonial system of government—an attitude, almost a mystique, which was much vaunted in Anglo-Indian literature.35

The technocracy of the new Raj:

The purported compatibility of the British colonial regime with the

34 Stokes, The English Utilitarians and India, 21.
35 Kipling’s story "The Head of the District" is one of the most famous and heroic depictions of such. Among many interpretations of this tale, see Hutchins discussion in The Illusion of Permanence. For a searing critique of the ideology shaped and sustained by such Anglo-Indian literature, see Suhash Chakravarty, The Raj Syndrome: A Study in Imperial Perceptions. (Delhi: Chanakya, 1989). The tenaciousness of the mystique of the paternalistic district administration in postcolonial India, long after the departure of the British, is brilliantly lampooned in a recent novel by a young Bengali writer; see Upamanyu Chatterjee, English, August: an Indian story, (Delhi: Rupa, 1990).
traditional socio-political order and mentality of the idealized "real India" at the level of the rural districts was contrasted favorably with the proliferating centralized government departments and agencies including the Indian Medical Service, the Public Works Department, and the various survey departments, which were seen to be disseminating powerful tools for social change but with little sensitivity and knowledge of the potentially disconcerting cultural and political consequences of modernization.

For the Fabian critics, Sidney and Beatrice Webb, who toured India in 1912, the PWD and its officers epitomized the eminently fatal disconnection of the sclerotic colonial regime from the life and the sentiments of the people of India. In their tour diary they recorded their impressions of a visit to the great Chenab Canal Colony near Lyallpur in the Punjab. The colony was "...clearly a success in the main essentials, and thus reflects credit on the engineers." A great network of feeder canals and distribution channels had brought fertility, and with it two million new "colonists," to a vast tract of 5,000 square miles that twenty years earlier had been desert. Yet, they continued, "...no provision whatever was made—hardly any is yet made—for the conditions of civilized life. It was regarded exclusively as a question of water engineering and land allotment—neither the Educational nor the Medical Officers were asked to report what such a Colony required, and no one seems to have planned out anything like a model settlement." The failing was not, obviously, a lack of know-how, but rather the detached, disinterested attitude of the technical mercenaries which the British had become in India by the early twentieth century. "...The English engineer, who may have been good at his technical job, neither knew nor cared anything about the people, or their social and economic arrangements; and was, indeed, after more than twenty years in India, as ignorant of and as uninterested in the country that he was serving, as the ordinary sailor is about the ports at which he touches. All he had picked up were the common prejudices and dislikes of the English community."36

From the 1860s on, the increasingly specialized and sub-divided

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machinery of the administration was seen to be evolving into a technocracy, alienated from its Indian subjects by its self-absorption in the rarefied European cultural sanctum of its urban headquarters and the English language in which its business was conducted. In the presidency towns and the new provincial capitals the gulf between the senior administration and the "real India" became ever wider with the growth of government services and, ironically, the progressive indianization of the bureaucracy this entailed. A growing cadre of educated English-speaking Indians came to staff the subordinate ranks of the revamped civil administration in the years following the Queen's proclamation of 1858.37 This buffer of indigenous intermediaries absolved the British departmental superiors of any need to deal with "the people" directly.38

As the dependence of the British on this clerical sub-class grew, unease over their loosening hold on the Indian Empire found expression in a mounting animosity toward this unnervingly competent and familiar class of "others" in their employ. The reassuring cultural and political contrasts by which the power of the ferrengi was asserted among the "primitive" unchanging tribes and peasants on the frontiers of British India were not so obvious at headquarters. The evident possibility that English education and social reforms in India could erode the intellectual and moral differences between the colonizers and the colonized provoked a subconscious reaction, in the language and attitudes of the British colonial sub-culture, to amplify and distort whatever collectively distinguishing characteristics could be discerned from the

37 Among various measures of clemency and tolerance designed to soften her proclamation of direct crown rule following the suppression of the rebellion of 1857-58, the Queen declared her will that

...so far as may be our subjects, of whatever race or creed, be freely and impartially admitted to offices in our service, the duties of which they may be qualified, by their education, ability, and integrity, duly to discharge.

This seemingly minor concession would repeatedly prove one of the most damming thorns in the side of the Raj as the sluggish process of indianization led to the faster growing disaffection of the ambitious class of educated middle class Indians who turned from the closed doors of the government bureaucracy to the embrace of the Congress party and nationalist agitation. Proclamation by the Queen in Council to the Princes, Chiefs, and People of India, 1st November, 1858.

38 Chesney, Indian Polity, 181-183.
blurred self-comparison of the ruling class with their aspiring, assimilative Indian subordinates. To this end, a sense of racial and cultural virility were stirred up in the popular consciousness of the conquerors. "Difference" was promulgated in the opposing caricatures of the stern and manly English "sahib" versus the superficially cultivated, effete "baboo".

A traditional term of respect, meaning "Mr." or "Master", the Bengali word "babu" had come into common colonial usage in reference to the native clerks in the employ of the British administration, specifically those who could speak and write English. By the second half of the nineteenth century the term had gathered a distinct savour of disparagement as the baboo came to embody, for the colonial British establishment, the unsettling modern challenge of class conflict and social change they thought they had left behind in England. Nostalgia for the raw justice of the frontier and autonomy and respect accorded to the colonial administrator in the Indian districts was, essentially, a paean for the arcadian simplicity of the pre-modern world -- as the Romantics imagined it -- and the social prerogatives of its ruling classes that the Indian civil service held out for the jaded elite of Victorian England to pursue. But the hold of the British on that traditionalist illusion was perceived to be weakening with the creeping tide of modernization they had brought upon India. The civilizing consequences of colonial conquest on the changing Indian social order were denigrated rather than praised. As one eminent "civilian" found fit to intone:

...I'd sooner be robbed by a tall man
who showed me a yard of steel,
Than be fleeced by a sneaking Baboo,
with a peon and badge at his heel.39

Rationalization, Standardization, and Control in Design

3. TECHNICAL DEVELOPMENT

The primacy of British technique in the world of the 18th and 19th centuries was of seminal importance in first gaining, then consolidating imperial control of India. British naval and military technology, followed by transport and communications, were the tools which directly accomplished the task. Indirectly, the preeminence of the British textile industry and heavy manufacturing in the world economy up to the middle of the 19th century generated the necessary wealth and bolstered the necessary sense of racial and moral potency, by which such a distant and extended conquest could be carried through. In the final century of British rule in India, the applications of technique ramified greatly with the methodical development and expansion of the communications infrastructure and the gradual transfer of technical knowledge to the mass of subordinate Indian technicians who were required to operate it. In the end as passion for Empire, and the political and financial feasibility of sustaining it, evaporated, the concrete legacy of the colonial engineers—the railways, dams, planned settlements, and essential service buildings such as hospitals and schools—were among the only products of the colonial state regarded with unmitigated pride.

Yet, recognition of the significance and status of the "nuts and bolts" business of Empire-building was surprisingly hard won; and, as we have begun to examine above, was a process perceived to be at odds with certain values deeply entrenched in the conceptual framework of the British Indian Raj. In the rest of this chapter we will further examine the place of technique in that evolving conceptual framework, and trace the course of development that eventually saw a technical development policy institutionalized as an instrumental arm of the utilitarian government bureaucracy consolidated in the 1860s.

The traditional ambivalence of the administration to public works:

From its formal establishment in the Government of India in 1855, the Public Works Department evolved in parallel with the new I.C.S. Yet the former stood in important ways for everything the idealized Civil Service of the districts was against; it existed to transform the India those
paternalistic administrators endeavoured so passionately to sustain and preserve. But "civilians" were not the only members of the colonial power structure to resist the material and technical development of India and the proliferation of a centralized technocracy which such seemed certain to promote. The Indian Army was another staunch opponent of change to the status quo.

The military establishment had previously undertaken all buildings, roads and communications, military and civil, on behalf of the Company regime through the agency of the Military Boards of the three presidencies. Therefore, it might naturally have resented surrendering its mandate to any new civilian authority. However, it was not so much the means which the Army resisted, surprisingly, but the matter of technical change itself. The Indian Army did not need improved transport it was argued; in fact it was better off without. In earlier days, when the Company's armies had staged campaigns or maneuvers, they had moved cross-country on the hard roadless tracts of the Indian plains like all other Indian armies of the past. This had taught the troops to be in an excellent state of readiness and experience for actual engagement in combat—making and breaking camp, negotiating topography, judging the land, etc., with regularity and efficiency. The troops of the railway era would be a less seasoned lot, it was feared, unaccustomed to a mobile camp life and dependent on good marching surfaces and railway carriages for mobilization, with all the complex logistics and expense entailed.1

Such practical arguments against the necessity for further proliferation of the Indian administration sat well with the Court of Directors in London, who were always ready to find wisdom in economy. The prevalence of campaign-hardened military officers in the upper echelons of the Company administration also tended to bolster the resistance to organization and investment in public works. Projects such as railways, but even such basic communications works as roads, would have to wait until the very last years of the Company regime before any funds and establishment would be sanctioned to carry them out. Colonial political imperatives in combination with technical and economic developments in metropolitan England at that moment, compelled that belated initiative

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1 Chesney, Indian Polity, 274.
after decades of hesitation. Many of the most urgent projects undertaken, however, were remedial works to restore and up-grade what could be salvaged of the substantial infrastructure the British had inherited from previous Indian empires. The ruin into which the sub-continent’s life-depending irrigation system had been allowed to decline during the initial period of British conquest was a poignant demonstration, for the purposes of advocates of a forthright programme of technical development, of the destructive rather than merely passive consequences of the policy of laissez-faire administration to which the East India Company had largely adhered through its century of parsimonious rule.

Early works of public improvement: irrigation

In the eighteenth century the British in India were consumed in a contest with other European powers to monopolize trade with India. Towards that end they succeeded gradually, by intrigue and entente, to encompass the whole of the Indian subcontinent under their effective control. The short-sighted majority of fortune-seeking traders, soldiers and servants of the East India Company had little concern for the preservation of the manifestly dysfunctional society and social infrastructure that had so easily fallen into their hands, let alone its material improvement. The backward and impoverished state of affairs they inherited was, however, the product of a recent and accelerated economic decline which the creeping incursion of the Europeans had actively exacerbated. The most active implication of the foreign power in this process had been its coercion of the weakening Mughal empire to award the East India Company an effective monopoly on external trade through exceptional trading privileges and exemptions on duties. This had undermined an economy already seriously destabilized by the break-down of central authority, precipitating the ruin not only of the comparatively small indigenous industrial sector, but the agrarian base as well.  

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2 British and Indian historians have expressed predictably diverging assessments of the economic impact of colonial conquest on India. For the former, see: R. Dutt, The Economic History of India, (Calcutta: 1903), and K.M. Fannikar, Asia and Western Dominance: A Survey of the Vasco Da Gama Epoch of Asian History, 1498-1945. (London: George Allen & Unwin, 1959). For the latter, see Percival Spear, A History of India,
While the British had gradually wrested de facto political control over the majority of India by the turn of the nineteenth century, legal sovereignty was still vested in the nominal Mughal Emperor in Delhi. This had its conveniences as the Company could, in the short term, profit from this unique situation of power without the reciprocal moral and economic obligations of a sovereign authority to insure the welfare of its subjects. The effects of the breakdown of this trust were physically manifested, with tragic consequences, in the decrepit state to which the irrigation infrastructure of the Mughal Empire and the other semi-autonomous regions of India had been allowed to lapse by the beginning of the nineteenth century.  

Opinions vary as to the actual sophistication of that indigenous irrigation infrastructure, from the dismissive attitude of some commentators who regarded the canal building efforts of the Mughal and Tughlak dynasties as little more than the amusements of sybaritic potentates intrigued with the sensual and poetic pleasures of water works, to the polemical claims of revisionist historians—echoed in the

which includes a useful bibliographical essay on British Indian historiography, generally. Contributors to the *New Cambridge History of India*, including C.A. Bayly, P.G. Marshall, and T.R. Metcalf have more recently commenced the re-writing of that history from a methodologically self-conscious, perspective from "below".


4 Those who dismissed the achievements of earlier rulers were not necessarily the European colonizers. The enthusiasm of Anglophile elements among the Indian intelligentsia for the benefits of British civilization, early in the era of Crown Rule, was often articulated at the expense of Indian civilization. As one peripatetic Bengali observer of the burgeoning British Indian Empire observed:

The Public Works of a people embody the forms and pressure of their age. The public works of the Hindus were royal roads, rows of trees, canals and bridges, tops of mango and peepul, tanks and wells, rest-houses for the night, durshalas or inns, hospitals, bathing ghauts, and temples -- all public works for the comforts only of the physical man. The Mohomedans nearly trod in the footsteps of their predecessors. Their reservoirs, aqueducts, canals, gardens, serais, and mosques, exhibit but the same cares for the material well-being of a people, without any progress made by humanity towards the amelioration of its moral condition. Far otherwise are the public works of the English. Their schools and colleges, literary institutes, public libraries, museums, and botanic gardens, are proofs of a
accounts published in official government publications of the post-Independence era—and that the ancients were engineers of genius whose works had secured the growth and prosperity of the agrarian economy. The physical evidence suggests a respectable median between those poles of opinion.

The large imperial works of the past were few though of major significance to their immediate regions. The oldest of these was the Grand Anicut on the Cauvery River in South India, a great weir 329 meters in length which was first constructed in the second century. A permanent structure of granite blocks packed with clay was completed around the year 1000 by the Kings of Tanjore and was responsible for the continuous irrigation of a substantial portion of the Cauvery delta even before its repair and improvement by the British in the 1830s. A tradition of collective irrigation management relying on works of a much less grandiose scale and sophistication was, however, a fundamental dynamic of a more universal order and significance in the development of Indian civilization. The building and maintenance of simple wells, "tanks" (reservoirs), and distribution channels—as well as protective works against the equally disastrous potential for flooding of India's volatile rivers—was a basic undertaking at the lowest local levels of government, beginning with the villages themselves. From an ecological perspective this amounted to a relatively complex and resilient collective system of resource management which was incrementally tailored to the requirements and climatic conditions of whole regions.


7 The Sinhalese Kings of neighbouring Lanka (Ceylon) had developed what was possibly the most sophisticated and extensive irrigation system...
The instrumentality of irrigation for the prosperity of large parts of the semi-arid Indian sub-continent, and for basic survival in the not infrequent case of drought, was reflected in traditional land tenure systems and the revenue administrations that exacted taxes from these. In the Madras Presidency for instance the British revenue administration was, as in most territories under Company administration, grafted onto the established indigenous administration. Well into the nineteenth century the superintendence of irrigation works and their regulation was undertaken directly by the Collector-Magistrates on an equal footing with all other executive functions at the district level. The maintenance of the local irrigation infrastructure, and the construction of minor new works where required, was funded with government revenue collected through taxes on irrigation. Prior to the British era it had also been a common practice of the revenue administration to invoke the principle of "coo dimarut" which obligated ryots (peasant farmers) to perform unpaid labour on local irrigation works in return for concessions on their annual land tax assessments. In times of shortage or disaster the traditional system was, therefore, sufficiently flexible to ensure both its upkeep and the welfare of its subjects.

However, this symbiotic polity had seriously deteriorated as with most of the formal institutional structures of Indian society over the century of transition from Mughal to British supremacy. As the enfeebled throne in Delhi became less and less capable of securing the respect and confidence of its subjects, revenues dwindled and neither sufficient funds nor human resources could be mustered to maintain the physical infrastructure. This had largely collapsed by the beginning of the nineteenth century when formal administration had been substantially restored by the British.

in South Asia, but that too had fallen into disuse in the early era of European colonial incursion. Restoration of those works was commenced by the British administration early in the 20th century, and has been vigorously developed in the postcolonial era with major new works such as the damming and diversion of the Mahavelli River. The socio-economic implications of these major developments in the current ethnic strife of Sri Lanka—another legacy of colonial rule—are not insignificant.

But the Company regime was not immediately inclined to take remedial action, with the inevitable expenses such would incur. Where traditional jurisdictional authority over irrigation and other works had been restored, as in Madras, the concomitant technical obligation of that undertaking was initially evaded. Revenue officials amateurishly nursed the ailing irrigation and civil works of their districts themselves without technical or professional assistance. Although considerable inefficiency and excesses of cost were incurred by this ad hoc approach, it was only gradually and grudgingly conceded that technical expertise and substantial new investment in this vein were required.⁹

It is no surprise that the apathy of the administration with regard to public works and irrigation was attacked most vehemently by the frustrated engineers and technocratic visionaries who stood to gain most by a change in policy. "Public works have been almost entirely neglected throughout India..." wrote Major Arthur Cotton, the Madras irrigation engineer who would ultimately be lionized as a hero of British imperial progress. "The motto hitherto has been: Do nothing, have nothing done, let nobody do anything. Bear any loss, let the people die of famine, let hundreds of lakhs be lost in revenue for want of water or roads, rather than do anything."¹⁰

These words were a retrospective rebuke published in 1854 when Cotton’s fame was already well established and both official and popular enthusiasm for public works of all sorts had finally been rallied, in large part by the manifest success of the major damming operations he had carried out through the previous two decades in the great river deltas of the Karnatic. But they reflect the frustration of Cotton the anonymous young artillery officer of the somnolent Madras Army in the 1820s and 30s in his up-hill struggle to mobilize the sanctions and resources for the strategic assault that would make his career. The invisible enemy he was acutely concerned to neutralize was the endemic scourge of drought. The decade from 1832-1841 had been among the driest in the recorded history of India, with four years of famine and a further three of scarcity.

⁹ ibid., ff. 365.
Tragically, it taken the human disaster and resulting economic crisis of that prolonged scourge to sensationalize the need for constructive action and to provoke the first overtures to the substantial reforms in the administration of public works that would be effected in the 1850s.\textsuperscript{11} Damning correlations have been posited between the initial period of dilettantism in British administrative practice and several catastrophic famines estimated to have claimed up to a third of the population in afflicted regions of the subcontinent.\textsuperscript{12} It is difficult to gauge whether earlier regimes were any more successful in weathering the sporadic and occasionally catastrophically prolonged droughts to which the monsoon climate of South Asia is prone. However, when the restoration and improvement of some of the major irrigation schemes of the past were finally undertaken in the 1830s, the potential of such works to avert disaster was soon abundantly demonstrated.

In the south Maj. Cotton began in 1834 to build a low-level dam in the Cauvery River on the model of the Grand Anicut, a few miles downstream. The new dam was conceived to correct a silting problem in the river above the older structure, which had diverted much of the river’s flow. Completed in 1836, the 781 meter Upper Anicut did not fully resolve the problem—it now directed too much current down the old riverbed—but the experiment had reversed the deterioration of the existing irrigation works and had demonstrated the feasibility of executing new and improved works of a comparable scale. Ten years later Cotton returned to the Cauvery to add a higher masonry dam on top of the original block and clay structure of the Grand Anicut. This adjustment resulted in a 52% increase in the lands traditionally irrigated in the immediate delta region (from 270,000 to 410,000 hectares) and the enterprise proved, from the point of view of local land and irrigation tax revenues, to be wonderfully remunerative at a profit of 24% per year against the original outlay on the works. In 1846 Cotton commenced a more ambitious set of weirs on the same principle in the delta of the Godavari River, the longest of which was 3,600 meters in length; and in 1851 he extended the tactic to the

\textsuperscript{11} see D. Headrick, Tentacles of Progress. 179-180.

\textsuperscript{12} Romesh Dutt, The Economic History of India, (Calcutta: 1903), as cited in K.V. Mital, History of Thomason College, 9.
Krishna, the third of the great river deltas of the Karnatic.

In the north the largest of these early pilot projects was the restoration of the Mughal built Eastern Jumna Canal which ran through the fertile inter-fluvial region between the Jumna and Ganges Rivers. Beginning in 1821, the project was carried out at a snail's pace over the better part of two decades, due in part to the usual parsimony of the Court of Directors. Another retarding factor was the very limited expert knowledge of hydraulic engineering which the junior military engineers assigned to the task had in their command. The project was for many years scarcely productive, serving only as an experimental workshop for the builders who learned the principles and innovated technical solutions to the peculiar challenges of irrigating the disastrously capricious riverine tracts of north India, through numerous failures and tedious reconstructions. Work finally accelerated from 1833 onward when fees for milling, timber transport and cattle-watering rights, as well as for irrigation, had begun to cover the construction and administrative expenses of the canals. Permanent masonry headworks to regulate the flow of water were completed fortuitously in 1836, the year before a severe drought spread famine throughout upper India. Crops raised on the 366,000 hectares that had been brought under irrigation by the revamped canal were saved. This was a public relations coup for the technical development lobby.

The undertaking of several monumental new irrigation schemes in the 1840s was a significant premonition—both materially and symbolically—of the dawning sense of maturity and responsibility of the British in their colonial venture, which would finally be confirmed through the tumultuous trials of the following decade. The seminal project in this regard was the Ganges Canal.

This entirely new canal was conceived to traverse the previously un-irrigated inter-riverine tract between the Ganges and the Jumna, from the base of the Sawalik Hills south across the Roorkee plateau. First surveyed in 1836 by the Bengal artillery officer then superintending the restoration of the Eastern Jumna Canal, Captain Proby Cautley, it was

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13 Headrick, Tentacles of Progress. 176-180.
14 Ibid., 175-176.
Fig. 5.2: Solani Aqueduct-Ganges Canal. This massive masonry structure was designed to carry the canal across the course of the Solani River—a dry bed most of the year, but a torrential flow in flood. Source: Professional papers in India Engineering. Vol. III (Nov. 1866).
Fig. 5.3. Lahore Passenger Station. William Brunton, Chief Engineer, Punjab Railway. Source: Professional Papers in India Engineering, Vol 1,2 (Feb. 1864). At the time the railway reached Lahore in the early 1860’s. The Punjab was still very much ‘the Frontier’—the Wild West of British India. The new railway was regarded as a strategic life line, and stations as strong-points for the refuge of European Civilians in times of danger. The Punjab Railway was the first of the ‘State Railways’, built directly under the superintendence of the P.W.D.
Fig. 5.4. Railway and Military Stations, India. (C.1870's). Source: Quarter Master Generals’ Simla, 1877. By the mid 1870’s, the main trunk lines of the East Indian Railway, and the Great Indian Peninsular railway had been completed.
immediately apparent that the proposed canal would out-scale anything so far constructed in India. In fact it was to be the largest irrigation scheme of its day in the world, three times longer than the Cavour Canal in Italy.

Preliminary sanction was accorded by the Company in 1841 but the commencement of construction was delayed by several years while it was debated whether the canal should be redesigned to accommodate commercial navigation on the model of the barge canals of Industrial England. The delay allowed Cautley to return to Europe for a three year furlough during which he was able to compare his entirely empirical knowledge of hydraulics with the canals built by the great British engineer Thomas Telford and the above mentioned Cavour Canal in the plains of Lombardy. This rather impressed him with his own ingenuity as he found that he and his colleagues had independently arrived at novel and theoretically sound solutions for all the standard problems in this branch of engineering.

The major technical challenges posed by the Ganges Canal were all encountered in the first 30 of its 840 kilometers overall. Close to the entire volume of the Ganges at its lowest level—131 cubic meters of water per second—was to be diverted from the River at its point of issue from the Himalayan foothills and carried across a rough tract of land broken by numerous ravines, three seasonal torrents and another river bed, to the edge of the Roorkee plateau 75 meters above the adjacent plain of the Ganges. To accomplish this feat two of the torrents were carried over the canal bed on wide masonry aqueducts which Cautley dubbed "superpassages". The third torrent was allowed to enter the canal and flow out the other side through a pair of regulators on opposite banks of the canal. Finally the canal itself was carried across the Solani river an a massive masonry aqueduct 338 meters long approached by almost 5 kilometers of earthen embankments. The major obstacle in this and all bridge works spanning the rivers of India, was the enormous volume and velocity of the river during the annual Monsoon floods which could easily scour away several meters of river bed and any shallow foundations in a single season. The Solani aqueduct was necessarily a monumental affair of fifteen shallow vaults springing from massive piers footed six meters
below the river bed on several hundred cubes of masonry.\textsuperscript{15}

The technique of "block-sinking" had been known and employed for centuries in India as a method for building secure foundations in the bottomless sand of large riverbeds; and the work itself was carried out by the same primitive traditional methods of manual cutting and hauling that still to a large extent prevail in Indian construction today. For its sheer scale, however, and perhaps for the bravura of "taming the Ganges", Cautley's canal works excited great attention and a new enthusiasm in India for British technical hubris. The Ganges Canal was officially inaugurated in April 1854. Within a year a Public Works Department was, for the first time, formally established in the Government of India.

Conceptual change: "trust" and technical progress

We have digressed somewhat with the preceding discussion of irrigation works as it has helped illustrate the socio-economic context in which the earliest significant British initiatives regarding the material development of India were introduced. Further, it has served to elucidate the important conceptual change embodied in, and to some extent engendered by, the major technical developments that would follow. As early as 1851 the Governor of the North Western Provinces—a keen promoter of the Ganges Canal and one of the earliest and most ambitious technocratic visionaries in Indian administration—could remark with confidence that his government had embarked with all the energies in its command on "...the noble work of improving the conditions of the people and developing the resources of the country." However, he recognized that this was already a binding, irreversible state of change:

It (the Government) has made a commencement from which it is impossible to draw back, without damage to the national character and without the sacrifice both of income and power. Public buildings once made must be kept in repair, and increased to meet the wants of a rapidly augmenting population. Roads once constructed must be maintained and extended as new markets open. Canals which once have been excavated must be kept efficient, lest a people fed by artificial means should be

\textsuperscript{15} Ibid., 177-179.
exposed to the horrors of artificial famine. When landed property has once been made to rest on the basis of an accurate and scientific survey, the means must be provided of appealing to the record of the survey and repeating its operation. 16

The modernization brought about by the mature colonial administration entailed a surrender to government agency of the more direct collective control of the physical and social environment that had been inherent in the pre-colonial, pre-modern agrarian order of Indian society. In return for "progress", the modernizing society would develop much heightened expectations and a corresponding dependence on the technical expertise of an omniscient centralized authority. 17

Development on the frontiers:

In the quiet backwater that the southern Indian territories under the Madras Government had become in British Indian affairs by the mid nineteenth century, the evolution of an effective and appropriate engineering department for the execution of public works was a slow but methodical process by comparison with the mobilization of material development in other presidencies and provinces. In the north progress in this period was more sensational, though capricious. The geographical and conceptual proximity of the "Frontier" allowed a certain license in the administration of the outer provinces and territories of the still expanding British Indian Empire. Normalization according to the "regulation system" of the Bengal Government was widely deferred and a more provisional, experimental style of administration permitted to prevail. In the North West Provinces and the newly annexed territory of

16 James Thomason, Account of the Present State of the College for Civil Engineers at Roorkee and Scheme for its Enlargement. (Simla, 1851). As quoted in Mital, History of Thomason College..., 44-45.

17 This problem merits further discussion and, as will be encountered below, was anticipated in some regards in the early stages of major public works development in India by others as well, such as the maverick Governor-General, Lord Dalhousie. To depend on the initiative and the security provided by an abstract central authority was not a very healthy state of being from the traditional "English" standpoint. See also Anthony Giddens' more recent thoughts on "Trust" in post-industrial society, in his Consequences of Modernity, (Cambridge: Polity Press, 1990).
the Punjab in particular, this gave scope for maverick individual initiatives in the area of technical development which would presently provoke a change in the reticent attitude of the Government of India toward investment in public works, and the institutional reforms necessary to undertake them.

**Thomason's Initiatives in the North West Provinces:**

James Thomason, Lieutenant Governor of the North West Provinces from 1843 to 1853, was among the first colonial administrators to undertake public works on a significant scale. Notably, he was also the first provincial chief with an exclusively "civil" mandate and, hence, no strategic or fraternal preoccupations on behalf of the military to hobble him in this endeavour. 18

Thomason is credited with three major contributions to the technical development of India. The first was his powerful support for Col. Cautley's Ganges Canal Project. In spite of strong opposition from certain quarters, his persistent personal advocacy was instrumental in ultimately gaining the sanction of the Government of India for the scheme in 1847.

Thomason's second major legacy was the college of civil engineering that he succeeded in establishing at Roorkee in 1848. This was the first such school in India, and among the first anywhere in the British Empire. For all the marvels of British technique in the 19th century, the technical training of British civil engineers was virtually undeveloped as an academic discipline. Whereas in England convention (and opportunity) dictated that the aspiring engineer would gather his

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18 Chesney, *Indian Polity*, 275. Sir George Chesney, R.E., our chief source for this account of the background and internal workings of the PWD, was a military engineer himself. However, his emphatic approbation of Thomason's civilian initiative is indicative of the mood of strict professionalism and objectivity that had overtaken colonial affairs in the post-Mutiny 1860s when Chesney was writing. He was an outspoken advocate of reform, with regard to both the civil and military establishments of British India, but along conservative lines that would better confirm and define the specific role that each servant of the imperial enterprise was required to play. In chapter 6 we will discuss Chesney and this conceptual paradigm of the 1860s more fully.
learning in the school of practice by serving a "pupilage" on the great railway or ship-building works of the day, Thomason recognized that such circumstances did not apply in the field of Indian engineering. At the mid-point of the century there were great expectations for the imminent technical advancement of India and the demand for engineers was already well in excess of the supply furnished traditionally by the corps of military engineers. But, there were as yet very few works of any consequence in India from which practical knowledge of modern engineering might be learned. The brilliant exception to this state of affairs were the Ganges Canal works. At Roorkee, site of the Solani aqueduct—the most monumental of its several remarkable and ingenious headworks—the canal builders had established the base for their operations including large workshops, a technical library, and a model room. Above all, the cream of the Indian engineering establishment were regularly assembled there in the course of their business. Thomason saw this serendipitous concentration of resources and knowledge as the kernel of a teaching institution which could serve the immediate need of the canal builders for specifically trained subordinates who could superintend the routine extension of the canal southward through the plains of the Doab once the major technical challenge of the headworks had been tackled, but which could grow from that nucleus to meet the future need for fully trained civil engineers.

Thomason did not foresee that this supply would ever be met adequately by civil engineers recruited in England. In his proposal of the college scheme to the Government of India, in September 1847, he dwelt at length on the engineering requirements of the country—survey, irrigation, application of water-power, navigation, roads, bridges, railways—objects for all of which it was impossible to provide European engineering skill. A liberal of the "improving" vein, Thomason saw no reason why these challenges might not be met by Indian youths trained as full professionals themselves. The only impediment was the dearth of opportunities in India for a young man to learn through experience by indenturing himself to a practicing professional. In the context of the colonial state, however, it was perhaps natural that the government

19 Mital, History of Thomason College, 16
should assume responsibility for such training directly, as it would also
be the inevitable employer of the professional expertise produced. The
college of engineering he proposed could offer an ideal balance between
practice and theory, tailor made to the engineering requirements of the
government. For hydraulic engineering there could be no better practical
experience than what could be learned from the works at Roorkee.
Meanwhile, the broader gamut of technical training would be imparted
through a careful and systematic course of instruction which could
prepare the trainee engineer for the peculiarities of service in India
far more squarely and usefully than could the haphazard work experiences
of the professional market back "home".

Duly sanctioned by the Government of India, the Roorkee college
admitted its first students in January of 1848 and three years later the
first graduates of its engineering course began to enter government service
as sub-assistant engineers. In two additional departments of the college,
subordinate grades of skilled technicians were trained along side the
engineers for duty in the PWD as overseers, surveyors, draftsmen, etc. By
the mid-1850s, when the Public Works Department of the Government of
India had at last been set on a firm and independent footing, Roorkee men
comprised much of its subordinate ranks in northern India and a small but
growing junior component of its engineering cadre.

The founding of other technical colleges in Calcutta, Madras and
Poona followed shortly on the success of the Roorkee college as a
training school for the rank and file of the public works department.
Within India, however, the preeminence of the original institution was
ever really contested before the era of independence. But the success of
Roorkee as a bona fide engineering college, producing qualified "native"
professionals, posed an unforeseen challenge to the British engineers
who, as in all facets of the colonial administration, regarded the
executive ranks of the public works department as the exclusive preserve
of "Europeans". This appears to have played a direct part in instigating
the establishment of yet another engineering college, though this time in
England, to prepare Englishman for engineering service in India. The
discussion of the pedagogical wars waged between Roorkee and the Royal
Indian Engineering College at Coopers Hill will, however, be pursued in
the next chapter.
Road building was the third area of technical development in which Thomason was, quite literally, a trail-blazer. Investment in this most basic and seemingly essential category of public works had been repeatedly resisted by the Company administration and its directors in London. Even though detailed surveys of the deteriorating road network of the former Mughal Empire had been commissioned by the Company as early as 1750 it had been content to allow these to fall into disuse, along with the existing irrigation works of the country. Thomason pushed ahead regardless and made considerable progress in connecting the major cities and regions under his large and populous jurisdiction with metalled roads. This was facilitated by the hard flat topography of the gangetic plain and by the regional availability of a good grade of kunkar, a concretionary form of oolitic limestone ideal for paving purposes.

The Grand Trunk Road:

It was during Thomason’s tenure that the reconstruction and extension of the Grand Trunk Road of the imperial Mughals was undertaken to connect Calcutta with the North West Provinces and beyond to the advancing north-west Frontier. This was an ambitious affair whose strategic and symbolic affinities with other grand imperial works of the past, such as the Appian Way of the Romans, were clearly perceived and celebrated. When completed this "backbone of all Hind", immortalized in Kim (Kipling’s great ‘road novel’), would stretch over 1500 miles from the humid delta lands of Bengal to the wild frontier town of Peshawar at the mouth of the Khyber Pass. For most of its length it would pass under a continuous canopy of shade trees the species of which were selected from all over the subcontinent, and as far away as Australia and Brazil, for compatibility with the various regional micro-climates along the way.

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22 Maud Diver, *The Unsung, a record of British Services in India*, (Edinburgh: Blackwood, 1945), 17.
23 For a culture noted for its gardening passion, it is not
This avenue of trees divided the road itself into no less than three parallel roadbeds, a central metalled surface for high speed horse-drawn carriages and uni-directional tracks either side for slower ox-drawn carts and large animals such as elephants and camels. The road was, further, a secured and supervised artery with police stations constructed every few miles along its course. Realization of the Grand Trunk was, however, a slow and problematic endeavour. In addition to the sluggishness of most of the British administration to engage whole hearted in the building of public works, the road posed difficult engineering challenges with the many bridges required to traverse the Ganges and its various major and minor tributaries on its course across the alluvial flood plain of northern India. It was not until 1859 that the first through-traffic of horse-drawn mail carts began to reach Delhi regularly.  

The Pacification of the Punjab:

The greatest single impetus to road construction, and Public Works in general, was the annexation of the Punjab in 1849 following the Second Sikh War. The Punjab was the last of the major regions of the Indian sub-continent to be subdued by the British. The decision to bring it under direct British administration reflected imperial nervousness over their unguarded frontier with Afghanistan and Russian dominated Central Asia beyond. In order to secure this vast north-western tract, and inspire the loyalty of its greatly divided communities, an ambitious programme of material development was undertaken by an autonomous engineering department that was specially created to rapidly execute new

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surprising that the British avidly collected and experimented with the horticultural knowledge and material they encountered in the various corners of their global Empire. Botanical gardens were established in virtually all of Britain’s colonies to study and cultivate the local flora of each region, and to experiment with the practical and commercial potential of exotic species from other parts of the world exchanged through this network via its metropolitan hub, the Royal Botanical Gardens at Kew. A.J. Christopher, The British Empire at its Zenith, (New York: Croom Helm, 1988), 81-82. See also "Economic Botany and Tropical Plantations" in Headrick. Tentacles of Progress, 209-258.

24 Chesney, Indian Polity, 276.
roads and irrigation works throughout the new province. The efficiency and dynamism of this technical task force were insured by allowing it to operate independently of the sluggish conventional protocol for the execution of government projects which required that all proposals, estimates, etc. receive the sanction of the Bengal Military Board seated in distant Calcutta.

The development of the Punjab was, nevertheless, very much a military operation—a "pacification" measure. Military know-how, resources and discipline were turned to the business of forging a lasting peace through new construction and communications—technology in the service of a distant power which, in this instance, depended for its security on the well-being and loyalty of the newly subjugated "martial races" of the North-West Frontier which would in future be expected to defend the vulnerable flank of the British Indian Empire. The officer appointed to spearhead this campaign as the first Chief Engineer of the Punjab (1848-56) was Lieut. Col. Robert Napier of the Bengal Engineers, later the Commander-in-Chief of the Indian Army, distinguished by the exalted title of Field Marshall Lord Napier of Magdala. Napier’s aggressive and resourceful leadership in this initiative soon placed Punjab in advance of most other parts of the country with regard to the scale and sophistication of its public works. A decade later, however, Napier would be called upon to employ similar methods in another "pacification" exercise which revealed the steelier edge of the technocratic sword. Napier’s intrusive post-Mutiny assault on the rebel city of Lucknow heralded the impact on the colonial Indian townscape of the scientific new urbanism which was then reconfiguring the imperial capitals of Europe. Sanitary engineering and urban renewal would be used as tools of segregation and containment to secure the power elite from the threat of the disfranchised masses. We will return to these more draconian instances of "rationalization" in the material development of India under the regime of British engineers in chapter 7.

25 Ibid.
Dalhousie's technocratic vision:

Colonel Napier had been selected to lead the engineering assault on the Punjab by the maverick Scotsman, James Ramsay, Marquis of Dalhousie, whose extended tenure as Governor General from 1848 to 1856 was a major watershed in the history of British India. Dalhousie used the development of the Punjab as an experiment in an alternative approach to the administration of the Indian empire which might induce a greater efficiency and dynamism in the development of its extensive territory. The outstanding feature of this so-called "non-regulation system" was the concentration of all powers, executive, judicial, police and revenue, in the hands of the individual District Officers. The exceptional autonomy and personal responsibility invested in special technical officers such as Napier insured that the infrastructure and communications essential to the security and central coordination of this dispersed array of government representatives could be layered down with "authority and system". Communications were of paramount importance in knitting together a disciplined force over such far-flung distances in unsettled country. Control was achieved by a rigid system of recording and reporting through which responsibility for each decision and action on the part of an officer in the field was duly accountable. This was not the conservative paternalism of the Indian Civil Service of later generations, bent on preserving the traditional feudal order of Upper India from the homogenizing influence of the Bengal bureaucracy. This peculiarly radical system of institutionalized despotism provided Dalhousie an energetic, and economical tool for the rapid modernization of India. The conquest of the Punjab was followed by the annexations of several other substantial territories, in each of which Dalhousie's system was applied. Dalhousie has been described as a "natural alliance between the Tory gentleman and the scientific Benthamite administrator". In his study of the legacy of English Utilitarianism in British Indian administration Eric Stokes

27 Eric Stokes. The English Utilitarians and India. 245-248.
portrayed Dalhousie as a self avowed compound of despot and radical who, however exceptional in his individual consequence as a statesman, embodied the supreme confidence and pragmatism of the early Victorians as a whole. In the terse, simple language of his official minutes and despatches, free of all qualifications or ornament, Dalhousie could convey his meaning "...with the immediacy and directness of a physical shock...His Utilitarianism, if such it may be called, was characteristic of his age. It was no longer a fixed programme derived from the texts of Bentham, nor was it a set of intellectual dogmas. It was rather a practical cast of mind, a strong aggressive logic with which a man of affairs could approach specific political issues."

Dalhousie had come out to India infused with enthusiasm for the material and societal benefits of the technological transformation that England had experienced through its industrial revolution. He was determined to re-tool the colonial administration to make way for such change in India as well. Dalhousie was bolstered in this endeavour by the experience and convictions he had gathered in his preceding appointment as President of the Board of Trade during Britain's railway construction boom of the 1840s. Under the laissez-faire tenets of Liberal political economy, which constrained the British Government to rely almost entirely on the initiative of private capital to undertake most major works and buildings of public improvement, the Board of Trade had been the only arm of government to exercise any jurisdiction over public works in England. While this jurisdiction was very broad, it was peculiar and indirect and, to Dalhousie's frustration, had afforded little effective control over the planning and coordination of technical development. In India—as he made it clear for the record—Dalhousie determined to exercise his executive prerogatives as Governor General to the fullest to set the development of the colony on a clear and productive course which would not be hobbled by feeble political will and inadequate administrative authority.

Whereas his predecessors had looked to legal reforms, and the slow

29 E. Stokes, Utilitarians... 249.
diffusion of western knowledge and beliefs to the Indian elite through English language education, as their strategies—if any—for the development of a "modern" Indian state, Dalhousie was a consummate technocrat who perceived the task from "top down" and in essentially physical terms. His two key achievements were the concerted expansion of British territory to its logical limits (primarily through the contentious principle of "lapse"), and the consolidation of the empire as a political and economic unit through the construction of new systems of transport and communications.  

The pacification of the Punjab by constructive means emboldened Dalhousie to attempt the technical consolidation of British India as a whole. His pivotal action in this regard was to push forward with the construction of a railway system for India, after years of stalled negotiations on the part of his predecessors.

Railway Development:

The development of an Indian railway system had been proposed to the East India Company as early as 1841. But the Court of Directors was characteristically cautious in its enthusiasm for such a substantial undertaking, and it would take another decade for any construction to get under way. One excuse for caution was that the technical feasibility of maintaining railways in the extreme sub-tropical climate of India had not yet been demonstrated. But the principal line of resistance was the same argument applied in England's own railway development, that railways were not the business of government. As the Honourable Company had long been stripped of its monopoly interest in the commercial development of India its London directors had succumbed to the ponderously conservative political ethos that prevailed to varying degrees in British statesmanship over the half century from 1825 to 1874—a pessimistic belief that there was no economic process which government would not mar by its intervention. As one economic historian has proposed, policy in

31 E. Stokes. Utilitarians in India. 250
this period "...consisted in doing as little as decency would permit."\textsuperscript{33}

Independent railway lobbyists were not deterred, however, and in 1844 the entrepreneur, R. M. Stephenson, journeyed out to India to stir up support for an Indian railway. The considerable enthusiasm expressed by influential representatives of both the European and Indian commercial classes of Bengal was sufficient to provoke the first serious consideration of a railway policy by the Company authorities. An initial statement on railways was tabled accordingly in 1845 in a despatch to the Governor-General of India by the Court of Directors,\textsuperscript{34} in which the essential principles that would guide the first few decades of railway development in India were laid down. Unlike other works of public improvement such as irrigation canals and roads, which had in the past been financed strictly from surplus Government revenues, railways were to be built in India as they had been in England, as commercial ventures. Chartered railway companies financed by private stock-holders were expected to construct and operate the lines for profit, subject, however, to the specifications, planning and regulatory controls of the government. Pursuant to this despatch, the Court took the initiative to send out a consulting engineer in the autumn of 1845 to make more detailed recommendations concerning the technical and administrative means for carrying out such a scheme, and to consider the most desirable routing for the proposed rail lines. A trunk line from Calcutta north-west across the Gangetic plain to Delhi was considered paramount in strategic importance—a route roughly parallel to the Grand Trunk Road. Other key links projected were two trans-Deccan lines from Bombay to Calcutta and Bombay to Madras, respectively, and a shorter southerly traverse of the peninsula from Madras to the ports of the Malabar Coast.\textsuperscript{35}

The East Indian Railway (E.I.R.), which was to construct the trunk line to Delhi, and the Great Indian Peninsular Railway (G.I.P.R.) responsible for the two Deccan lines, were both formed in 1845 as private associations. However, neither was able to raise sufficient capital for

\textsuperscript{33} Leland Hamilton Jenks. The Migration of British Capital to 1875 (New York, 1927), 208-209. as quoted in D. Headrick. The Tentacles of Progress, 59.

\textsuperscript{34} Legislative Department, 7 May (No.11), 1845. As cited in ibid.

\textsuperscript{35} G.S. Khosa. A History of Indian Railways. 2-5.
these ventures under the terms of contract first proposed. A protracted and tortuous period of negotiations followed through which, in 1849, a more remunerative and risk free agreement for the private investors concerned was finally arrived at.  

When Dalhousie entered the fray in 1848 the already much modified deal the Court of Directors had tried to strike with the railway companies was on the brink of collapsing. The Court was at variance with the Government of India, on the one hand, and the Board of Control in England on the other, both of which were reluctant to absolve the railway companies of risk while insisting on government control over all planning and operations as well as an equal share in any profits. As we have seen, Dalhousie had hankered for greater State control in his earlier experience with railway development in England. In an important minute on railway issues penned in 1850 he extended that conviction to India, expressing the hope that "...the East India Company will ever avoid the error of viewing railways merely as private undertakings, and will regard them as national works over which the Government may justly exercise, and is called upon to exercise, a stringent and salutary control." Nevertheless, he was concerned not to squash the spirit of private enterprise. In India, in contrast to early Victorian England, material progress was impeded in his view by "...the total dependence on the Government, in which the community has placed itself, and its apparent helplessness to do anything for itself"--a perceptive premonition of the long term dependency syndrome that much of the former colonial world has suffered in the present century. In the short term, Dalhousie viewed private investment in the development of the Indian railways as potentially an excellent catalyst for further, more diversified investment of British capital in the colony. While he was still determined that the Indian Government should retain a firm and systematic control over the planning, standards and operations of the railways, he was confident of the profitability of the venture to all concerned and prepared to insure it in order to attract investors. In the precedent

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36 Enclosure to PWD Circular No. 25 of 1867; Extract from the Statement of the Moral and Material Progress of India, 1864-65, presented to Parliament, July 5, 1866 (London: H.M.'s Stationery Office, 1866); Khosla. Indian Railways. 5-9.
setting deal that was finally concluded in 1849 the E.I.R. and G.I.P.R. were incorporated as public companies whose return on investment was "guaranteed" by the Indian Government at a rate of 5% per annum for a contractual term of 99 years! Further, all land for the railways was to be purchased by the State on behalf of the companies. Under these very favorable terms, ample capital was finally forthcoming and construction got under way at last in October 1850.37

India's railway age was officially inaugurated on the 16th of April 1853 with the departure of the first train out of Bombay station on a 21 mile trial section of the Great Indian Peninsular Railway from Bombay island to Thana on the mainland. A year later regular traffic was running over 33 miles of track from Bombay to the base of the Western Ghats at Kalyan. On the other side of India work had commenced on the East Indian Railway in 1851 and in September of 1854—after an inordinate delay caused by the mistaken expedition of the first order of locomotives and rolling stock to Australia on its outward journey from England—the E.I.R. initiated traffic on its first 37 miles of track along the Highly River northward from Howrah, Calcutta's twin settlement on the opposite river bank. Meanwhile, construction had continued at a good pace and just five months later a further 90 miles were completed linking the coal fields of Raneeegunge, the first major commercial objective of the East Indian Railway Company, with the burgeoning colonial metropolis of Calcutta—Howrah. The Madras Railway Company was a late starter incorporated in 1852 (with the standard 5% guarantee) to construct the projected line from Madras to the Malabar coast. Construction began in June 1853 and the first 65 miles of line, from Madras to Arcot were in operation by 1856 when Dalhousie's term as Governor-General came to a close.38

37 Khosla. Indian Railways. 6-12; Sir Penderel Moon. The British Conquest and Dominion of India. 661.

4. THE INSTITUTIONALIZATION OF TECHNICAL DEVELOPMENT

The all-India technical departments:

The new railways, along with the fast ramifying networks of canals, roads and telegraph lines, were nascent "empires" in their own right. Not only were they reconfiguring the map of the subcontinent, these new lines of communication were steadily transgressing all frontiers, creating an entirely new imperial "space" into which the whole of India and the void between it and the imperial metropolis were seen to be collapsing. Dalhousie was anxious that this grand technocracy be managed appropriately, on a centralized, imperial basis that would not be hampered by local government interference.

The ad hoc works department that Robert Napier had deployed with such vigour and system in the Punjab, under the exceptional autonomy and authority accorded him by the central government in those frontier circumstances, was a model for the several "all-India" technical departments which the Dalhousie administration began to create subsequently in the Government of India to insure unhindered progress on all frontiers. Dalhousie's dictum for these new departments was "uniformity of management and unity of authority". They were to be directed by single department heads, whose function was to lay down policy and exercise a firm and coordinating control over all operations through a hierarchy of executive officers at the local level. 39

New technical agencies set up in subsequent years included the Telegraph Department, the Indian Forestry Service, and the All-India Medical Service 40. But the Public Works Department which Dalhousie succeeded in reconstituting on a fully autonomous basis in 1855 was, with the railways it was to superintend, considered among the most consequential legacies of his exceptionally prodigious tenure in office.

39 Stokes, The English Utilitarians and India. 251.
40 King, Bungalow..., 42.
Public works under the Military Boards:

A nominal department of public works had been in existence in the British Indian administration in one form or another throughout most of the preceding century. However, this had never been set on a solid footing.

Up to the middle of the nineteenth century, most works classified as "public" were actually carried out by the military establishment. From the strategic considerations of the expanding colonial regime, the distinction between public and military works was perennially ambiguous. Early in the days of Company rule "public works" fell under the aegis of the Public Branch of the Home Department. But, after 1775 responsibility was transferred exclusively to the Army, first under the Board of Ordnance which was established in that year, and from 1785 onward under the system of Military Boards, into which the latter was incorporated.41

Under these boards—of which there were three, one for each of the three presidencies—works such as buildings and roads were administered on the same footing as Ordnance, Commissariat, Stud, etc. Each such board was composed of the Chief Engineer (who was always the senior officer of the corps of Engineers) and his counterparts, the Commissary General and the head of the Ordnance Department. While there were occasional public buildings to be erected, and the odd country road or river embankment undertaken for civilian benefit, the majority of works carried out in this period by Government authorities were regarded as military works.42

The notion of a "public works department" did not arise until 1824 when it was decided to redesignate the Barrack Department of the Bengal Military Board as such. The latter had been formed six years earlier specifically to superintend the design and construction of military


buildings, but its responsibilities in practice had proved more general. In 1830 this change was ratified more concretely when the Bengal Military Board was re-organized into five distinct departments, including a Public Works Department which was charged with responsibility for all buildings, "public", "civil" and "military" as well as all roads and bridges. As the engineering successes of the Irrigation Department began, in the 1830s, to inspire a more progressive attitude in the British Indian administration, other significant buildings and works of public improvement were undertaken by the new public works department of the Military Board. The first post office in India was constructed in 1837, and the first experimental telegraph line—from Calcutta to Diamond Harbour at the mouth of the Hooghly—was completed in 1839. However, with the sharp escalation of civil and military works undertaken by the British, commencing with the annexation of Sind in 1843, the existing system of superintendence under the Military Boards was found to be inadequate to cope with the new magnitude of the task. By 1849, with the further addition of the Punjab to this load, it had become obvious that an alternative strategy for the execution and management of works was needed.

Organization of an autonomous department of public works:

The reorganization of the superintendence of public works on a civil basis was achieved by the Dalhousie administration in two stages. In 1850, having firmly resolved to commence the railways and to further develop the communications of India, it was decided to remove public works from the unsympathetic and bureaucratically cumbersome superintendence of the military boards in the hope that this might accelerate development. Meanwhile, the success of the more technocratic methods exercised experimentally in the development of the Punjab provoked the appointment, in 1851, of commissions in each of the

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43 PWD (Establishment) "A" Proceedings, May 1864, Nos.1-2: "Memorandum by Col. Strachey and Major Chesney on the Employment of the Royal Engineers Corps in India".

Presidencies to "...enquire into the superintendence and execution of public works in India, including the separation of the civil branch of public works from the duties of the Military Board."

In their reports the three local governments concurred in the opinion that the military boards had ceased to be relevant and effective authorities for managing public works. However, they also advised unanimously that dividing "works" into two separate categories, civil and military, attended to by autonomous establishments would result in unnecessary redundancy, and potential discordance. As the Bengal Commission wrote: "...there is...no incompatibility in Civil and Military Works, nor any sufficient reason why they should not proceed concurrently under the same executive management." The logistical imperative of keeping an officer's physical territory as small and manageable as possible, they argued, far outweighed any technical or accounting considerations that might be posited in support of parallel departments. If the existing engineers establishment was not to be dramatically augmented, each parallel department would necessarily have to distribute half the current complement of officers over twice as much territory; a physical impossibility.

Dalhousie had no objection to the combination of military and civil works at the local executive level. This was consistent with his non-regulation system of administration which, as we have described, sanctioned the concentration of authority in the hands of the district officers to facilitate efficiency and coordination in the various operations of the government. Accordingly, he saw that the Court of Director's sanction the proposal of the commissioners that "...each Executive Engineer should have charge both of the Civil and Military Works in his district." 45

On the other hand, there was no unity of authority provided at the top end of the system by the clique of doddering old soldiers who comprised the military boards. 46 The mandate of this institution had evolved so frequently and so significantly in the preceding decades that

45 Court of Directors Military letter No.25, dated the 3rd March, 1852. As quoted in Government of India, Report of Mr. Lyall's Committee.
46 P. Moon, The British Conquest and Dominion of India, 659.
it had become a mere patchwork of a system. With his initial measure, in 1850, of removing public works from the jurisdiction of the boards Dalhousie had sought only to re-align the building and engineering activities of the administration with the relevant civil departments. His later resolution, in 1854, to consolidate all such activity under one fully autonomous authority was a further remedial measure to bring order and accountability to the accelerating pace of technical development. But it would also make it possible in principle to chart out and coordinate a planned programme of works that could contribute directly and constructively to the imperial enterprise.

In the reforms of 1850, public works were placed nominally under the Public Branch of the Home Department in the Government of India. However, it appears that this hardly improved efficiency as no specific protocol was determined nor were specific officials designated to exercise that authority. The day to day administration of public works at the executive level continued to be handled in the field by the engineering cadres of the various local governments, but sanctions for all projects and expenses and instructions regarding any important professional or administrative issue, had to be sought "up" the system from the supreme government. With no expert agency for fielding public works matters the overburdened secretariat of the Home Department was often compelled to defer such business or to refer it on to other departments deemed in a better position to act. Where works such as the trunk road and railway networks passed through the native states of India, which retained their nominal independence from British India, the business was necessarily directed to the Foreign Department. Works carried out by the British at their strategic imperial outposts of Aden, on the Red Sea, and the Straits Settlements of Singapore and Molucca on the eastern approaches to the Indian Ocean were also administered under the Foreign Department of the Government of India. Both the Home and the Foreign Departments were compelled in many instances to refer public works matters onward to the Financial Department when any significant budgetary matters were in question.

In his decisive minute on public works of July 12, 1854, Dalhousie conceded the ineffectual state of affairs into which the half measures of his initial reforms had thrown the administration of public works: "There
has been and is no established system, no recognized authority to which Government might look for aid in the consideration of a project submitted to it; for to send it to the Military Board in past times would have been to consign it to a limbo whence it was hopeless to expect it to emerge within any reasonable time; while there is under the new system no Chief Engineer attached to the Government of India to which it could be referred." A proper secretariat with such a Chief Engineer as secretary to the supreme government would enable the administration "...to exercise the universal control confided to it over public works in India with the weight of scientific knowledge, with authority and system." This deficiency was becoming an ever greater problem which, he insisted, could no longer be remedied by "temporary makeshifts" as it had been so far: "...The great scale on which the Department of Public Works is likely to be carried on hereafter, renders it, in my judgment indispensable that the Government of India should no longer be dependent on expedients, but that it should be provided with a permanent and highly qualified agency to assist it in the directions of this most important branch of public affairs."47

Dalhousie’s proposal was received favourably by the Court of Directors and sanctioned in the closing business of 1854. An autonomous secretariat for Public Works was established accordingly in the Government of India on February 7, 1855 when the relevant despatch had reached Calcutta. Two months later the thus obsolete Military Board was formally abolished.48

The structure of the new PWD; staff and hierarchy:

The new departmental organization for public works served to institutionalize an unofficial system of management that had already evolved in practice. The first incumbent of the post of Secretary to the Government of India in the Department of Public Works was Lieutenant Colonel W.E. Baker, a veteran of 27 years service in India through much

of which he had been engaged in the great northern canal projects of the 1830s and 1840s. For the preceding four years, however, Baker had been installed in Calcutta as the Consulting Engineer to the Government of India for Railways. While the planning and progress of the East India Railway (in collaboration with its civilian promoters, R.M. Stephenson and George Turnbull) had been his principal concern, Baker had been made use of more broadly, during his tenure, as an unofficial consulting engineer to government for all manner of public works. Dalhousie’s proposal to create a proper department of Public works was motivated in part by his wish to recognize Baker’s labours and his minute to the Court of Directors expressly recommended that Baker be made chief of the new agency.49

Baker’s appointment respected the traditional dominance of military engineers in colonial public works. Dalhousie had no apparent qualms about encouraging a hegemony of military engineers in the new civilian works department, in spite of his dissatisfaction with the military boards as an administrative agency. In fact he expressly instructed that the top posts of the new department should always be filled by “highly qualified officers of the Corps of Engineers”.50 Accordingly, the supreme post of Secretary to the Government of India for Public Works would continue indefinitely to be held by military men as were the senior most posts of Chief Engineer at the level of the provincial and presidency governments.

Under the Dalhousie reforms executive decision-making had devolved somewhat from the absolute authority of the military boards to a limited local distribution of authority. The Chief Engineers of the local governments each headed a complete subset of the all-India department of works and these operated with relative autonomy in the execution of routine works. Subsequently, this authority was augmented further with these Chief Engineers representing their departments directly to their respective provincial or presidency governments as “Secretaries to

Government in the Department of Public Works". But the Secretary to the
Government of India in the Department of Public Works retained supreme
control over his subordinate officers including the posting and promotion
of all staff. 51

Under each of the provincial Chiefs were several "Superintending
Engineers" charged with the inspection and general control of all works
and operations of the department in their respective "circles". (A
"circle" was a group of districts or their equivalent, comparable to a
"division" of the revenue and judicial administration while usually not
encompassing the same territory.) The actual planning and execution of
works was conducted by the next grade of officer down the ladder, the
"Executive Engineers", who were aided by various grades of Assistant
Engineers and a staff of subordinates. These executive cells of engineers
and subordinates were distributed regionally on a district or divisional
basis throughout the territory of the province or presidency whose FWD
they served. Each Executive Engineer and his staff was responsible for
the preparation of plans and estimates, and direct "departmental"
construction or contracting and supervision, of all routine works and
buildings carried out within his territorial jurisdiction, in all
technical branches except irrigation, railways, and military works.

Technical branches:

In its initial incarnation the new department had no technical
subdivisions, although it undertook most all of the obvious functions one
assumes would fall under the mandate of public works. These included
civil buildings, roads, irrigation and railways. The FWD also assumed
responsibility for military works once the Military Boards were finally
abolished, but the old debate as to whether military buildings and
engineering should not be differentiated from civil works had not been
settled.

In the period of intensive reconstruction and augmentation of the
accommodation for European troops in India that followed the Mutiny, the

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51 Chesney, 1889 as quoted in Government of India, Report of Mr.
Lyall's Committee, p.3.
Military Department became increasingly dissatisfied with the variable quality of design and supervision of military buildings constructed by the PWD. This deficiency was particularly marked in Bengal where it was felt that the provincial organization of the PWD had not enabled necessary communication with the other branches of Army business which were exclusively administered in the supreme government. The grievances of the Military Department caused the question of technical specialization to be more closely considered, and in 1864 it was decided to reorganize the secretariat of the PWD in the Government of India into functionally distinct branches. Military Works were distinguished from civil works which henceforward were to be administered under the "Buildings and Roads" branch. Separate branches were also created at this time for Railways and for Forestry. Oddly, Irrigation—the most advanced arm of technical development under the PWD—remained a subsidiary of the Buildings and Roads Branch until 1867 when it too was set on its own semi-autonomous footing as a proper technical branch of the department.

Technicalities internal to the operation of the department itself were similarly distinguished in this overhaul of the PWD and four additional administrative branches were created in the Secretariat of the Public Works Department of the Government of India. These were the so-called "Establishment" branch (the Anglo-Indian euphemism for personnel); Accounts; a Registry Branch which maintained the records room of the department, recording and compiling all the correspondence and proceedings of the department in each of its branches according to a strict protocol; and a Drawings Branch which exercised much the same function as the Registry Branch with respect to all the graphic information, including plans, maps, surveyors' charts, etc. produced by the department in the course of its business. These internal branches had an important bearing on the day to day procedures of the department—work methods, managerial priorities, access to and uses of  

52 Chesney, *Indian Polity.* 277-278. This was not so much the case in Bombay and Madras where there was no provincial subdivision of the civil administration and the PWD and the Military Departments were represented equally in the presidential governments.  
53 "Reorganisation of the Office of the Secretary of the PWD with effect from 1 April 1864," PWD (Establishment) "A" Proceedings, Nov. 1864, Nos. 1-3.
technical information, etc. (In chapter 8 we will consider how this institutionalized methodology exerted certain cognitive constraints on the design production of the PWD.)

While works falling under the Buildings and Roads branch continued to be administered on a corporate basis by the provincial public works departments, according to the protocol established in 1855, a more centralized authority was exercised over the key technical branches—Railway, Irrigation, Military Works. Each of these was headed by its own Chief Engineer who, as Inspector-General of his particular branch, was the supreme authority within the PWD for all works falling within his designated competence.

The staff of the PWD was organized in one body with respect to establishment matters (pay, seniority, pension, rules of service, etc.), and was theoretically interchangeable between each of the branches, with the exception of Military Works which was the exclusive preserve of officers of the Royal Engineers. Practically, however, an engineer would usually serve out his career in the branch and the province (or presidency, in the case of Bombay and Madras) in which he was first appointed, as did officers of the civil service.

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Summary: This chapter has begun to examine the Institutional and conceptual frameworks in which the Public Works Department of the Government of India was first established. We began by considering the moral and administrative crisis in Indian affairs caused by the civil and military uprisings of 1857-58. The contemporary perception and explanations of the Revolt, and the remedial actions taken by the government, were interpreted as an index to the predominant political philosophies at play in the shaping of colonial policy at that crucial juncture in British Indian history. The reorganized colonial administration that emerged from this crisis revealed the Utilitarian cast of mind that was to have such an important bearing on the moral and material progress of India in the following few decades. We then briefly traced the antecedent of that conceptual system in the evolution of the British Indian polity under the regime of the East India Company.

The consolidation of the new Raj after 1858 was a paradoxical bid both to preserve and to progress. From a brief discussion of this paradox as it manifested itself in the bureaucratic development of the Indian Civil Service, we proceeded on to the question of technical progress itself. The traditional resistance to technical development by the Company and its Army was slowly eroded in the final years of Company Rule. We briefly reviewed the heroic early history of the Irrigation
Department, and subsequent initiatives in road building, technical training, and railway development that finally ignited both public and official enthusiasm for an organized strategy for the technical development of India. We concluded with an overview of the institutional background of the Public Works Department in the former Military Board of the Bengal Army, and an outline of the structure and mandate of that department in its first years of operation.

So far we have considered only very broad social and institutional frameworks of conception. In the following chapter we will try to examine the more specific professional conceptual systems of the engineers who actually conceived the colonial buildings and planned environments that we wish to explain in this study.
CHAPTER 6

CORPS CLASS AND RACE
THE SOCIAL AND EDUCATIONAL BASES OF THE PROFESSIONAL
CONCEPTUAL SYSTEM OF THE PUBLIC WORKS ENGINEERS

Introduction: This chapter closes the triangle of alternative
descriptions of the cognitive historical content and context of the case,
which have comprised Part II of this study. Here we shift our
perspective from the larger political and institutional frameworks of the
evolving British colonial regime in 19th century India, to the conceptual
frameworks of those decision-makers within the administration who were
actually responsible for its accommodation and physical planning. As it
developed and matured in the second half of the 19th century, the Public
Works Department was exceptional among the various departments and
services of the post-Mutiny regime as it brought together a heterogeneous
mix of persons in both its executive and subordinate staffs. This
entailed professional distinctions between military personnel and
civilians, as well as differences in race and social class, and in the
nature and quality of the technical training that each staff member
brought to the department. These differences had significant bearing on
the hierarchy of authority that evolved in the administration of the
department, and on its later restructuring in the last decades of the
century as a function of social and conceptual change in both England and
imperial India in that period.

This internal power structure of the department had both direct and
implicit influence on the decision-making process in all facets of the
Department's operation. How this power structure affected decision-making
in the design process is our specific interest, though its influence on
other departmental operations such as accounting practice and office
routine—as we will consider in Chapter 8—was often a significant
indirect mode by which the particular conceptual system of the dominant
professional group was actually brought to bear on the production of
designs.

These several discrete structures—the effective power structure of the
department, and the implicit conceptual systems of its various
differentiated sub-sets of staff members—will become more explicit when
later we examine some of the designs and related design discourse
produced by the PWMD in the crucial decade, the 1860s, when consciousness
of a new "professionalism" in all departments of the colonial
administration was particularly marked in the aftermath of the Revolt of
1857. For the present, however, we will try to discern the significant
facts, factors, and norms of the colonial and historical contexts in
which the PWMD engineers operated—the conceptual "content", that is—of
which their particular professional conceptual systems were composed. To
begin with we need to discern who these men were and how they were
categorized in the social belief system of the colonial society. We have
already sketched out the essential structure of the Public Works
Department, in the preceding chapter. We must now consider who filled the
slots of that departmental hierarchy.
1. THE PROFESSIONAL ATTRACTIONS OF COLONIAL SERVICE

Through to the end of the Company era the British in India had never really transcended their tentative, calculated attitude to the colonization of the subcontinent. The colonial venture had been an investment; a long term investment to be sure, but always essentially exploitative. The objective had been to realize a profit and eventually, in some unspecified future, to withdraw.

The Revolt of 1857 had changed that attitude significantly. The transfigured belief-system of the colonial sub-culture in the high Victorian era would be anchored by a pair of fundamental new notions: the idea of the "just rule" of the British over India, and the illusion of the permanence of that assumed trust.

The apparent rejection of modern social reform by Indian society—as the Revolt had been interpreted—had quelled the spirit of charitable condescension with which an earlier generation of English radicals and evangelical reformers had attempted to quicken the social advance of India. This was displaced by a fundamental new skepticism about the ability of the underprivileged ever to help themselves. If India was determined to remain in the debased state of social immaturity in which it was seen to be languorous then, like a wayward child, it appeared that it would always depend on the protection and guidance of a stern guardian. The suppression of the Revolt had reconfirmed Britain's power to dominate Indian society. An idea now began to impress itself upon the dawning imperial consciousness of the Victorians that the English were perhaps bound by destiny to perpetuate their rule in India indefinitely. A permanent raj now seemed a practical possibility, and this was to be confirmed subsequently by racial and political and religious theories as both sound and high-principled.¹

"Progress" had a rather ambiguous place in the belief system of this new raj. The very real progress of the British industrial state and its Empire, as it continued to extend and consolidate its global hegemony, served to inscribe the sense of confidence and control of the British

colonial servants in India. However, the application of that potential to the development of India was henceforward to be selective and carefully controlled, for unbridled "progress" in the emancipatory sense of that ideal was hardly on the agenda of a colonial regime that now sought to stabilize itself for the long term. Material development was to be a "tool of Empire", as Headrick has argued, the utility of which was the efficiency and economy it lent to the penetration and control of the vast and dispersed territory of the British Empire. The command and application of technique made imperialism affordable; its benefits for the subject populations were incidental and only encouraged, as in the case of the Indian railways, where that incidental public service had proved to be profitable.

The men who went out to British India in the 1860s to be the new Empire-builders were, thus, rarely motivated by a genuinely altruistic ideal of colonial service. The reformers of the previous generation—"amateurs" one and all—had asked themselves what the English could do for India; this new generation looked to what India could do for the English. The Englishman bred in the public school tradition looked upon his career in India as a test, a character building experience, precisely because (as it was now imagined) India would never really change. The civil service officer "betered" himself with his years of selfless, unimpeachable service in district administration and thus served the quasi religious cult of noble conduct on which the legitimacy of colonial rule was increasingly to be grounded. Through the vigorous pursuit of the ethics of hard work and good sport on the Indian field, fulfillment of the concept of the English gentleman was elevated and exploited by the colonial civil servant as a vocation in itself.

India and the other colonies of the British Empire created new markets not only for the manufactured goods of Britain's industries, but for the professional services of its rapidly growing middle class as well. Where suitable professional vocations for this surplus did not exist in England, they were invented in the colonies.

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3 Hutchins, Illusion of Permanence, 36.
For the men who went out to staff the technical departments of the colonial administration, India offered a new virtually undeveloped field of operation which could potentially sustain the professional employment boom of England's transport development revolution of the second quarter of the nineteenth century. Civil engineers who engaged themselves in the service of the Indian railway companies in the 1850s and 1860s entertained good prospects of subsequent employment in the Public Works Department once their contracts were fulfilled. Meanwhile, the long established professional group of soldier-technocrats gained a new lease on life in the peace-time consolidation of the Indian Empire as their utility as an organized and disciplined agency for the coordination of planning and construction was readily exploited, enhanced by the substantial augmentation of the British forces in India in consequence of the Mutiny.

Within the PWD, then, the moral and political destiny of "Empire" which was increasingly to capture the imaginations of the imperial pundits in Calcutta and Westminster, was rarely a matter of more than incidental concern. Consciousness tended to be constrained by the mundane technical and administrative issues of the department's business and the often only thinly veiled rivalry of the competing classes of professional men who found themselves grouped together in departmental service.

2. THE PROFESSIONAL "ESTABLISHMENT" OF THE PUBLIC WORKS DEPARTMENT

Military and civilian staff:

According to the Rules and Regulations applicable to the civil members of the Public Works Department, first published in 1858, the Engineer Establishment was "...thrown open to all classes of persons duly qualified." At the mid-point of the century there were, however, relatively few of such "qualified" individuals, of any class, available in India. The academy trained military officers of the Indian Engineers

Corps were the only well represented group with an established claim of professional qualification. But, much as they could also claim responsibility for nurturing the institution that had become the Public Works Department, the actual appropriateness of their training as military engineers to the tasks of peace-time civil engineering and architecture was not necessarily accepted; nor were the members of this elite corps necessarily disposed to such civilian duty precisely because their professional conceptual system was that of military officers rather than that of the still somewhat nebulous and socially un-established professional role concept of the "Engineer".

Civil Engineers, so titled, had begun to appear on the Indian scene in small numbers in the 1840s with the major initiatives of the Government in irrigation engineering. Their presence had become steadily more substantial from the early 1850s onward with the commencement of the Indian railways. The various railway companies relied naturally on the civil and mechanical engineering expertise of the men who had pioneered the technology for constructing and operating railways in the preceding two decades. Senior engineering staff were recruited directly in England by the railway companies, in many instances upon the recommendations of the Institute of Civil Engineers and leading individual representatives of the profession.5

This handful of accomplished professionals was accompanied out to India by a supporting cadre of technically skilled personnel recruited as foremen, surveyors, craftsmen, etc. by the British civil contractors who carried out the actual construction of the railways. With the dearth of technical expertise in India these technicians benefited from an acute demand for their services which considerably enhanced their conventional vocational status. On the other hand, however, this had the effect of compromising the professional status of the accredited civil engineers, as the boundaries of social class and cognate authority had become blurred.

Service in India often bestowed a status that was unobtainable at home. But claims of competence could not as yet disassociate one from

their original social rank, in the estimation of either official authority or the public. In the small-minded, status-conscious little society of the British colonial servants in India one was less likely to be praised for their accomplishments than derided for presuming to transgress their proper social station, and the aspiring new class of professional purveyors of technical expertise was a prime object for such defensive snobbery. 6 (see fig. 6.1)

The majority of men who aspired to serve in India as Civil Engineers were, however, of much the same middle-class stock as most of the military and civil service officers of the colonial regime. But, whereas the long established branches of the administration had evolved a protocol for the selection and training of such officers, the recruitment of civil engineering staff to the Public Works Department in its first years of operation was a haphazard affair. Unlike the railway companies with their ambitious short term development objectives, the PWD was an "establishment" which, with the rest of the colonial administration, tended to view service in terms of careers rather than departmental goals. Thus, it deferred from hiring accomplished civil engineers who would expect to be admitted to the upper ranks of the executive as such would have entailed the supersEDURE of established staff members (almost exclusively military officers) entitled to such positions by their accrued seniority in government service. Therefore, only unproven junior civil recruits were taken on by the Court of Directors, and generally on the strength of testimonials alone. A handful of capable young civilians found their way into the Department by this route but, as one critic pointed out, "...some also, upon reaching their destination, served chiefly to show how untrustworthy the most positive testimonials often are." 7

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6 In one amusing instance of this the Delhi Sketchbook, a satirical periodical published in the early 1850s, cast a jaundiced eye on the phenomenon of the civil engineer in a cartoonist's mocking "before and after" depiction of "the transformation of John Dobbs from honest English workman, earning 15s. a week, into East India Company Civil Engineer earning £500 a year." See: Denis Judd. The Victorian Empire, 1837–1901: a pictorial history. (New York: Praeger, 1970), 77.

Civil recruits and their patrons were frequently ill-informed concerning the nature and range of tasks the PWD engineering staff was required to undertake. In England a reasonably intelligent young novice engineer could generally mucker his way through his first years of professional duty in an established firm with the benefit and support of more experienced colleagues and supervisors. But the same man in India was immediately saddled with a comparatively great degree of responsibility yet far less access to the guidance and knowledge of superior officers. As such, many were found unequal to the task. In several instances, in fact, recruits arrived in India lacking even the rudiments of professional knowledge, evidently under the assumption that they would be trained on the job, and rather less as a professional engineer than as a privileged colonial "sahib" empowered exclusively to administer lower strata of technicians and labourers who would do the actual technical work of the Department. If, in instances of such misconception, the ill-prepared recruits didn't immediately surrender their commissions and return to England, they could find themselves necessarily placed for instruction under "natives" of the class of those whom they had been sent out to India to direct and superintend\textsuperscript{8}—with the inevitable loss of "caste" in the colonial community, and impediment to future professional stature that such an ignoble début entailed.

\textbf{Hierarchy and terms of service in the Engineers' Establishment:}

In view of the very uncertain qualifications of the in-coming civil recruits in these early years a hierarchical categorization favouring the traditional military sources of staff was imposed \textit{a priori} in the departmental protocol for first appointments to the engineers establishment. In ordinary circumstances new recruits were only admitted to the bottom rungs of the executive cadre, as either "Assistant Engineers" or "Apprentices". Those termed "Apprentices" were to be appointed from the Civil students of Indian Colleges (by and large Europeans with the statutory status of "natives of India" and "Anglo-Indians" of mixed race), and other Civil candidates. Those

\textsuperscript{8} \textit{ibid.}, 161-162.
accorded the title of "Assistant Engineer" (who began with starting salaries at least twice as large as their co-recruits) were virtually exclusively Europeans with some guarantee of qualifications. These entered the department from specified schools or services for which admission quotas were reserved. Military personnel, for instance, usually entered the Public Works Department in the first or second of the three possible grades of Assistant Engineer. Officers of the Royal Engineers Corps serving under the Government of India had a privileged claim to employment over all other candidates according to the length of their previous service. Other suitably qualified military personnel could expect postings as 2nd grade Assistant Engineers and were recruited from among junior officers (not above the rank of Captain) of the other branches of the Indian and the British Armies—Artillery, Cavalry, or Infantry, in that order. Candidate's in this category were required to pass a prescribed examination of general and relevant technical knowledge to confirm their eligibility.

Civilian candidates for posts of Assistant Engineer could only expect 3rd grade appointments. Eligible candidates included passed engineering students of the Thomason College and the Presidency College at Calcutta, and from 1859 onwards Civil Engineers selected in England under a recruitment scheme initiated in that year by the Secretary of State for India, Lord Stanley (to which we will return later in this discussion). Finally, individuals of the Upper Subordinate Establishment of the PWD itself could in principle be considered for promotion to the executive ranks on the basis of experience proven qualification and success in the standard examination prescribed for the military candidates.

Appointments to the first and second grades of Assistant Engineer were considered permanent while third grade appointments, along with apprenticeships, were probationary for at least the first year of


10 as the College at Roorkee was properly named following Thomason’s untimely death in 1853.
service. Promotion from the third to the second grade, after probation, required the writing of a examination to test the professional knowledge acquired. The aspirant had to demonstrate that he was capable of preparing designs and estimates for all descriptions of buildings and works commonly undertaken by the Department, as would be required of an Executive Engineer; that he was acquainted with the processes for preparing materials, and with the modes of construction in use in India; that he had a good knowledge of the resources and the local materials and their applications in the districts in which he had so far been employed, and that he understood the management of labour on the building site. Finally, he had to demonstrate his practical acquaintance with the accounting practices of the Department.

Promotion to first grade Assistant Engineer required the passing of a further examination, this time concerning the colloquial language skills required by the executive engineering staff in the course of their day to day work. Promotion to the rank of Executive Engineer—the next class of service grades in the engineers establishment, of which there were four—required a further language examination known as the "Lower Standard". This thorough test of both written and spoken fluency in Hindustanee (or other relevant regional languages) was also applicable to other departments of the administration. PWD engineers were additionally required to demonstrate an ability to read "native" letters and accounts relevant to contracting and construction. This combined qualification was known as the "Departmental Standard" and marked one's definitive graduation from a merely technically competent assistant to a fully knowledgeable executive in command of technical matters as well as all managerial matters, for which a firm command of communications was the essential skill.

Advancement in the upper echelons of the engineers establishment, through the four grades of Executive Engineer, four grades in two classes of Superintending Engineer, and ultimately through the three classes of Chief Engineer was, in principle, made according to the vacancies to be filled, and on consideration of the services and merits of the individuals concerned, without regard to mere seniority.
The subordinate establishment:

The subordinate establishment of the Public Works Department was recruited entirely in India, almost exclusively from the local engineering colleges. As such, they were in fact the most consistently and appropriately trained members of the technical staff, though they were not expected to rise to executive posts in the engineers' establishment. The principal ranks of this support staff were referred to as the Upper Subordinate establishment and consisted, in descending order of precedence, of Subordinate Engineers, Supervisors, and Overseers. Their function was essentially to translate the executive authority of the upper engineering staff into constructive action, thus mediating between the exclusively European executive and exclusively Indian staff of Lower Subordinates and the artificers and labourers engaged by the Department on the actual work sites.¹¹

As was discussed briefly in the preceding chapter, the Upper Subordinate establishment was comprised in large part of British soldiers who received a special course of training as Overseers at the Thomason College of Civil Engineering at Roorkee. The civilian portion of this establishment were also graduates of the appropriate Subordinate departments of Roorkee and the various presidency engineering colleges. In the early years of the Department these men were largely "natives" of India in the statutory sense, consisting of "Anglo-Indians" (persons of mixed European and Indian descent) and the sons of Europeans domiciled in India. In the last quarter of the century, however, those groups were effectively excluded from these ranks in favour of "natives of pure Asiatic descent" as the authorities attempted to appease the ambition of the Indian populace for greater access to Government employment while, in the PWD, specifically endeavouring to distinguish clearly on racial lines between a subordinate body of Indian technicians and the cognate authority and autonomy of an executive cadre of professional engineers who were almost exclusively English born and English trained.¹² This

¹² "Collection of Papers relating to the Reservation of Engineer Appointments in India to Pure Natives", PWD Miscellaneous Records,
racial phenomenon in the evolution of the PWD establishment had further important consequences to which we will return below.

Finally, in this initial overview of the departmental personnel, we come to the Lower Subordinate establishment. The exclusively Indian members of this cadre provided the basic technical and clerical support for the Department's executive and office functions, respectively. Although these men were trained and functioned only in their own vernacular languages, they were also graduates of two full years of instruction at the local engineering colleges. At the Thomason College at Roorkee the Lower-Subordinate course was parallel in content to the Upper Subordinate course but conducted in twice the length of time (two 10 month sessions) in Urdu, the local vernacular, such that the proficiency of the students in the fundamental skills of surveying, drawing, and estimating were actually better secured. In the second year of study the students were sub-selected into the particular specialty they were apparently best suited for—Sub-Overseers, Sub-Surveyors, or Estimators and Draftsmen, respectively—and their instruction was concentrated in those areas accordingly. Upon qualification in the Final Examinations, the Lower Subordinates were appointed to the PWD at starting salaries ranging from 25 to 50 Rs. per month—approximately one quarter of the starting salary of a native apprentice in the engineers establishment.  

3. THE CONSEQUENCES OF THE MUTINY FOR THE PWD ESTABLISHMENT

The immediate impact of the Revolt:

The events of 1857-58 greatly accentuated the demands of the new Public Works Department for qualified engineering staff. The mobilization of the majority of the existing staff to active military duty had brought almost all works to a halt in Northern India during the Revolt and had seen the loss of several officers in battle. Steadily mounting demands on the Department since its inception had already obliged an accelerated

Collections nos. 16, 23 and 24. [NAI]

recruitment of new staff. But by 1858 the Department was clearly facing a crisis as it anticipated a major new works program in addition to an exceptional surge of reparation work in the wake of the fighting.  

Concern over this acute deficiency prompted an urgent despatch from Governor-General Canning to the Secretary of State late in 1858 as the Revolt was finally coming to an end. Canning sought temporarily to make use of the surplus of Royal Engineers currently in the country as part of the augmented military forces sent out to assist in quelling the Revolt. However, he did not see that this could be a long term solution. Tours of duty in India and other colonial outposts were regarded, he presumed, as a form of "penance" by most of the officers of the Royal Engineers which they could not be expected to volunteer to prolong. Nor could those gentlemen officers be expected to stoop permanently to the "civil" status of service in the PWD and the gamut of mundane responsibilities which the generalist engineers of the department were required to assume in the course of duty. The "departmental" system by which virtually all works, with the exception of the railways, were carried out by the PWD—that is, without the intermediate agency of general contractors—required the departmental engineers to perform as both the technical directors and the financial managers of each project. This additional professional role of accountant was "...not familiar or congenial to the Royal Engineer system..." in Canning's view.

The military engineers who had formed the various presidential branches of the Indian Engineers Corps under the Company's administration had developed a service tradition that was relatively autonomous from the Royal Engineers of her Majesty's Army, much as the cadets of both corps shared the same initial training in practical engineering at the Royal Engineers Institution at Chatham. The amalgamation of the Indian Engineers Corps with its parent body, as a consequence of the reorganization of the Indian military establishment in 1858, posed the question as to how the two systems were now to be coordinated. The recurring notion of dividing the business of works into separate civil

15 Canning to Stanley, Allahabad 29/11/1858. PWD (Gen--Estab.) Public letter No.1 of 1858.
and military branches was mooted (once again) as a possible alternative strategy whereby the Royal Engineers could henceforward assume exclusive responsibility for military works while the Indian Engineers Corps could actually continue to exist as an autonomous civilian body concerned exclusively with civil works and public buildings. For the time being, however, both Canning and the Secretary to the Government of India for Public Works, Lieutenant-Colonel Henry Yule, firmly deprecated such a split.

Arguments for enhancing the military character of the Department:

Lieut.-Col. Yule expressed his opinion on the matter of the future role of the military establishment in the PWD in a further Home despatch of the Governor-General’s Council in July 1859. If the Royal Engineers Corps was to be involved in India on a permanent basis it would have to improve and specialize the training of its recruits to prepare them for the peculiarities of peace-time public works in India. But he was quite eager, nevertheless, to see the military character of the department fortified by an influx of such recruits. The extensive civil mandate of the engineer in India was a potentially “improving” challenge for the military man. At the same time Yule evidently felt it was not the nature of the tasks but, rather, the method and attitude with which it was executed that were of primary importance. Both the calibre of the work of the PWD and the service tradition of the military engineers in India would suffer, in his view, with any retrenchment of the military strength of the Department.

Yule conceded that the Royal Engineer cadets were not "to some extent" trained with the requisite knowledge for conducting civil works, but "...why should they not have it?.." he queried. "There is nothing in the fact of a man's being a Military Officer to prevent his being a good Engineer if he has proper training..." He specifically disparaged what he

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16 Memorandum by Lieut.-Col. H. Yule, Secretary to Government in the Department of Public Works, of 23rd April, 1859. Enclosure to Public Letter (PWD—General/Miscellaneous) No.40 of 1859, Fort William, 7th July 1859. The following quotes by Yule have all been extracted from the present memorandum.
regarded as the unconstructive distinction between military and civil engineering:

What are Military works? Are they to consist in making Barrack cots, mending panes of glass, deodorizing Barrack-Offices, and killing pariah dogs at threepence a head?—duties which long, and until lately, were among those of the Bengal Engineers, greatly to the mental detriment, as I verily believe, of many able officers; or in building Barracks and Fortifications and making Military roads?

If the latter definition applied, there was little further work to be done in the foreseeable future concerning India's legacy of fortresses and strong points; whereas who was to distinguish between a military and a civil road?

In no respect do Military roads differ in any essential from Civil roads; nor does the planning of great buildings to hold soldiers differ in any essential from that of great buildings for any civil purpose, nor the earth works of a rampart from those of a railroad...

Yet, while such categorization of works seemed entirely arbitrary, Yule did recognize a beneficial difference in the general fund of knowledge and experience that civil engineers had been bringing into the Department. As such he had no wish to exclude them from the Indian engineers corps. "A wholesome rivalry will do all good," he suggested, "...and the importation of a proportion of men who have gone through valuable experience in England, with the more elaborate appliances of English Engineering, is most valuable." Nevertheless, Yule was convinced that military engineers should continue to maintain firm control of the corps as they were actually better disposed to the prosecution of "Public" works than were civilians, from the fundamental point of view of their professional belief system as military men—that is, as disinterested "guardians"*17 of the public welfare. "I do believe..." he

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stated,

that the Military character of the Corps is highly beneficial to it in the exercise of its Civil duties, and that the Government would never find in any body composed of men brought from England in mature life that zeal for the interests of Government, and identification of themselves with those interests, which, in spite of all drawbacks and exceptions, I believe to be the most honourable characteristic of the Corps of Engineers.

To make this conceptual distinction more explicit and thus insure against the compromising of the Public's interest, Yule felt the Government should desist from the practice of contracting the execution of works out to private agency, as was the policy for railway construction. Both large works and small should be carried out "departmentally". This would also allow in the short term for the admitted deficiencies of the military engineers in certain areas of modern civil engineering, to be made up through the compulsion of responsible direct experience with such techniques in the field.

Yule was unabashedly partisan in his arguments for the augmentation and reform of the engineers establishment of the PWD on staunchly military lines. Nevertheless, he was concerned that the Royal Engineers who would take on that mandate should be better prepared for the task. Concluding his memorandum, on this note, Yule offered a candid critique of the standard training British military engineers had for years been receiving as cadets at the Royal Engineers Institution at Chatham. The whole Civil instruction of the officers required a major overhaul in his opinion. Interestingly for our purposes, Yule cited the "Architectural and Estimating Course" as a notorious exemplar of this deficient pedagogy:

What was called the Architectural and Estimating course in my time was a pure waste of time, and I doubt if it is much better now. It's whole essence consisted in colouring certain engraved Plans, and in copying out certain estimates and specifications. The result was an utter blank. I learn that this unprofitable system of transcription is still maintained. 18

18 Memorandum by Lieut.-Col. H. Yule, Secretary to Government in the Department of Public Works, of 23rd April, 1859. Enclosure to Public Letter (PWD--General/Miscellaneous) No.40 of 1859, Fort William, 7th July 1859.
Yule had significant recommendations to make concerning the problems and staff requirements of the subordinate ranks of the PWD as well. But we will return to those later when we examine the vocational and cognitive constraints within the PWD associated with the parameters of race and social class.

In this section we have considered some of the immediate consequences of the Mutiny for the PWD. Presented with the imposing challenge of substantial reconstruction combined with a rapidly expanding mandate for new works and buildings, the Department was faced with the obvious need to augment its establishment in order to cope. But such an augmentation posed a potential dilemma for the existing hierarchy of military engineers who had formed the original departmental establishment. To justify the recruitment of new military men to this civil department, and thereby preserve this curious niche of power and legitimacy that the military engineers corps had created for itself in India, they either had to redefine their professional role or redefine what "public works" in the context of a colonial state actually entailed. As we have seen, the military engineers might have wished to have it both ways. However, the politics of the issue were viewed differently by the British Government back Home which determined instead to promote the civil engineering profession in India, specifically to serve in an augmented Department of Public Works.

A new influx of civil engineers, beginning in 1859, was to gradually erode the control of the military establishment over the PWD. But this took quite some time and was not achieved without a struggle. One consequence of this was a sharpening of these engineers' consciousness of their respective professional beliefs as they were compelled to define themselves and their opponents' failings in the frequently bitter debates over professional competence and privilege which ensued between the contending civilian and military factions in the Department. A consideration of some of the content and objects of the arguments generated in this context of the 1860s will help us to deduce something of the professional conceptual system that was evolving in the PWD in this crucial period of consolidation and standardization of its methods of design production.
At this point, however, we must pause to consider the cognitive and social bases of the military service tradition of the Indian Engineers Corps which had evolved under the regime of the East India Company, and through the agency of which the PWD had been established. After 1859 the officers reared in that tradition had to defend their ways of thinking and doing, not only against the challenge of their civilian counterparts, but to some extent against the mentality and methods of the larger metropolitan based corps of Royal Engineers in which they were thereafter absorbed.

4. THE MILITARY SERVICE TRADITION OF THE INDIAN ENGINEERS CORPS

The social and cognitive status of the military engineer:

Engineer and Artillery officers could be described as the intellectual elite of the British military establishment in the nineteenth century. On the other hand their's were among the least exclusive of the officer corps of the British Army from the standpoint of social status. The gentry tended to favour the more chivalrous lines of military service such as the Cavalry, certain regiments of which became increasingly select havens of social security for the upper classes of English society as the century progressed.¹⁹

In the first half of the century the Artillery and the Engineers--the so-called "scientific corps"--were alone among the officers of the British and Indian Armies in receiving a rigorous compulsory academic training in their disciplines. Not before 1849 was even the most basic qualifying examination required of candidates for officers commissions in any of the other branches of the Army. Educational criteria were irrelevant as commissions were either given to or, in the great majority of cases, purchased at considerable expense by men of wealth or influence.²⁰


Traditionally, the Army had been a great conservative force in British life. Only the wealthy could afford a career in the Army, and although that category did not exclude the wealthy Bourgeoisie, the dominant element in this period were the landed upper classes—"...men who have some connection with the interests and fortunes of [the] country..." as the Duke of Wellington explained in defence of the patronage and purchase system of recruiting. 21

One still required patronage to gain admission to the Royal Military Academy Woolwich, where Artillery and Engineer officers were trained, but the more sober and cerebral character of the corps entailed a comparably modest, less expensive regimental tradition. This allowed a more modest sector of the privileged classes, such as country clergymen or doctors, to commission their sons in this line of military service. 22 The Artillery and Engineers therefore came to represent to some degree the challenge of the middle classes, and their meritocratic ideals of cognitive privilege in a Liberal society, to the institution of aristocratic privilege embodied in the other officers corps.

Social distinctions between officers of the British and Indian Armies:

The British officers of the Indian Army naturally shared much with their colleagues in the British Army. Before 1809, for instance, officers of the Indian Engineers were, with the Royal Engineers, products of Woolwich. But there were important differences as well. Before the restructuring of the military establishment in India under the authority of the crown in the late 1850s the service in the Indian Army was evidently unattractive to the aristocracy and landed gentry of England, as the army of a chartered company of merchants. In the beginning of the 19th century the proportion of officers of aristocratic title in the Indian Army was hardly one tenth that of the Home Army. As such the Indian Army was dominated by a very substantial majority of officers of middle class or socially "mixed" background such as the sons of merchant

families that had bought their way in to land and gentility. 23

On the whole the Indian Army was a more meritocratic institution than the British Army, headed by a demonstrably more professional combat-hardened body of officers who, between 1811 and 1867, led it in no fewer than 37 separate wars and campaigns. 24 In India, therefore, there was virtually none of the tradition of regimental exclusiveness by which the upper classes secured a privileged status in the British Army. There were exceptions, however, not the least of which was the Engineers corps. 25

In the first half of the century the upper classes increased their proportionate strength in the military establishment, in both the British and the Indian armies. A three fold increase is observed in the case of the Indian Army, between 1758 and 1834, although this augmented upper class element still amounted to only one quarter of the over-all officers establishment. Most interesting and surprising, however, is the fact that this trend had a disproportionate specific impact on the corps of Engineers. While this group represented on average only 3% of the overall officers establishment of the Indian Army in this period, it accounted for 7% of the aristocrats and 5% of the Landed Gentry among them, and only 2% of the officers from middle class backgrounds. 26

In contrast to the Royal Engineers of the home army, then, the Indian Engineers Corps could claim a fair degree of both social and intellectual exclusiveness. Comparative statistical analyses by Razzell 27 further corroborate this with the observations that, contrary to expectation, the Engineer officers of the Indian Army had virtually no demographic connection with the industrial regions of England from which the majority of civil engineers emerged in the nineteenth century; nor did they hail from urban areas in general.

Nevertheless, such aristocratic credentials only enhanced the

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26 Ibid., Table 4: "Status Group and Branch of Service of the Indian Army: 1758-1834", 250.
27 Ibid, 250-251.
fundamental authority of the military engineers in India which was founded upon their academic training.

The academic foundations of the Indian Engineers Corps: Woolwich and Addiscombe

The Royal Military Academy at Woolwich, founded in 1741, was for many years one of very few institutions in England providing a serious scientific or technical education. For that reason, the Artillery and Engineer officers that Woolwich produced were in wide demand well beyond the confines of the military establishment and, as we have seen, often found attractive "civil" appointments.28

The link between Woolwich and the Indian Engineers Corps was forged early in the history of the Academy. Up to the middle of the eighteenth century officer cadets for the Engineers tended to be recruited in India itself or in England by appointment to the Company's Infantry, from which a selected few were subsequently drafted into the Engineers and Sappers. However, the Infantry was generally the preferred line of service and it became difficult for the Engineers to procure the "right stuff". Consequently, in 1765, the Court of Directors began an alternative policy of procuring recruits from Woolwich, and in 1786 the earlier practice of appointing men in India—so-called "Country Cadets"—was disallowed completely.29 The process of tightening up control on selection and knowledge advanced another step in 1798 when the Court of Directors succeeded in having reserved a limited number of places at Woolwich for the direct training of Engineers and Artillery officers for the Company's service. This quota increased quickly from the initial ten students admitted who were allowed to swell the typical Woolwich entrance class of 90 cadets to 100 in 1798, to almost half the class (46/100) by 1807.30

Politics and military operations in India became rapidly more

28 W.J. Reader. Professional Men..., 97.
29 Such field recruits, as opposed to "Europe" cadets, had not been actual "natives", however, but European adventurers in India on "speculation".
complicated with the advent of the nineteenth century, the era of the Napoleonic Wars. The compulsion to overcome the threat of the French and their various alliances with native forces in South India increased the demand for skilled officers precisely when the supply of such from the conventional sources—the British Army and Woolwich—was most difficult to procure.

In this same period, the colonial administration had begun to undergo a significant remodeling under the Governor-Generalship of Lord Wellesley. The Civil servants of the Company, who had hitherto been merely pragmatic pounds and pence-wise merchants, were henceforward to present themselves as gentlemen and statesmen knowledgeable in History, Law, Political Economy and Languages. Wellesley set up a college in Calcutta for the rounding out of the education of newly arrived recruits for the civil administration. This was a short-lived experiment, but an indirect success as it was soon after reconstituted in England as the East India College at Haileybury. This latter institution would be responsible for the training of all subsequent civilian officers of the colonial administration during the company regime. 31

The implications of these developments for both the civil and military branches of the Company regime were significant. While a more sophisticated and perceptive political strategy would increasingly come into play over the course of the 19th century, the essential role of the military establishment in shoring up and executing the power strategies of the British in the South Asian theatre would be abundantly demonstrated. Thus, along with Haileybury, the Company decided to set up its own military college. Accordingly, in 1809 the so-called East Indian Military Seminary was established at Addiscombe House, Surrey to devote greater care to the education of its Engineers and Artillery, of whom a larger number would be required in the future. 32

Cadets were admitted to Addiscombe on much the same terms that applied to the students of Woolwich. Candidates could be as young as 14 years, not older than 18. The admission test required them to demonstrate basic English skills, a command of Latin sufficient "...to construe and

31 Ibid., 6.
32 Ibid., 7.
parse Caesar's Commentaries," and a good knowledge of "...all the rules of arithmetic usually taught in schools,..." which were itemized in the Terms of Admission as "...the Rule of Three, Compound Proportion, Practice, Interest, Vulgar and Decimal Fractions, and the Extraction of the Square-root." 33 Though not specifically tested in the entrance exam, Candidates were advised to acquaint themselves with the broader range of mathematics which would come into the curriculum at a later stage when those ultimately selected for the Engineers Corps would undertake their more specialized professional training. This included Algebra, Geometry, the use of Logarithms, Trigonometry, Analytical Conic Sections, and Statics. It was also considered desirable that a Cadet on joining the Seminary be able to draw with facility in Pencil, and shade with India Ink. 34

Candidates were also required to present references from the "master" under whom they had studied. 35 Such were often private tutors or the principals of so-called "cramming schools" for, in the early 19th century, young gentlemen were still not necessarily expected to have previously attended a formal school. The English Public School tradition had not yet been broadly established as the educational and behavioural foundation it would become in the belief system of the high Victorians.

Tuition and lodging fees at Addiscombe were 100 pounds per year (50 per term) for the two year course of four terms—a relative bargain by comparison with contemporary professional "pupilages". A trainee architect or civil engineer in the early Victorian era could expect to invest something in the area of 1000 pounds in premiums and expenses for four years of articles with a respectable principal. 36

As the one officers' school for all branches of the Indian Army, excepting the Cavalry, the cadets necessarily received a broad secondary education at Addiscombe which was intended to prepare them to pass directly into service in either the Artillery or the Infantry. Meanwhile,

33 East India Company's Military Seminary, Addiscombe House, near Croydon, Surrey. Terms of Admission. (IOLR: MSS Eur. D 1147)
34 Ibid.
35 Ibid.
36 Ibid.; W.J. Reader. Professional Men..., 121-122.
there was a selection and weeding process that went on within the course by which a hierarchy of future officers was determined. Those who were most distinguished in their studies were selected for the Engineers Corps according to the vacancies of that branch. These select few would subsequently proceed for a further course of specific training in civil and military engineering. Those immediately following in order of succession were promoted directly to the Corps of Horse and Foot Artillery. However appointments were not guaranteed to all cadets of Addiscombe as the annual output of qualified graduates did not always correspond to the annual quotas of new junior officers required in the field. 37

If successful in the examinations and at least sixteen years of age, cadets could leave the seminary any time after completing one full year of study in residence. When joining their regiments in the Army Addiscombe graduates took rank above all other cadets recruited "directly" within the period of three months preceding the Addiscombe cadet's qualification. A further perk was the practice of accounting years of service "in India", towards pension and seniority, from the cadet's sixteenth year of age onward regardless of whether they were actually in the field yet or still engaged in their studies at the seminary. 38

Practical instruction: the Chatham course

Addiscombe had initially been conceived to function in complete autonomy from the regular establishment of the British army. However, from 1815 onwards (that experiment having apparently proven to be not entirely satisfactory), those selected for the Engineers were subsequently obliged to proceed to the Royal Engineers Establishment at Chatham—latterly called the School of Military Engineering (SME), Chatham—for further training as Addiscombe's general course was not fully comprehensive in all requisite technical regards. Such included "mining"—that is, the

38 ibid.
special tactical technology and skills of the "Sappers and Miners" Regiment, the men who actually layed mines and constructed entrenchments and other military works—and so-called "practical architecture" which entailed those basics of building construction which any engineer might capably take in his charge. 39 (It was this component of the course that Col. Henry Yule recalled with such disdain in his memorandum on the augmentation of the PWD establishment, referred to earlier.)

In the 1830s, when the majority of the officers holding senior positions in the PWD in the 1860s had undergone their training, the ten month "Standard Course of Instruction in the Duties of Engineers in the Field, and in Practical Architecture" given at Chatham was still evidently regarded as an extension course with respect to the curriculum of Addiscombe, rather than a further "higher" degree. That is, a cadet's performance and grades were always referred back to the Military Seminary Committee at Addiscombe, from which the further qualified Engineer cadet officially graduated upon completion of the course. 40

The Outline of a Course of Practical Architecture which Col. C.W. Pasley, the long time commanding officer and principal of the School of Military Engineering at Chatham, compiled for the use of the officer trainees, offers some instructive insights on the specific "practical" object of the instruction at Chatham. 41

The aim of Pasley's course was to provide that component of the professional's normal training which was conventionally acquired during a trainee's practical pupillage, and which was rarely if ever discussed in the standard treatises of architecture. The course was designed specifically for those young officers in the engineering establishment of the Military who were not in a position to benefit from any special training in architecture, or practical experience of the building industry in England before being sent out to the colonies to fend for

39 Col. C.W. Pasley, R.E. Official Correspondence (1834-1838), Establishment of Field Instruction, Chatham. (IOLR L/MIL/5/411 (296))
41 C.W. Pasley, Outline of a Course of Practical Architecture, compiled for the use of the Junior Officers of Royal Engineers. (First published 1925) (Chatham: Royal Engineers Establishment, Brompton Barracks, 1862).
themselves in all branches of technical competence, military and civil, as was then, in the 1820s, becoming the norm of a career in the Royal Engineers Corps as of course in the Indian corps of engineers. 42

Pasley's concluding remarks in the preface to this course manual addressed the perennial conundrum of the military engineer in peacetime duty. These will serve succinctly to sum up the ostensive belief system we have digressed to discern in the preceding few pages to attempt to discern—that is, the ideology of the particular military service tradition through which the officers of the Indian Engineers Corps were encouraged to perceive their professional role in India.

Pasley argued that a soldier-engineer should and could be in all reasonable regards competent to undertake civil works, such experience serving in fact to hone his technical and managerial skills in preparation for the more traditional war-time challenges of his profession. In a modern, increasingly peaceful world, Pasley reasoned, the military engineers had little choice but to make themselves useful to the Public, if they wished to maintain their number and status in the military establishment:

By combining science and industry with the activity, zeal, and spirit of the military character, and by considering none of the multifarious duties he may be required to perform as a drudgery, since they are all equally useful to his country, the young officer of Engineers has it in his power not only to establish a reputation for himself, but to contribute towards maintaining the fame of his corps as one no less useful in peace than distinguished in war. 43

5. CIVIL RECRUITMENT IN THE 1860s

The "Stanley Engineers":

From a total of 113 engineer officers in the whole of India serving under the "public" aegis of the Military Boards in 1840, the engineers

42 We will consider the actual content of the Chatham curriculum, in Chapter 8. In that chapter we inquire into the design knowledge and skills that the PWD engineers took with them to India.
43 C.W. Pasley. Outline of a Course of Practical Architecture..., S.
establishment of the PWD had grown to 545 members by 1863. This increase consisted mainly of civilians despite the substantially augmented military presence in India in the years following the Mutiny. From a mere handful of 5 in 1850, the number of civil engineers had already matched the complement of military engineers by 1863. By 1870 they were substantially in the majority with 533 out of the total PWD establishment of 896 engineers.44

This rapid turn-around was the outcome in part of a recruiting scheme initiated in 1859 by the Secretary of State for India, Lord Stanley. Appointments under this scheme were intended for young civil engineers in training, who were expected to round out their professional studies upon arrival in India in one of the local engineering colleges. Such novices, it was reasoned, would not object to entering the Department at the bottom of the ladder. These were selected annually on the basis of a competitive examination given periodically at the India Office to fill the specified number of new appointments announced each year by the Government of India. Successful candidates—the so-called "Stanley Engineers"—became "covenanted" colonial civil servants, indentured to the Secretary of State for India for service in one or another of the local or supreme government public works departments.

Candidates for these government appointments were required to be British subjects not more than twenty-four years of age, a criterion which did not necessarily exclude colonial subjects of Britain residing in India though obviously few if any aspirants were expected to journey all the way to London to take their chances in the prescribed examination. Candidates also had to comply with at least one of three conditions: (1) to have passed at least three years of articled pupillage under a Civil, Mechanical, or Mining engineer; or, (2) to have practiced not less than three years under the same; or, (3) to have passed at least one year in practice under any of such qualified engineers, and a further two or more years of study in a school or college accredited by the Secretary of State for India as offering an acceptable course of instruction in one or another of the above mentioned Engineering

44 Daniel R. Headrick. The Tentacles of Progress, 318; Imperial Gazetteer of India, 310.
disciplines. (In 1870 there were 23 different colleges, academies and private schools in the United Kingdom recognized by the India Office in this regard, and four "foreign" institutions including the Ecole Polytechnique of Zurich and McGill College in Montreal.)

As with the haphazard civil recruiting efforts of the Court of Directors in earlier years, the class and calibre of men who presented themselves as candidates for professional employment under Stanley's scheme varied greatly. Of all major occupations which had any claim to be considered professions in Victorian England, engineering was the most accessible to capable men without much money—as well as those less capable who could afford to compensate a practitioner sufficiently for the burden of an unpromising pupil.

Professional standing of the civil engineer in Victorian society:

Although the Civil Engineers of England had established their own professional institution as early as 1818, they had not as yet layed down hard and fast rules by which admission to their ranks was prescribed. Theoretical training and formal accreditation were beginning to be recognized as desirable professional credentials by the middle of the century. But such were a long way yet from being required of all practicing engineers, in the way, for instance, that qualifications were strictly regulated in the medical and legal professions. As the eligibility requirements for the "Stanley" examinations indicate, it was possible to be trained as an engineer through either pupilage, or untutored practice, or a combination of either or both with book learning gathered more often than not through evening courses at mechanics institutes. Such an eclectic training could be acquired for much less than the very substantial sum of £1,000 for premiums and expenses which,

45 "Particulars respecting the competitive Examinations of Candidates for Junior Appointments in the Engineer Establishment of the Department of Public Works in India, to be held at the India Office in London, in July 1870", Collected papers concerning "Engineers' Examinations" Vol.2, 1867–1871 (IOR: L/PWD/B/2).

46 Public Letter (FWD--Gen./Est.) No. 5 of 1860 (Canning to Wood, Headquarters, Camp Lahore, 16th February, 1860).

47 W.J. Reader. Professional Men, 123.
for example, was considered the minimum necessary investment for a proper
pupillage with a respectable architect. While Medicine, Law, and
Architecture increasingly, were rendered socially exclusive professional
domains in consequence of the cost of professional training, as much as
anything else, the engineering profession was still distinguished, indeed
lionized in the estees of Victorian society, by the great "self-made" men
of British engineering of the first half of the century. Among the most
celebrated of such was George Stephenson (1781-1848), the pioneer of the
first steam powered railway, who began his working life as a colliery
workman, so ill-educated that he was almost illiterate. Other examples of
this "rags-to-riches" mystique of the Victorian engineer were the clan of
engineering Napier's—to which belonged Col. Robert Napier, the officer of
the Bengal Engineers Corps whose technical development of the Punjab we
encountered in the previous chapter—who descended from a blacksmith
employed in the eighteenth century by the Duke of Argyll.48

Civil Engineers were among the fastest growing of a wide range of
vocational groups in Victorian Britain that were angling for full
professional recognition of technical and creative disciplines at the
fringes of the traditional domains of professional knowledge. From 853
members of the profession listed in the Occupation Abstract of 1841,
their number increased more than eight hundred per cent in forty years to
a figure of 7,124 accredited members listed in the Census of England and
Wales of 1881. The British population had increased in the meantime by
only sixty-three per cent. "Authors" were the only faster growing
profession; Dentists and Musicians a few steps behind. Architects had
been better established than Civil Engineers in 1841, with 1,486
accredited members, but made less dramatic gains in the period in
question with just 6,898 members accredited in the census of 1881. The
older established professions continued to grow in this period, but only
nominally relative to the general population growth. They were concerned
to consolidate their ranks and weed out poseurs and quacks. Physicians
and Surgeons for example, which was the largest declared professional
group in the Occupational Abstract of 1841 apart from Teachers, actually

48 W.J. Reader. Professional Men, 70-71, 118-124; Margali Sarfati
registered a decline in their accredited number by 1881. 49

Poor employment prospects for civil engineers in the 1860s:

By mid-century civil engineers had accrued sufficient public esteem to begin to legitimize the credentials of their profession as an honourable and progressive calling for the self-respecting young gentlemen of the new middle-class. However, the dramatic rise in the supply of engineers that ensued did not ultimately reflect an equivalent demand for their services. As was indicated earlier, the boom in the growth and esteem of the Civil Engineering profession had been propelled largely by Britain’s transportation revolution of the first half of the century and, along with the other professions, by the social and economic benefits this bestowed. But the technical revolution had already been substantially accomplished by the 1850s and the bottom was beginning to fall out of the "home" market for this new plethora of engineering expertise.

The feverish railway construction in England between the 1820s and 1840s had been the catalyst for both the boom and the subsequent bust in development, with which the as yet only nominally organized civil engineering profession had been caught quite by surprise. The rag-tag tide of self-styled engineers that the boom had spawned, were formed professionally by the tasks they undertook. While the exceptional state of demand had lasted there had been little consciousness of a professional esprit de corps among them, and no compulsion to organize and control their ranks and qualifications. The more brilliant among them had been able to secure positions of authority through which they had managed to further their mastery in their respective disciplines. Those less talented could still get employment as surveyors and draftsmen. In this manner a large body of men had become "...rapidly congregated, with no organization, no security for education, no definite aim but to do the work of the day, --to make as rapidly as possible the railways and subsidiary public works, for which the public found the money." 50

49 W.J. Reader, Professional Men..., Appendix 1: "Table 2: Increase of 17 Professional Occupations 1841-81-1911 and of Commercial Clerks", 211.

50 "Engineering Education", The Builder 28, 1452 (Dec. 3, 1870):

The sudden drying up those funds in the 1850s was perceived by the profession (in retrospect) as the great mistake of the state and the financiers in their all too hasty rush to complete the railway network in one go. The consequence was a stunning cessation of work and ensuing economic depression. The droves of professionals and labourers who had carried the boom found themselves unemployed, and many of the contractors and companies that had not foreseen the bust were ruined. 51

Demand for the services of civil engineers had shown a distinct down-turn by 1860, as a somewhat despairing senior engineer observed in an eloquent paean to his profession published in the Builder. 52 Nevertheless, the social esteem of the profession had never been higher with the consequence that many young men were being inducted into more and more expensive and protracted apprenticeships with established practitioners, but with no reasonable prospects of sufficiently remunerative work once they were qualified to seek it. The author addressed his cautionary tribute to those young hopefuls, not to dissuade them but rather unrealistically to bolster pride in their chosen profession which might gird them for the lean years ahead. The civil engineer was, in his view, the consummate Renaissance man of their age:

Of all the trades, callings, or professions by which men of the present day earn wealth and fame, there is not one requiring more education, experience, and natural talent than that of the civil engineer. To be properly fitted for discharging his various duties creditably, he must understand the theory and practice of land surveying, levelling, mapping, architecture, bridge-building, road-making, railway engineering, construction of canals and harbours, etc., etc., in addition to the mathematical and mechanical training required for the foundation of this superstructure of knowledge, to all of which is to be superadded hydraulics, hydrostatics, pneumatics, geology, chemistry, minerology and other sciences. 53

957-958.
51 ibid.
52 "The Profession of Civil Engineer", THE BUILDER, XVIII, 919 (Sept. 15, 1860): 596-597. The pages of the Builder provided a forum for a lively exchange of views and concerns about the state of the various building professions in Victorian England and its Empire, to which we will refer repeatedly in the following discussion.
53 Ibid.
The development of this noble, all-encompassing vocation must not be manipulated or artificially curtailed for short term economic interests, the author argued, despite the current shortfall in the market for such services. Aspirants were advised to be prepared to support themselves independently, "...to labour for practice, and the information acquired thereby..." But, for the profession to adopt the practice of certain of the trade societies of limiting the numbers of apprentices a master could employ to insure against the oversupply of services, was thought to be an unprofessional "fettering" of the action of the individual practitioner.

Clearly the profession was not really traumatized by this hiccup in the course of technical progress. The accomplished engineer could afford to subsidize his unemployment on the surplus gained in the first boom. Meanwhile the profession could continue to grow as the younger men exploited the greater wealth and opportunities of the British Empire available to them in the colonies. The Government of India's marked new demand for engineers from 1859 onwards was therefore timely and welcome, and the terms and civil orientation of Stanley's recruiting scheme may well have reflected a certain political deference for an up and coming element of the middle class electorate.

Yet, surprisingly, the invitation of the India Office to compete for covenanted positions in the Indian PWD was never as avidly responded to as expected. In general the number of candidates barely exceeded the number of appointments such that there was only nominal competition. The prescribed examination, which covered essential skills and knowledge in mathematics, engineering and surveying, therefore tended to serve only as a qualifying test rather than a means of selection. As it was, usually only a portion of the candidates were successful in passing this examination such that the annual quotas of the PWD were met in only five out of the twelve years during which the Stanley scheme was in effect. Towards the end of this period, when the Government of India further augmented its demand for engineers in preparation for the second phase of Indian railway development—which was to consist primarily of "State railways" to be undertaken directly by the PWD itself—it was compelled to make urgent additional requisitions for men from England. In 1867 alone seventy such additional recruits were sent out to India on top of the successful examinees. In the circumstances, however, these had to be
picked up as best they could be, with the inevitable shortcomings of the old haphazard recruiting methods of the days of the Company administration. 54

Grievances of the civil members of the PWD:

The feeble enthusiasm with which career opportunities in India were pursued by civil engineers was analyzed at some length in a letter submitted in 1865 for publication in The Builder, the influential trade journal of the British building professions, by an anonymous correspondent described as "one of the senior and more fortunate" of the Stanley Engineers then serving in the Indian PWD. For the benefit of those young engineers who might be considering an Indian career, the correspondent sought to describe the professional conditions of service with which the civil engineers of the Indian PWD were compelled to contend, and to communicate in the same effort several grievances which the civil branch of the Department felt it might, with justice, posit against the Government of India. 55

The average status and qualifications of the candidates for "Stanley" appointments in the PWD had fallen off quite distinctly after the first few years of recruiting. This, it was argued, was a reflection of the inadequacies and injustices of the civil engineer's lot in the Department, news of which had percolated back Home in the accounts of the first few Stanley engineers. Qualified engineers with a few years of practical experience were evidently able to market their services to better paying and more respectful employers at home or in the settler colonies such as Australia or Canada. The writer did not believe it was the desire of the Government to recruit green, relatively untrained youths for service in the Department. Rather, he saw this as the consequence of a niggardly underestimation of the civil engineering profession for neither the pay nor the status offered as first

55 "Public Works Department in India", THE BUILDER, XXIII, 1185 (Oct.21, 1865): 743-745. All references and quotations in the following section are taken from this article.
appointments to the Stanley Engineers were sufficient in his view to attract the class of gentlemen the Department surely desired to comprise its engineering staff:

If the Government would appoint the Stanley Engineers as first-grade assistants upon landing, they would attract a better class of men than they can expect to get at present.

They should require two years practical experience in all cases, and should raise the minimum age. The last two or three batches have consisted largely of very young men, from "cramming schools;" and scarcely more than one or two articulated pupils of engineers of any standing have entered of late years.

The correspondent dwelt at length on the issue of pay. The salaries in 1865 of the several grades of the engineer establishment were as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>£'s/annum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief and superintending engineers</td>
<td>1,200 to 1,380</td>
</tr>
<tr>
<td>Executive engineers, 1st grade</td>
<td>1,080</td>
</tr>
<tr>
<td>&quot; 2nd grade</td>
<td>900</td>
</tr>
<tr>
<td>&quot; 3rd grade</td>
<td>720</td>
</tr>
<tr>
<td>&quot; 4th grade</td>
<td>600</td>
</tr>
<tr>
<td>Assistant engineers, 1st grade</td>
<td>480</td>
</tr>
<tr>
<td>&quot; 2nd grade</td>
<td>360</td>
</tr>
<tr>
<td>&quot; 3rd grade</td>
<td>240</td>
</tr>
</tbody>
</table>

The period of service in each grade varied greatly, according to merit, luck, and interest, but the average for civilians in the department was:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Executive engineers, 1st grade</td>
<td>3</td>
</tr>
<tr>
<td>&quot; 2nd grade</td>
<td>3</td>
</tr>
<tr>
<td>&quot; 3rd grade</td>
<td>4</td>
</tr>
<tr>
<td>&quot; 4th grade</td>
<td>2.5</td>
</tr>
<tr>
<td>Assistant engineers, 1st grade</td>
<td>3</td>
</tr>
<tr>
<td>&quot; 2nd grade</td>
<td>1.5</td>
</tr>
<tr>
<td>&quot; 3rd grade</td>
<td></td>
</tr>
</tbody>
</table>

At this rate, a member of the PWD engineering establishment could expect to take an average of twenty years to reach a salary £1,200. The first batch of Stanley Engineers had only been in service for six years by this point and the highest post any of them had reached was Executive engineer, 4th grade. (3 in all, the rest remained Assistant engineers, 1st grade). Comparison of the standing of these civil engineers, after six years of service in the PWD, with that of railway engineers, or
officers in other departments of Government service, such as the army staff, the medical service, and the civil service, showed the PWD servants to be underpaid. Railway engineers, along with officers in the medical and civil services, began with salaries in the range of 400 to 500 pounds sterling per annum, what the civilian engineers of the PWD could only hope to receive as a 1st grade Assistant Engineer after at least 4 to 5 years of service. Even an army Lieutenant, whose work and qualifications were considered very meager indeed, began service in India at a salary of £300 per year.

On top of this parsimony the correspondent claimed that living costs in India were such that salaries considered adequate in England had less than half the equivalent buying power in India. A man would

...be no better off with 1,000 [pounds sterling] out here than with 500 in England. Clerks and shopmen, who would be paid 60 to 100 [pounds] a year in England, receive 250 to 400 [pounds] in India...[It] is the opinion of the writer that no young man of decent abilities who can obtain any employment in England or elsewhere, on however small a salary, would be prudent in coming out to India for less than 400 Rupees per month [i.e. 480 pounds per year]. That is the lowest salary upon which any one in the position of a gentleman can live with ordinary comfort. Even this will not admit of many luxuries.

But the principal grudge the correspondent presumed to express on behalf of his fellow "Stanley" recruits concerned their relative social status within the PWD. On the one hand they were refused parity with the military engineers of the Department. On the other hand they begrudged the insufficiently differentiated distinction between themselves--"covenanted" civil engineers sent out from England—and the "local" product of Roorkee and the other Indian civil engineering colleges. Frustrated by their oppression by the military class, the Stanley engineers sought to claim the privileges of a superior "professional" status of their own, at the expense of the locally spawned Roorkee men, Europeans as well as "natives", who were evidently perceived to be only semi-skilled provincial lackeys with no right to presume equality with the young professionals sent out from Home:

The Government has admitted the principle of allowing for past experience by bringing in several young officers of the Royal Engineers as assistants of the first grade, on the plea that they had been employed on works at home. A similar
consideration should be shown to Civil engineers. At present, civilians who have been two years at the Roorkee College (where they are educated at Government expense), and who have had no practical experience at all, are admitted on exactly the same footing as the Stanley engineers, who are required to have had three years professional education at their own expense, and who must, according to the rules, at least, have had not less than one year’s practical work.

Differential treatment for soldiers versus civilians in the PWD was the Stanley engineers’ greatest bone of contention. In all other civil departments, and even in the semi-military police department, salaries were "consolidated" such that both civilian and military officers of the same grade were paid alike. The PWD was an exception in this regard where soldiers received their regular army salary as well as a separate departmental salary. This could sometimes amount to actual net incomes of twice the earnings of civilians holding the same appointments and doing the same duties, and the not uncommon circumstance of a military subordinate earning more than his civilian boss. The correspondent offered the following comparative table of respective monthly salaries (in Rupees):

<table>
<thead>
<tr>
<th></th>
<th>Military</th>
<th>Civil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chief engineer</td>
<td>1,827Rs.</td>
<td>1,400</td>
</tr>
<tr>
<td>Superintending engs.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st grade</td>
<td>1,627</td>
<td>1,200</td>
</tr>
<tr>
<td>2nd grade (Lt.-col.)</td>
<td>1,527</td>
<td>1,000</td>
</tr>
<tr>
<td>Executive engineers,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st grade</td>
<td>1,240</td>
<td>900</td>
</tr>
<tr>
<td>2nd grade (Major)</td>
<td>1,140</td>
<td>750</td>
</tr>
<tr>
<td>3rd grade</td>
<td>792</td>
<td>600</td>
</tr>
<tr>
<td>4th grade</td>
<td>692</td>
<td>500</td>
</tr>
<tr>
<td>Assistant engineers,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1st grade (Captain)</td>
<td>642</td>
<td>400</td>
</tr>
<tr>
<td>1st grade</td>
<td>442</td>
<td>400</td>
</tr>
<tr>
<td>2nd grade</td>
<td>392</td>
<td>300</td>
</tr>
<tr>
<td>3rd grade</td>
<td>304</td>
<td>200</td>
</tr>
</tbody>
</table>

The favoured status of the military officers extended to their pension terms which guaranteed a stipend of £200 per year after twenty years of service, while the civilian staff of the department had to serve a full thirty years before they were entitled to apply for a pension and then it was not guaranteed but only "given as a matter of favour".

Promotion also came quicker and easier to the military establishment than to the civilians by a system that could be described as "one of combined seniority and selection, considerably modified by luck and personal interest at head-quarters."
As of 1865 the whole of the PWD secretariat and the twenty highest posts in the department were in the hands of Royal Engineers, hence it was no surprise in the correspondent’s view that the system operated with such partiality on behalf of the military officers. *Esprit de corps* was something he could understand; he could not accept, on the other hand, the Government’s ignominious insistence on the theory of equality where clearly it did not exist. If the fact of preferential advancement for Royal Engineers were properly declared as standing policy, the civil engineering establishment could not, at least, claim to have been deceived, though the attractions of service in India would likely have been even further diminished.

Meanwhile, the proportion of civilians to soldiers in the engineering establishment of the Department was already two to one and growing (a rather exaggerated approximation, to my knowledge), chiefly because of the early retirement after twenty years of service of most military officers while the civilians were compelled, by their delayed pension privileges, to slog on for another ten years.

A final grievance put forward in this exhaustive testimonial was concern over the departmental practice of recruiting “outsiders” to the more senior engineering posts in the "Minor Administrations" under the Supreme Government such as Burmah, Oudh, Mysore, and the Central Provinces. Such outsiders included freelance railway engineers “staying on” in public service after completion of their original short term construction contracts with private railway companies. These interlopers further diminished the expectations of the civilian career engineers for just and regular promotion in the Department. Such external recruits may well have been deemed necessary, with respect to the skill and experience they did on occasion bring into the department, the calibre of junior engineering staff having noticeably diminished in the preceding few years. However, in the correspondent’s opinion this fact only emphasized the need for reform in the recruiting and advancement policies of the PWD. "Let the Government but offer liberal terms, and convince the public of their good faith, and..." he concluded, "there will be no lack of qualified candidates."
Fig. 6.1. "...The transformation of John Dobbs from honest English workman, earning 15s. a week, into East India Company Civil Engineer, earning £300 a year." Source: Cartoon from the Delhi sketchbook (a newspaper published at Delhi in the 1850's) as reprinted in D. Judd. The Victorian Empire, 1837-1901: A Pictorial History. New York: Praeger, 1970. A satirical jibe from the "Civilian" establishment of British India at the new-comer Civil engineers, who had just begun to make their impress on the Anglo-Indian scene, in the early 1850's.

6. PROFESSIONAL COMPETITION BETWEEN CIVIL AND MILITARY ENGINEERS

Competence vs. Privilege: the civilian assault on the Corps of Royal Engineers

The unequal battle of civil engineers with their military counterparts in the Indian Public Works Department was just one theatre of conflict in a struggle that was simultaneously being waged in England and various other corners of the British Empire wherever the Royal Engineers Corps was
engaged in building or managing works. What was really at issue, it appears, was the distinction between professional authority and institutionalized privilege. These were confused and the former undermined, in the civilians' opinion, in the service tradition of the military engineers. The civil engineers sought privilege themselves, of course; particularly access to lucrative government works, military and civil, which had traditionally been the monopoly of military engineers. But, as long as this was denied them the elitism of the Military was a useful scapegoat on which to vent their frustrations.

Through the 1850s and 1860s the Builder fielded a heated campaign of grievances on the part of civil engineers and architects concerning the alleged professional inadequacies of the Royal Engineers. This polemic of competence versus privilege directed attention to technical deficiencies and professional negligence demonstrated in a wide range of civil and military buildings, and public works, in England and abroad, for which officers of the Royal Engineers had been responsible.

On "Home" ground the assault concentrated on the issue of barrack design. The construction and maintenance of accommodation for the troops was among the most basic responsibilities of the military engineers, yet one in which they had a particularly poor track record with regard both to the quality and economy of their designs, and to their essential effectiveness as collective habitations for the maintenance of healthy, operational troops. This critique efficiently brought to the fore, in an explicit architectural example, the elitist disconnection with modern social realities and obligations of the upper strata of British society, which had fallen back on the military establishment as a refuge from the increasingly populist Liberalism of the Victorian age. The alleged failing of the Royal Engineers to embrace and apply the principles of modern sanitary science in the design of such barrack buildings indicated

56 This tendency was observable in a broad sociological sense. However, as discussed earlier, detailed historical analysis of the relationship of the British and Indian Armies to changing British society in the nineteenth century indicates some complexity and interesting exceptions to the attendant hypothesis that the upper social stratum concentrated its numbers in the honorific institutions of the military most closely linked to the old feudal order of society. P.E. Razzell, "Social Origins of Officers in the Indian and British Home Army: 1758-1962," 248-260.
a reactionary insensitivity, in the estimation of their critics. The barrack design issue was an instance of the larger contemporary issue—much debated at the time—of the obligations of enlightened society to sanitary reform and the improvement of the housing conditions of the working class poor.

Launching the assault in the Builder in 1858, was a frustrated civil engineer and erstwhile military architect who spared no pathos in framing this question of professional negligence in the grandeur of the imperial tableau:

Will a nation that so eagerly responded to appeals on behalf of the Crimean or Indian sufferers, or that employs its power to sever the chains of the African slave, look without sympathy upon this subject, and continue unaltered a system proved to have destroyed so many of our bravest sons by means, perhaps, less revolting than the savage massacre of Cawnpore, but, nevertheless, equally odious in our eyes and certain in its effect? That the evils complained of are traceable to the ill-arranged and badly-ventilated barrack accommodation we cannot for a moment doubt, when we consider the facts now made known by the Commissioner’s report. It is not possible to preserve health in such apartments as have been illustrated in late issues of the Builder. "...[W]ith few exceptions, every barrack in the kingdom is most defective, and that notwithstanding the enormous amount annually expended through the medium of the Royal Engineer Department, there is not that improvement which the public has a right not only to expect, but to demand...

The Royal Engineer officers were, in the correspondent’s view, a louche gang of upper class reproaches who failed to demonstrate professional skill or responsibility, living like lords in their opulent officer’s quarters while the wretched soldiers of the Queen’s forces and their families succumbed like flies to the negligence of their inept barrack designs:

As a nation, we liberally provide means sufficient, in judicious hands, to maintain our military establishment in a

57 "Royal Engineers versus Military Architects: conditions of barracks", THE BUILDER 16, 790 (March 27, 1858): 207.

58 The Builder had headed off two earlier issues that same month (March 6 and 13, 1858) with lengthy editorials on the allegedly deplorable sanitary conditions in various military barracks in the metropolis.
state worthy of our position amongst other nations; and it is a sad reproach to us to find that means in the hands of improper or incompetent officials fail to accomplish the ends desired. At present the majority of our barracks might be defined as irregular piles of buildings thrown together without order or arrangement, disregarding even the ordinary requirements of those who are expected to occupy them.

The writer went on to offer his prescription for the reform of this unacceptable state of affairs. The details of such are not so much of interest to us in the present discussion. But his further critical observations on the organization of knowledge and procedure in the military system of the Royal Engineers, which emerge from his suggestions, tell us something about the respective conceptual systems of these opposing civil and military professional factions.

The writer recommended that a scheme for the general improvement of all existing barracks be carried out immediately. This would establish the new minimum standard for all future design and construction in this vein. He further recommended that competent persons (presumably civil engineers and architects without the unprofessional conflicts of interest of the Royal Engineers' corps) should be entrusted with carrying out the details of such a scheme, and preferably in a permanent capacity such that the particularities of a specific locality that might have a special bearing on the optimum interpretation or adaptation of the general guidelines to that locality might be intimately known by the engineer concerned. The Royal Engineers tended to be rotated through numerous postings for short intervals and thus were at a disadvantage to build appropriately in many cases for lack of knowledge of local building practices. This was further exacerbated, in the writer's view, by the hierarchy of military authority which called upon superior officers to exercise decision-making powers by virtue of rank regardless of their usual ignorance of the particulars of the problem concerned. The hierarchical logic of the bureaucratic organization of knowledge in the Military had, he concluded, encouraged a "...circumlocution of official red-tapeism which now usurps the place of independent professional knowledge."

59 We will return to the issue of barrack design in more particular detail in the next chapter.
The propagation of the Royal Engineers’ system abroad:

This technocratic predilection of the military mentality was the crux of the problem, as civilian practitioners perceived it. The Royal Engineers system seemed to be incompatible with the logic of professional conduct. Nevertheless this counter-productive system had propagated itself extensively, according to its bureaucratic logic. An executive hierarchy of military officers directing a substantially civilian cadre of subordinates, similar to that which was evolving in the Indian PWD, could be found in most corners of the Empire where the local British administration had any commitment to public or military works and buildings.

In Bermuda for instance—as we learn from the grievances of yet another disgruntled civil engineer, whose case was aired in the pages of The Builder in 1858—^—the works department was lorded over by a handful of Royal Engineers who took all the credit for the work of their department in addition to the lion’s share of the payroll. In fact, the salaries of the five military officers in question almost equaled the total budget expended on actual works on the island. Yet their personal productivity was alleged to be negligible. Although “...deprived in the most unjust manner of the credit of their professional labours...,” the civilian subordinates of the department (including the clerk of works whose testimonial we quote) effectively did all the work, for the military engineers were purportedly “...incapable of performing any important professional duty, of themselves...” While the system furnished them with authority, the military engineers nevertheless found themselves in a situation of dependency for lack of relevant practical knowledge. The memorialist actually claimed that neither he nor any of his civil colleagues in Bermuda had ever witnessed their military superiors lift pencil to paper to make an original drawing or an estimate. He was quite convinced, in fact, that they were incapable of the task. 61

The academically cloistered training of the Royal Engineers was

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61 ibid.
regarded, therefore, as the other significant problem behind this unsatisfactory state of affairs. A few months of practical instruction at Chatham could hardly equip the Royal Engineer officers with the necessary hands-on knowledge of practice which civil engineers gathered only through years of on-the-job experience under the pupillage system of professional training.

In the case of the Bermuda works department this practical ignorance of the Royal Engineers served obliquely to exacerbate the incongruities and injustices of the hierarchical system of authority as the proud young gentlemen officers were inclined to cover-up their professional incompetence by pulling rank on their civilian colleagues. The latter not only had to suffer this humiliation but exert themselves doubly to correct the errors of their impudent department heads, most of whom tended to be their juniors with regard to age. 62

The integral role of civilian technical staff in the operations of the Royal Engineers Corps was officially recognized in the "Engineer Code" in which the rules and regulations of the Corps were laid down. In principle civil officers held the equivalent ranks of commissioned officers in the military, a first class clerk of works being entitled to the authority and respect accorded a "Captain" in the officers corps. In practice, however, such respect was not forthcoming. Again in the case of the civilian works establishment in Bermuda, our clerk of works alleged he was regarded only with contempt and mockery by officers and enlisted men alike, and even by labouring convicts, as at best a non-commissioned officer whose orders were worth nothing without the sanction of a bona fide military officer. 63

Political reception of the argument for reform:

Public esteem for the military had reached a low point by the late 1850s, following the disastrous Crimean War which had broken out in 1854 and ended only shortly before the ensuing calamity of the Indian Mutiny. 64 As

62 ibid.
63 ibid.
64 to which many British regiments were sent directly from the Crimea
such the calls for reform in the Royal Engineers department, along with other branches of the military establishment, found generally sympathetic ears among British politicians. Lord Stanley’s snubbing of the military establishment with his initiative in 1859 to recruit civilians for the Indian Public Works Department was evidently an active response to the civil engineers’ lobby in Parliament.

The grievances of the clerk of works in Bermuda actually made it all the way to the House of Lords where they were tabled in a debate of 1858 provoked by the much publicized attack on the Royal Engineers with regard to the issue of sanitary barracks design. However, for all its polite attention, the Government was not inclined to regard the alleged deficiencies of the Royal Engineers with the same degree of indignation as the civilian plaintiffs. In the debate there was a good deal of parlaying of the issue back and forth, questioning, from the military recollections of the various noblemen, whether or not the problem was really as bad as the press was tending to represent the case. For the time being the policy makers arrived at a mollifying consensus in the notion of "Progress" which appeared to diminish the urgency of any immediate reforms in the case of the Royal Engineers Corps. It was the nature of "Progress" to challenge what had been considered perfectly acceptable standards in the past, they argued. In the case of building standards expectations concerning health and comfort had been rising with the times, such that what had sufficed as reasonable in the past was now considered intolerable, and what was now considered an acceptable minimum standard would surely need to be revised yet again in the future.65

Similar arguments on these relativistic lines could be offered in defence of the service traditions, methods, and conceptual framework of the Royal Engineers Corps, which had achieved much in the past though now they posed an obstacle to the ambitions of a new profession desirous of upward mobility.

The verbal battle between civil and military engineers continued on


through the 1860s with little substantial change to the balance of power though, as we have seen, the proportion of civil engineers in government service increased substantially in the meantime.

The Ganges Canal Inquiry:

Back in India the balance of opinion finally began to tip in favour of the civilian usurpers in 1865 when critics of the military engineers' competence were blessed with the sensationally embarrassing public disclosure that the preeminent achievement of the Indian Engineers Corps, the Ganges Canal, had proved to be seriously flawed in its design.

Soon after its inauguration in 1854 it was discovered that the canal had been designed with too steep a slope such that the excessive velocity of the water coursing through it was scouring the canal bed. But the Mutiny had prevented engineers from taking any significant remedial action apart from restricting the flow of water to a fraction of its theoretical capacity. 66 A decade later, however, it was becoming ominously apparent that major repairs had to be undertaken soon as this scouring action was beginning to undermine the major head works of the canal including the Solani aqueduct. As James Thomason had foreseen at the outset of India's major irrigation development two decades earlier, this had serious implications, quite apart from the material and professional costs, as any closure of the canal for repairs could destroy a whole new agricultural economy that had developed rapidly in the few years of the canal's operations in complete dependence on the artificially engineered supply of water. 67

The heroic bravado of the 40's and 50's had been sobered somewhat by this set-back, and members of the Public Works Department, among them certain indignant military officers, descended to open inter-fraternal criticism and recrimination over this serious and embarrassing instance of design failure. A committee of inquiry comprised exclusively of Royal Engineers of the Department was set up in 1864 to look into the matter.

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66 Headrick, The Tentacles of Progress. 179.
But its official report, published in August 1865, was considered too
deferential. The committee had not approached the problem with sufficient
objectivity and foresight in the opinion of its critics including Sir
Arthur Cotton, the famous Madras Engineer responsible for the major
irrigation works in the South who appears to have been determined not to
have his reputation sullied by the errors of his colleagues in the north.
Accordingly a second committee was convened in 1866 consisting of
engineers, civil and military, with less direct interest and pride at
stake in the outcome of the affair. On the basis of this second
committees's recommendations the problem was gradually rectified.

But the affair had drawn attention to the deficient practical
knowledge of the Indian Engineers Corps and the potentially disastrous
implications of design failures with the extensive scale and
ramifications of the works those engineers had been carrying out. The
designer of the canal, Col. Proby Cautley, had relied on the best
existing theory available, using the formulas devised by two French
hydraulic engineers, Dubuet and Prouy, to calculate the slopes. But, the
great scale of the Ganges Canal, and its particularities with regard to
soil mechanics, were so unprecedented that such a straight-forward
application of theory had been decidedly naive. Cautley had actually been
better placed to add data to the search for empirical design formulae
than the existing formulae were in a position to guide the design of so
singular a project.

Civil engineers pounced on the findings of the official inquiry, and
once again used the pages of The Builder to articulate their critique of
the manifest incompetence of their military counterparts and hence, the
Government's misplaced trust in the institution of the corps of military
engineers. For the purposes of their polemic, Cautley and his
collaborators exemplified the dilettantism of the gentlemen-engineers who
emerged from the cloistered sanctum of the military academy with an
extensive smattering of theoretical knowledge but with no real experience.

68 ibid.
69 Joyce Brown. "Sir Proby Cautley (1802-1871), a Pioneer of Indian
Irrigation," History of Technology 3 (1978): 69. As cited in Headrick,
Tentacles of Progress, 179.
of practice and professional judgment to guide them in the application of	heir book-knowledge in the field. The critics lamented the waste and
expense of Cautley's error, above all the opportunity that had been lost
for more appropriately qualified civilian members of the profession to
employ their expertise in India on this and other of the Public Works
Department's grand projects.

Deteriorating professional relations in the Indian PWD:

With the Ganges Canal affair, the argument for a more responsible
involvement of civil engineers in the PWD appears, finally, to have
succeeded in winning some support from the policy makers—at least with
regard to the irrigation branch of the Department. By the end of the
1860s major new schemes such as the projected Eastern Ganges Canal were
being planned and designed entirely under the authority of civil members
of the Department, who had begun to fill posts as high as Superintending
Engineer in the departmental hierarchy. But the general lot of civilians
in the Indian PWD was still far from equitable with their military
colleagues. Over the course of the 1860s the frustration of the civil
engineers increased, and the tone of the debate between the rival camps
became increasingly vindictive. By the end of the decade the issue was
once again placed before Parliament as the civilian's grievances and
bitter attacks began to be countered by the military establishment with
equally aggressive allegations concerning the professional integrity of
their civilian rivals.

In late 1869 the civil members of the Department were provoked to
make a virtual declaration of war. This took the form of a pamphlet
published in London which reproduced the text of a letter to the
Secretary of State for India in which the "objectionable treatment" of
the Civil Engineers' establishment in the Indian PWD by the military
hierarchy was once again decried. The letter had been prompted by what
were interpreted as particularly derogatory allegations tabled in a
recent Memorandum of the Government of India (presumably on the advice of
the military hierarchy of the PWD) to the effect that the Civil

71 "The Projected Eastern Ganges Canal," THE BUILDER 28/1447
(Oct. 29, 1870): 863.
establishment had been improperly accepting "commissions" with respect to the execution of their professional services in the department, in addition to their salaries. The Civil engineers had been profoundly insulted by this scarcely concealed accusation of graft and their letter described the now seemingly irreconcilable state of relations between the two professional cadres:

Of course, the Military officers of the Department of Public Works cannot expect that the civil engineers of the department will ever again be able to act with any cordiality; and by their intended impeachment of both probity and skill of an educated large, and influential profession, they have not merely provoked inquiry into the affluence of their own skill, and the sublimity of their own virtue, but have opened issues they will never be able to close. The railway works which have been carried out in India by English engineers, in spite of a few failures in the bridges of one particular line, have been executed in a skillful and creditable manner, and have been completed in the course of a few years, while the whole works of the antecedent century, during which military men have been alone employed upon such undertakings, have been few in number, and, in general, poor both in design and execution—the native idea generally shining through a thin varnish of European art apparently elaborated from books.\textsuperscript{72}

The pamphleteer was not without some respect for certain achievements of the military engineers in the old days of the Company. There were still some old-timers in the military establishment whose "zeal, sagacity and talent" had been amply manifested in their works, and whose combination of tried and tested technical knowledge and long-term acquaintance with the country and the languages of India could not be possessed by newcomers. Such men still had very obvious services to offer, if they could be utilized "by some suitable arrangement". But, if the work of the public and technical improvement of India was to be carried out in earnest, an organization of civil engineers of sufficient strength to be proportionate to the magnitude of the task would have to be properly established with a clear mandate to carry out that initiative. The Military men, on the other hand, would be much better disposed to undertake their proper calling at the head of regiments of

\textsuperscript{72} "Indian Works and English Engineers: A letter to the Duke of Argyll, Secretary of State for India, By John Bourne, C.E., Longmans 
Sappers and Miners in constructing much needed "roads and works of strategical importance" in the hills.

While the military establishment still maintained control of the PWD, however, it was not disposed to be limited by such categories. In fact it was poised at that moment to expand its civil mandate still further.

The issue came to a head in the following months as the Government made its intentions clear with regard to future railway development in India. Whereas the first phase of development had been undertaken wholly by private railway companies which had engaged their own engineering staff to design and superintend the works, the Government now intended to build "State" railways, to extend and complete the system, which would be carried out directly by the railway branch of the PWD. While this would in fact create many new positions in the PWD for civil engineers, it promised at the same time to compromise their professional autonomy in the only area of technical development in India in which they had so far maintained the manner of professional authority and freedom of agency they were accustomed to in standard practice in Britain.

In view of this potential further set-back to their professional progress in India, the civil engineers were provoked to take even more aggressive political action at this point. With the representation of a sympathetic M.P. named Kinnaird they called for the appointment of a Parliamentary Committee on Indian Public Works that would be compelled to investigate their grievances in full and present its findings to Parliament with recommendations for remedial legislation, if necessary.

Meanwhile, Kinnaird set about preparing the case by sending out a circular to all civil engineers in the Indian PWD inviting them to submit information to him, in confidence, "...bearing upon the incompetence of military engineers, and the inefficiency of the department under their rule..." As illustrations of the manner of incriminating information he sought, Kinnaird listed various known instances of such incompetence including the "disgraceful failures" of the suspension bridges and

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73 ibid.

74 This call was evidently heeded in the form of the Lansdowne Committee of 1870.
Custom-house sheds at Calcutta, and the recent collapses of a barrack building at Nusseerabad and an unfinished church at Jubbulpore. 75

But Kinnaird's key concern was to make a case against the new departmental policy of railway development which threatened the interests of the British contractors and railway financiers who had profited in the initial phase of railway building in India, along with the civil engineers. Towards that end his circular also sought testimonials of "...instances of the absurd discrepancy between original estimates and actual cost of works..." These, he explained, would "...help capitalists to determine how much confidence they may place in the assertions of the military engineers as to the great saving they mean to effect in the cost of railways." 76

The circular went on to surmise that a comparison of the time and money expended by the military dominated PWD on its great works of communication and irrigation, such as the Bari Doab and Ganges Canals, the Grand Trunk Road, etc., with the outlay and duration of the major railway works completed under the standard contractual system by civilian engineers would be very unfavorable to the military engineers and thus of great value in building the case for the advancement of the civil engineers in India. For all their theoretical knowledge the military engineers were, further, accused of basic technical backwardness, especially in any area touching on mechanical engineering. From the point of view of their civilian rivals they were an irrational and reactionary lot, "opposed to all improvements" and possessed of the "...inveterate propensity to be penny wise and pound foolish." 77

All of this Parliamentary lobbying had some ostensible success. The derogatory accusations by the Government of India concerning alleged improprieties committed by civil engineers in the PWD were hastily withdrawn in a departmental Circular issued in October 1869 in which the Government attempted to disavow any implication of impropriety on the part of the civil engineers, while insisting that the civil norms of professional practice and its mode of remuneration back in England were

75 "Engineers in India," THE BUILDER 28/1413 (Mar. 5, 1870): 183.
76 ibid.
77 ibid.
simply not compatible with government service in India. In the first edition of the PWD Code—which had evidently been drafted from the salaried, duty-bound point of view of the military engineers—the question of "commission" had been overlooked. Future editions of the Code would therefore be explicit on the matter. Meanwhile, the Government of India "unreservedly" wished to declare its complete confidence in the body of Civil Engineers in its service. The circular concluded with promises that the Civil Engineers' just cause for equal status and remuneration in the PWD was presently before the appropriate authorities of the Government of India, and would be soon be acted upon.\(^78\)

The Government did immediately set about drafting a revision to the constitution of the PWD whereby, in future, the civil establishment was to be placed on an "improved footing", their emoluments to be made "in every way equal to those of the military employees". Typically, however, the administration was slow in implementing these reforms, and inconsistent even in its procrastination. Civil engineers recruited for the new state railway works were treated most favourably, their salaries equalized with their military counterparts retroactive to their first appointments in that branch the year before; but civilians in other branches of the Department were offered only future parity and no such retroactive compensation for past wages due. Meanwhile, military officers who officially maintained active fighting status—"on call", that is—with their regiments were still to receive an additional "retaining fee" on top of their standard departmental salaries.\(^79\)

The military engineers still had the upper hand in the Public Works Department.

The counter-attack of the military establishment:

After over a decade of ragging by their civilian rivals (who outnumbered...
the military members of the Department by a ratio of 3:2 by 1870\textsuperscript{80}, the military hierarchy of the PWD had been compelled to make some concessions of power and privilege. However, their pride and conviction in the merits of their traditional academic training and their bureaucratic notions of professionalism, had if anything been strengthened by the prodding of their critics. The, at best, middling success of the various efforts to recruit capable civilian professional expertise for the PWD over the preceding two decades, offered all the evidence the Royal Engineers in India felt they required to throw the civilians' accusations of professional incompetence right back in their faces.

From the outset Lord Stanley's recruiting scheme had been a failure in the eyes of Royal Engineers such as Captain R. Maclagan, the principal of the Thomason College at Roorkee (1847-52, 1856-60), who was charged with the task of rounding out the training of those civil recruits upon arrival from England, prior to taking up their first posts in the Department. In his annual report on the progress and performance of the college for 1859-60, Maclagan complained that the poor quality of the candidates had evidently allowed for little sensible pre-selection to be exercised in the recruitment of the first batch of probationers sent out under the scheme in 1859. Besides being "extremely deficient" in their theoretical knowledge of Maths and Engineering, practical knowledge of their profession and of those domains relevant to Indian works, was in several cases extremely limited as well. If these young hopefuls had not spent their pupilages entirely at desk work, their practical experience likely consisted of a mechanical specialty of little applicability to the usual range of civil works undertaken by the Indian PWD.\textsuperscript{81}

The deficiencies of the majority of these competitively selected and hence supposedly superior products of contemporary civil engineering training in England were such that Maclagan was uncomfortable in placing them in the same classes with the regular students of the college. In

\textsuperscript{80} G. Chesney. Memorandum on the establishment of a Civil Engineering College for India, 7th Oct. 1870, pp. 4-5. Included in W.T. Thornton, Secretary, Public Works Department. Return to an Address of the Honourable House of Commons, 16th March 1871, for "Further Papers relating to the Indian Civil Engineering College." (IOR: L/PWD/B/9).

\textsuperscript{81} Canning to Wood, Camp Bhugwan Talao, 18th Dec. 1860. Public Letter (PWD--Gen./Est.) No. 20 of 1860.
order to win admission to the department the latter had to strive to attain a much higher standard of professional knowledge through their studies than did the "Stanley" students, whose appointments had already been secured for them. Indeed, the regular students were required to matriculate from the Calcutta University as a basic prerequisite for admission to the Thomason College, a qualification far in excess of those the typical probationers from England had earned. In fact some of the probationers were so insufficiently schooled, Maclagan found, they could hardly make use of the courses at Roorkee. For these various reasons his subsequent recommendation that the Stanley recruits be excused altogether from this supplementary academic training was soon accepted, if only to avoid wasting time and expense on the part of the Government which was anxious in the early 1860s to get as many new men into active engineering service in the field as quickly as possible. 82

Thus, the majority of younger civil members of the engineers establishment recruited from England were presumed, with some cause, to have inadequate training in both theoretical and practical aspects of the discipline, in the estimation of their military superiors in the Department.

Critical reflection on the failure of Stanley's recruitment scheme to procure a dependable supply of competent civil staff prompted military critics inevitably to question the soundness of the civil engineers' much vaunted orthodoxy of "practical" training. In that system--according to Lieut.-Colonel George Chesney's skeptical account--a young man paid a fee, or "premium" as it was called, to a civil or mechanical engineer for the permission to work in his office or workshop and "pick up some crumbs of knowledge as fall in his way". Chesney was doubtful one could learn anything of consequence by that method, particularly any of the theoretical points and principles of the discipline. But such was not the typical case in any event, for the majority of civil engineering pupils did not get genuine professional experience at all, Chesney asserted.

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Rather, they would spend two years in a second rate school that professed to teach engineering then proceed to spend a third ostensibly under a practicing engineer. But, according to Chesney, "...the leading civil engineers (would) not take pupils for a single year" and neither they, nor the more common hacks would normally presume actually to "teach" a pupil. Hence, most students would find themselves in their final year of training with a professional "crammer" instead who merely styled himself as a practicing engineer, and whose qualifications were limited to being able to teach a little drawing and surveying.\textsuperscript{83}

Chesney's criticisms were supported by evidence submitted to a Select Committee on Scientific Education convened by Parliament in 1868.\textsuperscript{84} According to the testimony of Professor Fleeming Jenkins of the University of Edinburgh--one of the very few accredited professors of engineering in Britain at the time--lads of 17-18 years entered into their pupilages "...wonderfully unprepared; they literally knew nothing that they ought to know, except reading, writing, and some arithmetic." Algebra was beyond the typical trainee such that they were not generally able to use the formulae that they found in common reference aids of the day such as Tempelton's hand book, or The Engineer's Pocket Book. Whatever drawing skills a trainee possessed had little chance to develop, as they were afforded no opportunity to make sketches of works or machinery in the typical engineering office. Professor Jenkins suggested that such was often expressly forbidden in order to protect professional intellectual property from dissemination outside the office. But there was usually no time for drawing in any event as the foremen who supervised trainees tended to squeeze every ounce of work they could out of them, though usually on the most repetitious and uninstructional labours which would otherwise be left to semi-skilled subordinates.

The principals themselves had no time for their pupils. Hence, Jenkins cautioned, the letters of recommendation they provided for their proteges upon completion of their pupilages, could not be counted on to provide any true picture of the pupil's abilities. Such letters were commendatory by convention. Future employers and Government departments

\textsuperscript{83} ibid., 6.
\textsuperscript{84} ibid., appendix.
such as the PWD thus had no useful information to depend on and were always gambling against unknown odds in taking on such recruits.

It was perhaps no surprise that this seriously dysfunctional system of instruction ultimately produced far fewer practicing engineers than the quantity of pupils it presumed to train. But Jenkins offered a broader explanation which he framed, interestingly, in the contemporary conceptual paradigm of Darwinian functionalism. It was "...very much due to that natural selection we have in England,..." he reasoned. There was such a preponderance of good engineers competing for work in England that none but the fittest novices could expect to succeed in the profession. 85

Certainly, in the views of prof. Jenkins and of Colonel Chesney, the young gentleman who had aspirations for a successful career in engineering had poor odds in the existing system. To seek a superior academic training in the discipline was obviously one's best option for improving their prospects—at home and abroad. In their considered opinion, this was an idea who's time had finally come. But in England, at least, professional schools of the scope and calibre required did not yet exist.

For his part, Chesney made no pretense of disinterestedness in his critique of the prevailing inadequacies of the civil recruiting system of the PWD. His thorough memorandum on that issue, to which we have referred at length in this section, posited his argument for the abandonment of not only the Stanley scheme, but the whole conceptual system of the civil engineers concerning professional training, with its overriding emphasis on empiricism and individualism. This was the backing of his argument for the creation in England of a Government college of civil engineering which could strictly tailor the supply and the qualifications of civil recruits to the prescribed requirements of the Indian PWD.

However, as we shall examine in the following section, Chesney's college proposal—subsequently realized as the Royal Indian Civil Engineering College, Cooper's Hill—was perceived by various factions as, at best, an ambiguous undertaking. Chesney capitalized on a critical moment in the evolution of the Liberal polity of Victorian England when the encouragement of science and "practical knowledge" in the curriculum

85 ibid.
of institutions of higher education began to be recognized as a matter not merely of professional significance, but of potentially great economic and political consequence for the British Empire as a whole in the increasingly competitive late Capitalist age of European imperialism. His persistence, and eventual success in winning the support of the British Government for the establishment of the Royal Indian Engineering College in this moment of conceptual change, caused both military and civil factions of the engineering profession in India to assert their objections to an institution which would potentially compromise the vested interests of all concerned. Once again they were provoked to differentiate and defend their respective professional conceptual systems in the face of what, in effect, portended their mutual incorporation in the technocratic conceptual framework of the mature Department of Public Works in the last quarter of the century.

7. SCHOOLING PROFESSIONALISM

The uncertain place of technical knowledge in Victorian academia:

The increasing competition in the British engineering profession in the 1860s, coupled with the shortcomings of the practical pupilage system of training, had raised demand for alternative, academic sources for acquiring essential professional knowledge. But this had almost exclusively been answered, as we observed earlier, by an informal industry of private tutors and "cramming schools" through which a hapless pupil might be coached by rote to survive a qualifying examination, but hardly properly trained for a professional career. What creditable academic instruction in engineering subjects was available in Great Britain were courses such as those delivered by professor Jenkins at the University of Edinburgh. However, these did not comprise complete degree programs. With the exception of the exclusively military institutions of Woolwich and Chatham, no university schools of engineering or accredited independent engineering colleges offering a full-fledged professional training had yet been established in Britain by the late 1860s. The Royal
Indian Engineering College was to be the first. 86

This virtual dearth of academic options was a consequence of the deep-seated beliefs about what constituted professional technical knowledge, and where it was properly to be acquired, which were stubbornly maintained by both the professional and academic communities. Although the tide began to turn in the last quarter of the century, it was actually not until 1903 that the Institution of Civil Engineers finally placed the sanction of the profession behind the system of higher education in engineering. The academic establishment, for its part, had traditionally been none too accommodating either. Notably, it had been universities in the industrialized North of Britain, beginning with the University of Glasgow in 1840, which had introduced engineering courses to their curricula. 87 The great universities and schools of southern England had generally resisted the integration of science and technology. But it was these that were compelled first to change their views.

Official dissatisfaction with the state of technical training in England had been mounting for the better part of two decades by the time Parliament convened its select committee on scientific education of 1868, to which prof. Fleeming Jenkins had testified. A Royal Commission that investigated Oxford and Cambridge in the early 1850s had deprecated the reverse discrimination by academicians against technical knowledge, urging the universities to apply their resources to professional education. Meanwhile the public schools had come under fire from the Clarendon Commission for the overwhelming classical bias of their curricula; criticisms which were followed up a few years later with calls for drastic reforms by the School Enquiry Commission. 88

This traditional intransigence to technical matters in the belief system of academicians was explained by Dean Farrar, one public-school headmaster in this period who was keen to see some change in the status quo. There were subjects he felt, particularly in science, which could provide an intellectual training as good as that provided by the classics—which, anyhow, he thought were taught badly and unimaginatively.

87 ibid., 18.
88 W.J. Reader. Professional Men..., 110-111.
in the general case. Moreover, he felt a scientific education would be useful. But "...no sooner," he wrote,

...have I uttered the word "useful" than I imagine the hideous noise which will environ me, and amid the hubbub I faintly distinguish the words, vulgar, utilitarian, mechanical... Well, before this storm of customary and traditional clamour I bow my head, and when it is over, I weekly repeat that it would be more useful--more rich in practical advantages, more directly available for health, for happiness, for success in the great battle of life. I for one am tired of this "worship of inutility". One would really think that it is a crime to aim at the material happiness of the human race.

Admiration and anxiety concerning European progress in technical education:

The concern the various official commissions of the 1850s and 1860s had raised over the willful detachment of academia from the practical issues and challenges of the fast changing world of the nineteenth century, evidently reached a height in 1870 when the fast growing technical prowess and industrial might of continental Europe was demonstrated with a shock in the Franco-Prussian War. If the British were to preserve their security, let alone their traditional preeminence in engineering, it was abundantly clear that they could no longer afford to be complacent. This message went beyond government circles to be debated in earnest in the professional journals and the deliberations of the professional societies.

In 1870 the Institution of Civil Engineers published its own extensive report on the issue of technical education and its implications for the profession. Significantly, the international perspective on the issue was paramount. The report consisted in large part of statistics and facts comparing training practices in Britain, as favourably as possible, with those of several of the other most advanced countries of Europe, along with opinions on the subject solicited from various Englishman "of more or less eminence". Not surprisingly, in the heat of the critical assault on the profession for the alleged backwardness of its training

99 ibid.
practices, the purpose of the report was not to reform so much as to
defend the status quo by an objective and exhaustive comparative analysis
of the issue. But not all were prepared to keep towing the line of praxis
indefinitely. 90

The anxiety of the more outward looking British professionals of the
day was expressed in the comments of an independent reformer, John Scott
Russell, which were extracted in the text of the Civil Engineers' report
from Russell's own previously published inquiry into technical training
titled Technical Education for the English People. Russell drew attention
to the impressive standards of European railway engineering by comparison
to the norms in Britain, to illustrate the cause for his alarm. According
to Russell, it was "notorious" that the railways of Germany and
Switzerland (in particular) had been constructed much more cheaply than
those of Britain while excelling over the latter in every element of
comparison except speed. By contrast to the practically trained engineers
of Britain's rail system, railways in Germany and Switzerland were
designed and built by pupils of the industrial schools and technical
colleges of those countries. 91 Throughout those railway systems, he felt,
"...the experienced traveller can read as he travels the work of a
superiorly educated class of men...We everywhere feel that we are in the
hands of men who have spared no pains, and who have applied high
professional skill to minute details." This meticulousness, quality and
economy of design extended to the railway architecture and the industrial
design of the rolling stock, as well as to the fiscal management of the
construction and operation of those lines.

Russell's litany of examples of the waning superiority of British
heavy industry and the home-grown technologies it had been built on,
extended to marine engines and naval ship-building; to artillery, with
special notice of the impressive attainments in heavy armaments of the

91 Ibid., France, Switzerland and Germany had already firmly
established traditions of academically based professional training
through the polytechnic schools of Zurich, Stuttgart, and Paris. These
were increasingly the envy of perceptive British engineers and architects
who could foresee the imperative of better consolidating and controlling
the respective knowledge bases of their professions.
Krupp works of Germany (which had just demonstrated their power in the conflict in Alsace and Lorraine); to smelting, mining, locomotive building, and the great branches of commercial machinery; and finally, significantly, to the organization of skilled labour.\textsuperscript{92}

But concerns such as these were merely counterpoised by the compilers of the Civil Engineers' report, with an unsubstantiated, doctrinaire retort by the president of their institution that the professional performance of the experience-trained British engineer was still manifestly superior to that of his academically grounded European counterpart in the "practical branches" of the discipline. Such ingenuous dogmatism was sorely regretted in a review of the Civil Engineers' report that appeared later that year in The Builder. "Such a statement," the reviewer observed, "however true it might have been twenty years ago, can now tend only to mislead. The idea of balancing what is called a 'practical' against a 'theoretical' education, is one of those shifts by which the introduction of any system of sound training has often been most successfully resisted. Put in its true light it means 'Rule of thumb for ever'."\textsuperscript{93}

The amateurish informality with which one was supposedly prepared to adopt the title of "Engineer" under the prevailing system of training, reflected a characteristically Anglo-Saxon attitude toward professionalism, in the estimation of The Builder's reviewer. Of the 19 European and two North American states that had been surveyed in the report on technical education, only the latter two--Canada and the U.S.A.--shared with Great Britain the assumption that "any body is as free to assume the style and title of Civil or Mining Engineer as he is to take that of blacksmith,...without any regard to school diplomas." While professional titles were not necessarily protected legally on the Continent, the possibility of competing with the academically trained and accredited ranks of the engineering establishment, without a thorough theoretical and professional grounding, would be very unlikely; let alone assuming equivalent social status, which was generally determined meritocratically by official rank in the centralized technocracies of the

\textsuperscript{92} ibid.
\textsuperscript{93} ibid.
European states.

It was time to dispense with the hagiography of untutored practical genius through which the British civil engineering profession had so long validated its professional belief system, but which threatened to hobble it critically in the increasingly complex and competitive professional market of the future. In any event such was substantially a mythology, as the skeptical reviewer in *The Builder* felt obliged to remind his colleagues. Certain of the earlier pioneers of the industrial revolution, such as Telford, Watt, and Rennie, had indeed risen to fame and fortune by their sheer wits, and had no self-conscious, received profession to speak of. But, others who followed and excelled in the period of unprecedented demand for civil engineers driven by the railway construction boom had required more than an intuitive grasp of expert knowledge to rise above the throng. Robert Stephenson, for one, had "...reaped the full benefit of the education which his father had practised an honourable parsimony in order to afford him"; and, "...Isambard Kingdom Brunel brought to the aid of hereditary genius the unusual advantage of thorough scientific training, having been a pupil at the Ecole Polytechnique."

*The Builder* closed its disgruntled commentary on the Institution of Civil Engineers' half-hearted and non-committal assessment of the professional education question with a further goading comparison. Returning yet again to the old debate between the military and civil engineers, the reviewer offered a surprisingly respectful re-appraisal of the Royal Engineers' professional probity. It had to be recognized that their military colleagues were "...the most highly educated body of men amongst [them]." While he felt strongly that the great volume of work, at home and in the colonies, that was presently falling upon the Royal Engineers to execute, might indeed more naturally, and with more satisfaction to all parties, be discharged by civil engineers; this would require that they be at least as well educated as their military counterparts. It was increasingly obvious, from the perspective of the editors of *The Builder*, that proper professional schooling, on the model of European technical education, was precisely the tool the civil engineers required to correct the professional injustices they had so long endured at the hands of the military engineering establishment:
The attempt recently made to depreciate the value of the professional service of the architect and the civil engineer, to throw the responsibility of civil works, or of private speculation, on officers of the Royal Regiment, and to "sprinkle-in" decorations by the employment of any architect who will condescend to take the part of a painter or decorator, is, we feel certain, most pernicious. In the face of a body either of civil engineers or civil architects educated and organized as they are on the Continent, such an attempt would not only have been futile, but it would never have been dreamed of. As things stand,—thoroughly wrong as we are convinced that it is,—it can hardly be said to be without excuse.\footnote{ibid.}

Col. Chesney's arguments for a civil engineering college:

In that epoch of rapid change and shifting perspectives, Colonel George Chesney was no doubt thinking a few steps ahead of the civil engineering establishment when, in 1869, he tabled his proposal for a civil engineering college to furnish the PWD with its supply of English recruits. As the tide was inevitably turning in favour of academic professional training—which was sure to improve the over-all competence and status of the civil engineers in the Department—Chesney recognized that the Royal Engineers would have to re-think their own role in the Department if they wished to retain some measure of their traditional authority and control of that arm of the Indian public service. In seizing the initiative to establish a teaching institution that might dependably prepare civil engineers for the particular requirements and peculiarities of the Indian engineering service, Chesney anticipated the utility of such a school as a socializing device that could groom the in-coming civilians in a mode of professional thinking and conduct compatible with the established military "system" of the Department.

On a limited scale, such institution-building would also create new and influential positions of authority—in teaching and academic administration—which could be secured for Royal Engineers with knowledge and experience in the field of Indian service, for some time to come. (Chesney, at least, was to benefit from that opportunity, serving as the
principal of the college in its first nine years of operation!)

Of course Chesney was not so forward with his own professional agenda in his advocacy for the plan. The college was proposed specifically as an answer to the problems with the existing civil recruiting system of the Indian PWD; and, though he was quite conscious of the precedent-setting implications of the college for British civil engineering education in general, Chesney made pains to justify the scheme—to the British Government and the metropolitan representatives of the profession—with particular regard to the special constraints and requirements imposed on the civil engineer destined for Indian service.

Indian engineering was a special case of professional practice which required special training. In this argument Chesney could rely on the agreement of any civil or military engineer with Indian experience, even his rival in the matter of engineering education, Major J.G. Medley, the principal of the Thomason College at Roorkee (1863-1871). As Medley explained with regard to the pedagogical objectives of his own institution (which he was subsequently provoked to defend against the threat of the new English college), the nature of an engineer's work in the Indian PWD implied different educational priorities than those the civil engineers maintained back Home. In England the subdivision of labour had been carried out to such a degree that a man rarely attained eminence in any calling who did not confine himself to some special branch of it. For most this meant that even preliminary training had to be highly specialized "if only for economic reasons". Practical training by the pupillage system was appropriate for this manner of professional formation, but in India the situation was quite the opposite. The engineer serving in India was necessarily an absolute generalist and an all-round college training with a mix of theoretical and practical instruction was best suited to serve his requirements. 95

In India the typical engineer had nothing but practical work to devote his skill and energies to, in a career of relative physical isolation and the independent resourcefulness that entailed. What he almost never got the chance to acquire once he had taken to the field was

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further theoretical knowledge. The Stanley recruiting system had put the proverbial cart before the horse in this respect, as Chesney analyzed it, endeavouring in India to cram necessary theoretical knowledge into young men of inevitably inadequate and largely irrelevant English engineering experience. The theoretically unexercised minds of the recruits had been un receptive to this belated book learning while their limited precedent knowledge of British engineering practice could prejudice them against the work methods and solutions considered most appropriate to the peculiarities of engineering and building in India.

On-the-job experience in the Department itself was the ultimate practical course of instruction for new recruits to the PWD engineers establishment. But Chesney had no illusions that such field experience could be training enough. His investigations into the facts behind the tradition of the practice based pupilage system of the civil engineering profession had reconfirmed him in his own bias for the tradition of academically based training which he and his fellow military engineer officers in the PWD had benefited from at Addiscombe and Chatham. It was high time, Chesney implied, that his civilian colleagues recognized their delusion in this regard; if not to follow the military example, then merely to catch up with their civil counterparts on the European continent.

In concluding his argument, Chesney considered the more general implications of his proposal for the profession. The college, he argued, would remedy the dearth of theory in typical professional engineering training in England and even improve on the most practical aspects of the pupilage system as on-the-job learning. The college would complement rather than replace practical training by preparing the student sufficiently in advance to be able to make good use of subsequent experience—and to demand it of their employer/mentors. (In the prevailing system, as we have seen, trainees were generally excluded from any significant involvement in the work of the offices to which they were articled for lack of basic technical skills and knowledge, obviously

97 ibid., 12.
gaining little from such "experience" except a substantial drain on their finances to the benefit of the principal of the practice concerned.)

Only with an additional academic foundation could the English engineer continue to claim true leadership and all-round competence in his field, over and above his European colleagues. As things stood, neither the Continental nor the existing British systems could claim to impart to their engineers-in-training a balanced command of both the practical and the theoretical aspects of the discipline.

The rationale for an English college:

In India, of course, a tradition of academic professional training was already well established for the engineering service, among other branches of the public service. The pioneering Thomason Engineering College at Roorkee had already been in existence for over two decades and three additional Indian colleges of engineering—at Calcutta, Madras and Poona, respectively—had been established in the meantime. 98 Hence, the proposal to establish a further college, in England, to supply the engineers establishment gave cause for consternation—particularly in the case of the college at Roorkee.

Economic and geographic considerations were Chesney's ostensible rationale for snubbing Roorkee (at which he himself had acted briefly as Assistant Principal, in 1854 and again in 1858-59 99) with his plans for the new college. But it appears that these only thinly veiled more essential racial and social class factors in his reasoning. Although

98 Dalhousie had, in fact, proposed in 1848—the same year that the Roorkee school was established—that an engineering college be established in each of the three Presidency towns. An engineering class was offered at Elphinstone College in 1854, but was soon discontinued for insufficiency "of suitable candidates for admission." It was not until 1856 that any new institution wholly devoted to engineering, was established. The first of these was set up in the Writers' Building (the Secretariat) in Calcutta, moving some years later to suburban Sibpur. Similarly modest schools were established in Madras and Bombay in 1858, for which proper campuses were built a few years later—in the latter case at Poona, the summer capital of the Bombay Presidency. Misra, B.B. The Indian Middle Classes: Their Growth in Modern Times. (London: Oxford, 1961), 185.

99 K.V. Mital. History of Thomason College..., 70.
Roorkee had had a substantially European and Eurasian student body from the start, Chesney evidently preferred to regard it, with the three other Indian colleges, as the schools for the "native" recruits to the engineers establishment; and, more essentially, as the training ground for the rougher sort of men, Europeans and Indians, who formed the subordinate ranks of the Department. What was wanted was a superior school, in England, which could produce civil engineers equipped with the requisite technical knowledge as well as the knowledge "generally esteemed to form a necessary part of a Liberal education," which only the "right class" of young gentlemen raised in England could bring into their training and future professional conduct in India.

Given his fundamental condescension concerning Indian versus "Home" institutions, Chesney was actually quite admiring of what his predecessors and present colleagues in the Royal Engineers had achieved as pedagogues at Roorkee. The relative success of the Thomason College in producing engineers and subordinate technicians uniquely prepared for duty in the Indian PWD was actually invoked by Chesney, in his arguments for the new English college (such that he mentioned the rather compromising fact of its existence at all\(^{100}\), as proof of what could be done by Government in the way of affording systematic technical training for its own servants:

Roorkee labours under the drawbacks of climate and of distance from the great centres of scientific and professional movement, and those of its pupils who have been born and educated in India necessarily start at a disadvantage compared with young men brought up under the influence of European civilization. Yet Roorkee turns out so useful a body of servants, that, although their education (which is wholly gratuitous) is given at great cost to the State, the expenditure has always been ungrudgingly bestowed,...if so much can be done in a remote corner of India, we may reasonably expect a high degree of success here, without the cost.\(^{101}\)

Chesney indicated his respect for what Roorkee was doing and could potentially do as far as the training of "native" engineers was concerned. But he was not very hopeful of rapid progress in this regard:

\(^{100}\) ibid., 70.

\(^{101}\) G. Chesney. Memorandum on the establishment of a Civil Engineering College for India, 7th Oct. 1870, 11. [IOR]
One thing seems clear. Adequate provision should be made for admitting qualified natives of India to this branch of the public service [i.e. the engineers establishment of the PWD]. And it will be satisfactory to know that this important point has been fully provided for. The Government guarantees eight appointments yearly to qualified students of the Roorkee College, the native members of which receive, in addition to a gratuitous education, a scholarship or stipend sufficient for all expenses. But a large proportion of the available scholarships have lapsed from not being sought for, and the taste for civil engineering is likely to be of slow growth among the people of India.

European and Eurasian "natives of India", on the other hand, had clamoured aggressively to the opportunity for professional service in the colonial administration which Roorkee had opened to them. As such there was no short-fall in the number of qualified students the college produced to fill its annual quotas of guaranteed junior appointments in the engineers establishment. But notably, Chesney virtually ignored this fact in his elliptical assessment of the state of technical education in India—through which he apparently hoped to mollify any concerns about possible competition between the proposed English college and the existing Indian institutions. Extending his selective observations to the equally slow progress of the other colleges in producing "native" engineers, and the apparent cultural factors entailed, he indicated that there could really be no contest:

The qualified students of the Calcutta Civil Engineering College...have, I believe, all obtained appointment on completing their course of study, but the class of Bengalee youths which frequents the college is not apt at engineering, and can take the place of European engineers but very gradually. The out-turn from Poona and Madras has hitherto been scarcely appreciable, but here, as elsewhere, the degree of facility afforded by the Government to its native subjects has been in advance of the desire manifested by the latter to avail themselves of them.

These indications of the incompatibility of the engineering profession with "native" mentality (on the part of the tiny class of

102 ibid., 3-4.
103 ibid.
"natives" who were in a position to take a degree from Calcutta University in order to be qualified for entrance into Roorkee, as regulations then stood,) provided sufficient reason, in Chesney's opinion, to rule out the Indian engineering colleges as an effective source for the PWD's urgent staff requirements.

"Esprit de corps":

As an officer of the Royal Engineers, Chesney's advocacy for a new civil engineering college was puzzling to certain of his colleagues in the corps (see "Implications of the Civil Engineering College...," below). But his actual proposal had obvious parallels with his own military alma mater, Addiscombe, which had been closed with the demise of the Company administration and most of its autonomous institutions following the Mutiny. 104 In the closing remarks of his memorandum of 1870 on the proposed college, Chesney permitted himself to wax nostalgically on the "esprit de corps" of the Indian Engineers Corps which he credited in part to the shared experience of the old Addiscombe cadets as fellow students in the formal institutional framework of the military seminary. Even for civilian trainees, such a sense of "corps" was among the more important of the benefits to be bestowed by a formal course of instruction in the institutional atmosphere he proposed this civil engineering college should provide:

There can be little doubt...that it has been as much on account of the guarantee afforded by their high standard of conduct, as for the ability they may have displayed, that the services of the old corps of Indian Engineers have always been so much appreciated by the Government of India. That the maintenance of this high standard of integrity of public spirit among all members of the department, civil or military, will be of incalculable advantage to the public service, everyone who is conversant with it will agree. Having been a member of that service for twenty years, I believe I only express the sentiments of the great majority of its members when I say that some bond of union, which shall serve to identify them in

104 The amalgamation of the former Indian Engineers Corps with the Royal Engineers Corps had rendered Addiscombe redundant. All military engineers were thereafter schooled at the Royal Military Academy, Woolwich, as none were trained exclusively for Indian service anymore. See Vibart, Addiscombe, its Heroes and Men of Note.
interest with each other and with the Government they serve, is felt to be at the present time a great and urgent want, and I believe that in no way can the sort of sentiment which it is desired to engender be better cultivated than by bringing the future members of the service together while under education, in the enthusiasm of youth, to cultivate a spirit of honourable pride in their calling, looking forward to service in India as their common goal.

Supporters of Chesney's scheme in the administration responded with particular favour to such "moral" arguments for the college. As the incumbent Secretary for Public Works in 1871, W.T. Thornton, eloquently extrapolated, the young civilians going out to India from the new college at Cooper's Hill would possess

the corporate sense of honour, and, what is part of the same thing, the dread of doing anything to disgrace their corps, sure to grow up amongst young men educated together with express view to their entering the public service. All the better spirits will certainly learn to take such pride in that service as will first ensure in themselves loyalty and probity, and will then, by the contagion of example, imbue their inferior companions with similar virtues.

Not only would the benefits of such a high-minded corporate sense of professionalism be felt in India—where the monetary savings effected by a selfless, more conscientious PWD could be very substantial—but could extend back to England where, as Thornton envisaged, the reputation of such an exemplary body of Government engineers could "...contribute to the moral exaltation of the whole engineering profession." "Not impossibly," he speculated, "...the brilliant example set at Cooper's Hill may stimulate the distinguished Civil Engineers deservedly looked up to as the heads of the profession in this country [England], to go and do likewise for the training of worthy successors to themselves."

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106 W.T. Thornton. Indian Public Works and Cognate Indian Topics, 164–165.
Official reaction to the college proposal:

Chesney's proposal for the Royal Indian Engineering College was submitted to the Secretary of State for India, the Duke of Argyll, in 1869, but faced considerable resistance at first from various quarters. The key belligerent was the Government of India under the incumbent Viceroy, Lord Mayo, which was strongly opposed to any further institutional proliferation of the administration.

Taking office at the tail end of the post-Mutiny development boom of the 1860s, Mayo's administration had inherited a substantial deficit which he was determined to eradicate. Mayo's stringent economy drive across the board had particular bearing on the Public Works Department, for which he had assumed personal responsibility both from his own keen interest in development, but also because the PWD had acquired one of the worst reputations for extravagance and waste of money among the government departments. Expenditures had not infrequently exceeded works estimates by more than one hundred per cent in the preceding period, and such negligence and incapacity had been compounded ignominiously by endemic corruption.107 What was needed, in Mayo's view, was "good supervision and one thing at a time." While he accepted that the supply of engineers from England had been inadequate both in quantity and in quality, his immediate determination was to optimize the effectiveness of the existing establishment which entailed streamlining the work load of the Department rather than augmenting staff, and reducing the costs of training them.108

Mayo had his way in India where his authority was supreme, succeeding in cutting down the program of works substantially, especially the accelerated building program of the Military Works Branch which had dominated the Department's annual budgets throughout the 1860s. Back in England Mayo also had some powerful support for his economies. Among these, his reticence to augment government expenditure on civil

107 Indeed, to the end of the British Raj "PWD" was considered by the less charitable of its critics to stand for "Plunder Without Danger". Penderel Moon, The British Conquest and Dominion of India. (London: Duckworth, 1989), 819.
108 ibid.
engineering education, which the proposed new engineering college would entail, was seconded in Parliament on behalf of influential military engineers in India who resented any improvement in the stake of the civil engineers in the Indian PWD for fear of "...early closure to their brother officers of one of their finest avenues to engineering fame."\textsuperscript{109}

Nevertheless, Chesney's arguments for the college prevailed with the Secretary of State for India who eventually succeeded in winning support for the scheme from the British Government. This personal coup evidently hinged on George Chesney's own considerable influence in government circles at that moment as the author of \textit{Indian Polity}, an exhaustive analysis and critique of the colonial administrative structure of British India which he had published in 1868. Following on his initial recognition within the PWD for comprehensive reforms in accounting practices which he had spearheaded a few years earlier, Chesney's book was to have an important impact on the Indian administration as a whole through wide ranging bureaucratic reforms it inspired in the following decade.\textsuperscript{110}

The implementation and evolution of the college:

The Royal Indian Engineering College commenced classes in 1871 at a site called Cooper's Hill, a small ridge south of the Thames about thirty kilometers west of London.\textsuperscript{111} Chesney himself was to preside as the first principal of the college, from 1871-1880. The college was open to all British subjects who could pass the entrance examination. As such it did not expressly exclude "natives" of British India, but the same logistical barriers that earlier prevented Indian candidates from sitting the Engineer Exams under the Stanley scheme were again in effect in the case of Cooper's Hill. It was assumed that both Indians and Europeans residing in India would continue to receive their professional training as previously in the various engineering colleges already established in

\textsuperscript{110} H.M. Vibart, \textit{Addiscombe...} Chesney's accounting reforms will be discussed in Chapter 8 below.
\textsuperscript{111} K.V. Mital. \textit{History of Thomason College...}, 69.
India. Admission was otherwise unrestricted, but unlike the Indian colleges which were fully subsidized by the Government of India, the Cooper's Hill students were required to pay an annual tuition fee of 150 pounds sterling. This insured that only the "class of gentlemen" the Government desired to recruit for the Indian public service could think of applying. An official report described the typical students of Cooper's Hill as follows:

The students are drawn from the public schools in general, and mainly from the modern side; for the most part they are sons of persons of the middle class in easy circumstances. Their average age at entrance is 19, and this average is slightly on the increase. The annual expenses of a student (i.e. during the 37 weeks of residence at the College in each year) are estimated at 275 pounds on the average; the course extends over three years; and the scholarships are trivial in value.

112 One has to admire those very few Indians who attempted to apply for their determination and humility in the face of the bureaucratic quagmire that the admissions officers of Cooper's Hill appear to have willfully tried to draw them into in the hope that they would be dissuaded from pursuing the matter. According to the regulations in effect at the beginning of this century, natives of India were not excluded outright from studying at Cooper's Hill. If they were "subjects of Britain" they were theoretically entitled to stand for admission and, if sufficiently meritorious, to earn one of the limited annual quota of commissions in various departments of the Indian Public Service, primarily the PWD. "Natives of India" who were subjects of native states did not come under the term "British Subjects" it was stipulated (P.W.876, 22/05/1900). However, it is not spelled-out clearly in this correspondence who could claim British subject-hood. Failure to establish that status (through the presentation of a certain official "identity certificate" that none of the native applicants seem to have been able to procure) allowed the authorities to relegate these candidates to be considered only as "extra students". Applicants in this category were admitted to the college provided they could pass the entrance exam and present a recommendation on their behalf from the Government of India, and that there was "extra" room available in that year's class to accommodate them. Such applicants were emphatically understood that they would not be able to compete for any of the appointments offered. President's Memo, Cooper's Hill, 26/04/1901. In collection of correspondence re. "Natives of India"; candidates for Royal Indian Engineering College, 1901-1902. (IDLR: L/PWD/8/243, file 196).

113 W.J. Reader. Professional Men..., 143.

The curriculum developed by Chesney during his nine year tenure as principal of the college stressed greatly the importance of "physical science". His rationale was, again, the special case argument with respect to the peculiarities of colonial service: The engineer in India had to rely wholly on his own knowledge and industry even to mobilize the basic material for construction let alone the matter of design. There were no contractors and manufacturers to whom one could turn for information and norms behind which to hide for ignorance of building materials, structure and appropriate specifications. In the field he would very often have to manufacture his own bricks, fell his own timber, dig and burn his own lime for mortar. 115

Thus, for all the polemical emphasis on the need for academic training in the theoretical aspects of the discipline, the course at Cooper's Hill was to be quite practical in intent, though ambitious in the range of subjects and skills it dealt with. The obligatory subjects covered in the three year program were mathematics pure and applied, with the mechanics of engineering; theory and practice of construction; surveying; mechanical drawing and descriptive geometry, and natural science. Instruction in the Hindustani language and in Indian History was also an obligatory component of the curriculum. 116

The last of the required subjects was a series of elementary architectural lectures on the "principal styles and their chief characteristics". However, this was only a very cursory introduction to the formal elements of the classical as well as the Hindu and Islamic building traditions prevalent in India. It was originally allotted only two percent of the teaching time, and was phased out of the curriculum altogether in the lean later years of the college along with other courses deemed to be of "relatively minor importance". 117 (We will return


116 W.J. Reader, Professional Men..., 143.

117 "Report from the Board of Visitors of the Royal Indian Engineering College to the Right Honourable the Marquis of Hartington, M.P., Secretary of State for India," Cooper's Hill, 26th May 1882. Appendix 2; East India (Royal Indian Engineering College), "Correspondence relating to the remodeling of the studies and retirement of certain of the professors and lecturers," (London: 1901).
to consider the content of this architectural instruction, and the implications of the low priority it was given in the professional value system of the PWD engineers, in chapters 8 and 9.)

The college curriculum officially included a fourth year of articulated practical training in England according to the conventional pupillage system, upon completion of the three year year course of academic study. But it was not before the college had already been in operation for eight years that this component of the program was actually initiated. Up to that point, while the high demand for engineers to serve in India had lasted, Cooper’s Hill managed exclusively to serve its intended purpose as the supplier of junior civil engineers for the Indian PWD. Appointments in the PWD were secured in the pre-entrance competition such that all students admitted to Cooper’s Hill proceeded to follow their studies with the confidence of a guaranteed career. The urgency of getting each new batch of graduates into service in the field in India as soon as possible had depreciated the necessity (or the relevance) of them gathering practical experience of works in England. From 1880 onward, however, the much more limited and variable number of appointments available in the PWD were reserved to be awarded on a merit basis to the most accomplished graduating students only. The college was increasingly compelled in the meantime to fill its classes (and thus keep its costs in control) with paying students who did not necessarily expect to serve in India. The necessity of marketing the college as a general professional school for English engineers, in this regard, tended thereafter to increase the importance of the English practical training component of the program.118

The early change in prospects for guaranteed PWD employment had its source, indirectly, in a series of famines through the 1870’s—the last, in 1877, coinciding with the calamity of the Afghan War. These events destabilized the finances of the Indian Government,119 an immediate consequence of which was a hobbling of public works and hence the expansion of the PWD Establishment and promotion of its officers, which had been proceeding steadily since the late 1850s. By the time this

118 J.G.P. Cameron. A Short History of...Cooper’s Hill, 10-11.
119 The Rupee tumbled 30% in value between 1873 and 1890. Ibid.
economic depression had set in, however, the major works initiated in the previous decade had progressed to such a state that there was no question of abandoning them. Rather, the move was to decelerate and distribute expenditure and human resources over a longer period of time. Very soon the steady supply from Cooper’s Hill of approximately 48 new engineers per year was far in excess of requirement.

In 1879 a committee of members of the Indian Engineering Service was formed to look into the issue of stagnation in the PWD establishment. (With 5 Royal Engineers and just one civilian member, the composition of this committee reflected the still very dominant position of the military officers in the PWD). Subsequent to its recommendations, published in 1883, the engineer appointments guaranteed to the Cooper’s Hill graduates were cut from 44 to just 16. Two additional posts were earmarked specifically for the Telegraph Department which, along with the Forestry Department from 1887 onward, would provide other avenues in the Indian public service in which Cooper’s Hill students could potentially find appointments upon graduating. Still wider afield, the college sent graduates to Egypt, The Ugandan Railway, and South Africa in the last two decades of the century. In the latter case they went out primarily during the Boer War, via the Royal Engineers and Royal Artillery in which some fifty commissions were secured for Cooper’s Hill men in the crisis; the old distinctions between civil and military engineer had evidently been blurred substantially by their now very similar academic training as professionals. The remainder who did not drop out, entered into private civil engineering practice in Britain. 120

Cooper’s Hill had a relatively short life of just over three decades. By the turn of the century the cost of maintaining this small autonomous institution—to both Government and students—had become untenable in view of the dramatically diminished demand for engineers in India and the development in the meantime of other competitive options for academic training in Engineering. It was closed in 1903. 121

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120 ibid.
121 Report of the Board of Visitors..., 1901.
The Implications of Cooper's Hill for the military engineering establishment in India:

In retrospect, the creation of the Royal Indian Engineering College could be interpreted as a counter-measure by the military hierarchy of the Indian works administration to forestall the advance of the civil engineers by rationalizing and strictly controlling the standards and the process according to which they would thereafter be obliged to enter the PWD. And, as we have already observed, Col. Chesney had anticipated in particular the socializing influence of an institutionally based professional training, which was in effect to make a para-military corps out of the civil members of the Department. Nevertheless, Cooper's Hill was always perceived as a somewhat ambiguous and doubtful enterprise, especially by certain of Chesney's own military colleagues who saw it as an omen of the potential eclipse of the Royal Engineers in the Indian PWD.

Major General Sir J.L. Simmons was one who was sufficiently vexed by Chesney's scheme to table his own counter-proposal in 1870, while official sanction for the college was still pending. Simmons urged a complete reversal of the trend toward a civilian run department. It was imperative in his view that plans for the college (or any other measure to improve the fitness of civil engineers for Indian service) be scrapped, and that the contingent of Royal Engineers in India be substantially augmented to fill all positions in the engineers establishment of the PWD.

Respectful of the sentiments of his superior officer and eager to reassure his fellow engineer officers of his loyalty to the corps and its best interests in India, Chesney produced an additional confidential memorandum on the subject of the college in response to Simmon's challenge.122 His arguments in this regard offer further interesting

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122 G. Chesney. Confidential memorandum concerning employment of Royal Engineers in India considered with reference to the Civil Engineering College, India Office, December 1870. Included in W.T. Thornton, Secretary, Public Works Department. "Return to an Address of the Honourable House of Commons, 16th March 1871, for Further Papers relating to the Indian Civil Engineering College." (IOR: L/PWD/8/9). All quotes and references in the following section are drawn from this document.
insights on the belief system of the military engineers in India—particularly what the old guard valued of their former autonomous service tradition under the Company regime by contrast to the detachment of the new generation of Royal Engineers with their allegiance to the central, metropolitan authority of their Corps.

Simmons had proposed that the civil branch of the PWD be phased out and replaced entirely by Royal Engineers acting directly under the War Department of the British Government; autonomous, that is, from the civilian authority of the "local" colonial administration. In his rebuttal Chesney analyzed the doubtful feasibility of such a move. For one, he raised the question of whether the Royal Engineers under their new Imperial mandate (since the amalgamation of all the European corps and regiments of the former Company Army with the British Army) would be willing to commit their whole careers to Indian service in the civilian sector. Under the terms of service of the amalgamated engineers corps this would entail an effective surrendering (in all respects but nominal rank and title) of status as a bona fide soldier. Previously, as Chesney explained,

...the great attraction of employment on the Indian PWD had been, that while an officer thus escaped the monotony of regimental life in peace time, he sacrificed none of his privileges as a soldier by so doing, but was held to be just as much a part of the regular forces as are the other branches of the army, and was able to look forward to getting his share of active service, with all the distinction and contingent advantages attaching to it, and of eventually succeeding to military commands.

Chesney made an important distinction between the basis of the military engineers' control of public works under the old system, and possibilities for such under the prevailing revised organization of the military in India. He saw no parallel between the previous autonomy of the Government of India with its own army and its respective corps of engineers trained especially for exclusive service in India, and the alternative protocol Simmons proposed of extending the services of engineer officers of the British Army to the Indian PWD, among other
colonial outlets for their professional endeavour. An exclusive pursuit of the latter protocol entailed the potential problem of inadequate representation of particular Indian problems or points of view in the formulation of the global colonial works policy of the Royal Engineers Corps. The likely result of such, Chesney speculated, would be a tendency "...to make the Indian system conform to that in force among the branch of the corps serving elsewhere, an influence being applied in this direction which, however honest and well meant, would be decidedly injurious to the interests of the Indian Public Works Department."

Among the simplistic rationalizations compelled by the incorporation of the Indian Engineers Corps into the centralized technocratic organization of the Royal Engineers Corps was—as once again—the problematic classification of "military" vs. other types of works. A significant faction within the Royal Engineers "...looked coldly, if not with disfavour, on the employment of its members on any other than what they deem to be military duty." Chesney related the views expressed by Sir William Denison, former Governor of Madras and a senior officer of the Royal Engineers, as an example of this species of opinion:

Denison found the major part of the (old) corps of Madras Engineers engaged during peace time in civil engineering, chiefly in connection with irrigation works, and he thereon represented that this was not a proper mode of employing military engineers, and recommended that the practice should be discontinued. His remedy was, however, not that they should be relegated to military duty, for in fact none such could be found for them, but that their functions should be limited to the repair and construction of the military building of the Presidency; in other words, that they should surrender all the interesting and important work of the department to civil engineers, and pass the rest of their days whitewashing barracks.

However, views such as Denison's were more deeply ingrained in the system than mere opinion. By 1870 legally binding precedents had already been established in the service protocol of the amalgamated Engineers' Corps which effectively coerced officers either to abandon the military or to opt out of long term deputation to the PWD lest they be required to resign from "active service" for excessive engagement (i.e. beyond ten years) in activities outside the "legitimate employment of the regiment".

In his argument to exclude civil engineers from the Indian PWD,
Maj.-Gen. Simmons had deprecated the potentially increasing competition at the recruiting level between the separate corps of civil and military engineers serving in the Department. He was also concerned about the possible "depreciation in estimation" of one group to the other if caused to work together. Returning to his argument for the need for a civil engineering college, Chesney countered that such would only be a problem should the two corps be caused to go through the same course of basic instruction together, in a single institution of engineering where (as at Woolwich) the cream of the crop would be ultimately selected for a conventionally preferred corps (the Royal Engineers) the remainder filling the ranks of the other. Should these former class fellows, impressed with their respective superior and inferior corps status, be compelled subsequently to serve side by side in the PWD then, "...no doubt, a certain degree of jealousy might be engendered...since that branch which was supplied from the upper ranks of the college might disparage the abilities of the others." But a complete training and professional formation in wholly autonomous institutions for the different corps would, in Chesney's opinion, effectively discourage such comparisons.

Chesney concluded his response to Simmon's challenge by speculating on what could be the real motivation for the uncompromising reforms the latter had proposed. If there was any reasonable alternative to the status quo, he was convinced that a restoration of the old system of the former corps of Indian Engineers would be the best way of securing the most desirable career prospects for his fellow Royal Engineers. He surmised that the hegemonic, inherently self-preserving "traditionary rules of the British corps" were themselves the only basis on which the otherwise unproductive (if ostensibly rational) further centralization of works activity in India that had been proposed, could be justified.

8. THE BUREAUCRATIC INCORPORATION OF PROFESSIONALISM

The contest between civil and military engineers in British India in the middle years of the 19th century—which we have been examining in this chapter through the professional issues and arguments it instigated in
the development of a recruiting policy for the engineering staff of the PWD—can be interpreted from a more detached sociological perspective as a by-product of the gradual assimilation and incorporation of the individualist, socially and culturally ambiguous civilian professionals into the British Indian power structure. The order of things in that colonial polity—i.e. the "categories" of colonial social status—were better defined and better defended in a bureaucratic organization of knowledge and agency.

In the evolution of the professional conceptual system of the engineering staff of the mature public works organization which finally emerged with the normalization of the recruiting system in the years following the establishment of Cooper's Hill, there was a trade-off that transpired between the professional aspirations of the rapidly growing market-seeking class of English Civil Engineers and the entrenched corps of military engineers in India. For the civilians this consisted in a surrender of the coveted autonomy of the idealized "free practitioner" in a market of services in exchange for the security and relative power vested in the corporate methods and mentality of a salaried specialist in the greater hierarchical organization of the colonial bureaucracy. Access to professional employment in India was achieved in essence by transcending the conventional model for the professional organization of knowledge on which the modern professions had developed.\(^{123}\) For the military engineers the trade-off was comparatively minor; an acceptance of a broader and less exclusive categorization of the expert professional services they could be asked to provide. They were not compelled to make the fundamental conceptual change of their civil counterparts for they were already incorporated in a framework of dependent bureaucratic relations as a long established profession, incompatible in fact with the contemporary market project of professionalization.\(^{124}\)

For the civil engineers in particular, incorporation into this colonial bureaucracy had the consequence of shifting responsibility for the application of professional engineering knowledge (and the architectural design knowledge which the engineer in India presumed to be


\(^{124}\) ibid.
a master of as well) from the individual professional—and the quiddity of his personal conceptual agency—to the Public Works Department itself through the agency of its rules and procedures. The establishment of a code of departmental rules and the standardization of procedures for the design, execution and accounting of departmental works progressively reduced the potential for any individual professional to make his personal mark in the Department—as an engineer, that is. On the other hand the corporate hierarchy of the department became increasingly important as engineers now proceeded to monopolize cognitive competence as professional bureaucrats, in the broader domain of project management and departmental administration. Meanwhile the encoding of the more nuts-and-bolts aspects of their expert knowledge, in the form of standard designs and procedures, enabled less qualified subordinates to apply it effectively with consistency and system.

The race and social class based organization of professional knowledge and agency in the mature PWD:

Once the establishment of the College at Cooper's Hill had prescribed the exclusive portal through which professional knowledge and status were to be acquired for engineering service in India—and clearly put this out of reach to actual "natives of India"—a united "Indian Engineers Service", comprised of English military officers and gentlemen professionals, could turn its energies away from the self-defeating squabble between soldiers and civilians, to the increasingly important distinctions of race and class in the colonial polity of British India in the late Victorian era.

This new schism was as much a conflict between core and periphery, as it was a racial issue. The easy assurance of European dominance which was maintained in the earlier phases of colonial conquest and pacification became more difficult to sustain with time and general material progress; and the social change this was encouraging, particularly among those members of Indian society directly serving the colonial regime.

The division, in 1892, of the Engineers Establishment of the PWD into the separate "Imperial" (European engineers) and "Provincial" (Indian engineers) Engineering cadres was a way of defending, by
re-defining, the privileged bureaucratic preserve of those with knowledge of "principles", from those in the hierarchy empowered only to apply "procedures". The "native" Provincial engineers were relegated the "routine" work of the Department which they were acknowledged to be capable of executing essentially by rote, whereas the English Imperial engineers were thereby liberated to return to being hands-on professional practitioners once again, albeit only in those cases where the complexity or scale of a project required the direct consultation of a man of superior professional attainments and judgment.

This further structuring of the bureaucratic hierarchy of the PWD created exclusive slots to exploit and contain each piece of the complex racial and class mosaic of the colonial society represented in the Department:

The ambitious "babus", who had earned their professional qualifications in the Indian engineering colleges, could be side-tracked from completely fulfilling their professional aspirations through the nominal authority afforded them in the Provincial Engineering Service.

Europeans of lesser status could be kept in line in a special "middle-management" category of technical services.

Eurasians (half-castes) were regarded as ideal transmitters of mechanical and technical principles received on high, to actions executed below through the procedures they applied in the management of "native" manpower on the building site.125

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Summary: In this chapter we have examined at some length the recruiting protocol of the Public Works Department in the crucial first two decades

125 This was a policy and prejudice that had been established in the later years of the Company era when the logistics of introducing railways and other "advanced" mechanical technologies to India was first contemplated. As early as 1831, it was proposed—in a report to a Select Committee of the House of Commons—that young "Anglo-Indians", of mixed descent, might be "...brought forward as mechanics with veru great advantage..." This was thought to be "...a suitable form of encouragement..." for a population out-cast by both Europeans and Indians, but who showed technical competence and ability equal to the Europeans, in the eyes of the British administrators, hence a potentially very useful but "naturally" subordinate class. B.B. Misra, The Indian Middle Classes..., 193-194.
of its development. Through a parallel consideration of broader contemporary issues in the rise of the professional classes in England, and the technical disciplines in particular, we have attempted to determine some of the bases of the professional conceptual system of the engineering staff of the Department. Finally, we have begun to consider the manner in which this conceptual system became by degrees a practical mode of reasoning and ultimately a normative framework, institutionalized in the bureaucratic structure and codified procedures of the department.

As we will examine more closely in Chapter B, the bureaucratic organization of knowledge in the PWD had an internal logic which tended to ramify "procedures" of all sorts, including standardized procedures for design generation, through which the culturally and conceptually heterogeneous department staff could manage to function with consistency and system. Practically, the hierarchy and division of labour in this bureaucracy enabled inter-professional and inter-racial competition within the Department to be reasonably controlled.

The challenge to the established authority of the military members of the engineering staff, which was posed by the accelerated incursion of civil engineers into the department in the 1860s, was evidently counter-acted conceptually through an augmentation of discipline and procedure in the operations of the Department. This tended to devalue the intellectual agency of the individual professional, stressing a para-military corporate way of thinking—what we might call "departmentalism"—in its stead. This departmental conceptual system was manifested variously in management reforms within the department, and in its output of architectural designs and settlement plans, among other works, in this period.

In the next chapter we will examine some of these manifestations of the departmental conceptual system of the PWD in practice in the 1860s—the decade of the post-Mutiny rationalization of the colonial administration, its institutions, and methods.
PART THREE

RATIONALIZATION, STANDARDIZATION, CONTROL

1857-1901
CHAPTER 7

PEACE AND PUBLIC WORKS

THE RATIONALIZATION OF THE COLONIAL ENVIRONMENT

IN THE POST-MUTINY ERA

When by the blessing of Providence, internal tranquility shall be restored, it is our earnest desire to stimulate the peaceful industry of India, to promote works of public utility and improvement, and to administer its Government for the benefit of all our subjects resident therein. In their prosperity will be our strength; in their contentment, our security; and in their gratitude, our best reward. And may the God of all power grant to us, and to those in authority under us, strength to carry out these our wishes for the good of our people.

---Her Majesty the Queen in Council, 1858

Introduction: In the third and final part of this study we return to the historical processes and problematical issues of rationalization, standardization, and control through which the design practices of the Public Works engineers of British India were progressively institutionalized over the course of the second half of the 19th century.

The preceding two chapters have introduced the important conceptual and institutional changes that took place in the colonial community of British India in the middle decades of the 19th century. Taking into consideration related social and political processes in contemporary Britain, I have tried to establish some of the essential social and educational bases of the conceptual framework in which the British colonial officials in India thought, and the more specific professional conceptual system of the engineers who staffed the Indian Public Works Department. In Chapter 5 we considered the historical circumstances and the broader institutional framework in which the Public Works Department was created. Chapter 6 was a description of the range and hierarchy of the various social and racial groups that served in the PWD, and an account of the evolving professional issues that concerned the engineers establishment in particular, from which I have begun to discern certain convictions, intentions, norms, etc. which together may be said to have comprised (in part) their professional conceptual system.

In these final three chapters we will examine how that professional conceptual system, and the normative framework of colonial government service in which it operated, constrained the reasoning of the PWD engineers in their roles as architectural designers and as planners, and ultimately as technocrats responsible for conceiving and applying a set of bureaucratic procedures for a more or less automatic production of design solutions to the building requirements of the colonial

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1 Proclamation by the Queen in Council to the Princes, Chiefs, and People of India, 1st November, 1858. "Collection of papers relating to the reservation of engineer appointments in India to pure natives", AppendixB.17-18. PWD Miscellaneous Records. [NAI]
administration.

We resume our inquiry in the present chapter by considering the PWD engineers' efforts to "rationalize" their building designs and planning strategies in the period of consolidation and reform that followed the Mutiny. We will consider their modes of reasoning in defining and resolving the design problems they addressed, as well as the "rationale" they offered in justification for these sometimes draconian measures. We pick up the account of colonial technical development in India where we left it off in Chapter 5, with the general call to order in the colonial administration in the wake of the Mutiny, and the major new programme of construction which the Public Works Department was called upon to execute.

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1. CONCEPTUAL CONSOLIDATION IN THE AFTERMATH OF THE REVOLT

Development policy in the 1860s:

The general shock and indignation that the Mutiny had provoked in the European colonial community gave way after the event to more sober reflection, and increased conformity and discipline in most every department of the colonial administration. The colonial venture soon resumed in earnest, but with a new objectivity at the level of policy which sanctioned a cooler and more detached professionalism on the part of the colonial civil servants—a tyranny of expertise.

By the middle of the following decade this pursuit of stability and system had all but eclipsed the concern for the "moral" improvement of India, which had so driven the pre-Mutiny policies of reform and development. "To keep peace, and to push on the public works" was, tout court, the policy of the Indian Government, as the Secretary of State for India, Viscount Cranbourne, chose to describe it in his budget speech of 1866. These two objectives were intrinsically intertwined. The means to peace were internal security and social stability. These could be substantially engineered, it was felt, through judicious physical planning. In a rationalized colonial social space, ameliorated with strategic transport and communications, Law and Order could also be enforced when necessary. At the same time peace and stability were a

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2 "East India Revenue Accounts," *Hansard (Commons)* 184 (July 19, 1866): 1079-1137.
necessary condition for major public works to be undertaken and, as Cranbourne promised, the basis on which the colonizers might further the technical development of India, through scientific cultivation and industry, to "...draw forth the enormous elements of prosperity that lie in the richness of her soil and the teeming millions of her population." In enunciating this policy Cranbourne used an architectural metaphor that would increasingly be invoked to characterize this period of consolidation in the colonial development of India. The fragile edifice of the Indian empire, which had been so sorely rattled in the events of 1857-58, was being placed "...upon foundations that cannot be shaken."³

The need for a more comprehensive knowledge of India:

This strategy of consolidation and control had a global scope. Concrete action in the form of new designs and plans required, first of all, a firm foundation of knowledge of existing conditions. Beginning with systematic surveys of the destruction caused by the fighting, the aftermath of the Revolt was a period of intensive stock-taking, cataloguing and documentation. The disparate knowledge of Indian society and culture that had only been gathered informally in the past by orientalist scholars and "amateurs" among the Company's officers, was now to be methodically compiled and applied, while the many gaps and inaccuracies in that knowledge base were now to be rectified.

It was in this period that the emerging sciences of social and cultural inquiry, such as ethnography, demography and archaeology, began to be formally applied to the colonial enterprise.⁴ The Archaeological Survey of India was established in 1862 as one of the new "scientific" branches of the growing technocracy of the British Raj. Meanwhile the first full-scale census of India was to have been attempted in 1861. This was ultimately postponed a whole decade, however, for fear of causing undue interference in the life of a people that (in Northern India, at least) was presumed to be still raw with rebellious sentiment after the

³ ibid., 1091-1092.
⁴ B.S. Cohn, "Representing Authority in Victorian India", in Hobsbawm and Ranger, eds., The Invention of Tradition, (Cambridge: Cambridge University Press, 1983).
suppression of the revolt of 1857-58. But the decennial Census of India, first published in 1872, was to become the necessary prerequisite for the *Imperial Gazetteer of India* and for the series of official ethnographic tomes on the Tribes and Castes of the subcontinent on which colonial government policy toward Indian society was to be closely based up to the end of the British era. Even to this day, according to Cohn, much of the basic scholarly apparatus used for both administrative and scholarly activity in India, is founded on ethnological knowledge constructed in important part through the census operations of the 19th century.⁵

Administrative necessity was the official rationale given for the first of the all-India censuses. It was argued that without precise information:

regarding the numbers of the people, ... the basis is wanting on which to found accurate opinions on such important matters as the growth and rate of increase of the population, sufficiency of food supplies, the incidence of local and imperial taxes, the organization of adequate judicial and police arrangements, the spread of education and public health measures.⁶

But the value and the nature of the knowledge the census served to construct was at least as qualitative as it was quantitative in terms of the data of which it was comprised. Cohn observes that deeply held beliefs about the various Indian sub-cultures, castes, and races—which the census taking operations as much as the data itself had contributed to significantly, on the part of both the British and the Indian colonial communities—were to play much the same role in shaping policy in the latter half of the 19th century that ideas about the village community and the nature of property had played previously.⁷ Perception of the problem of controlling India, by its colonial rulers, had evolved from a matter of mapping and rationalizing social relations in essentially spatial terms, to an increasing concern with the classification and categorization of that society in terms of what we might call "cognitive

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⁶ Ibid., 242.

⁷ Ibid., 243.
mapping".

This earlier "spatial" paradigm in the conceptual system of the British colonizers was represented by the doyen of the scientific branches of the colonial administration, the office of the Surveyor General of India, created in 1815. This bureau unified the three provincial offices of Surveyor General, which had been operative as early as 1767 in the case of Bengal, to create a single cartographic agency for the Indian Empire. The Great Trigonometrical Survey of the Indian subcontinent which that department embarked upon in 1818 and carried out incrementally over the course of the subsequent quarter century, ostensibly served the practical and strategic purposes of generating a reliable cartographic image of the vast and varied expanse of territory the British had brought under their control. However, as Mathew Edney has argued, the representation of that geography through the cartesian framework of European cartographic science was an act of cognitive conquest in its own right which was ultimately of greater ideological utility than of actual practicality with respect to the business of colonial administration and development. The mapping of India served to create and maintain an image of the rational system, the order and regularity, with which the British were wont to believe they had subjugated India to their imperial dominion.

The quest for a more coherent social knowledge of India was a logical extension of the project of the cartographers—to add cultural content to their spatial depiction of the subcontinent. The first effort to produce a comprehensive Gazetteer of India as a whole had been produced in 1820 by Walter Hamilton, who had aimed to "...reduce the Geography of Hindostan to a more systematic form than had yet been attempted ... and at the same time to present a description of its internal economy." Hamilton had relied on what published materials there

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9 Walter Hamilton, A Geographical, Statistical, and Historical Description of Hindostan and the Adjacent Countries, 2 vols., (London, 1820). As quoted in B.S. Cohn, "The Census and Objectification in South Asia", in B.S. Cohn, An Anthropologist Among the Historians, (Delhi and
were at that time, the *Memoir of a Map of Hindoostan*, published in 1793 by Major James Rennel, serving as his main source for geographical information.  

In the second half of the 19th century, both the spatial and the social mapping of India continued in earnest. The two endeavours assisted and shaped each other in their contributions to the greater colonial project of amassing a comprehensive, total knowledge base for the purpose of administration.

As the map of India itself was completed, the anxiety to bind and consolidate the fragile empire of the British in South Asia directed the attention of the cartographers to the vulnerable northern frontiers of the subcontinent and the strategically important territory which lay beyond the political control of the British. To map those forbidden regions, however, required considerable ingenuity and a departure from the conventional methods of orthodox European land survey. The story of British endeavours to incorporate Tibet into its web of dependent native states is particularly intriguing in this respect as the Survey of India resorted to extraordinary tactics to create the first moderately accurate maps of that forbidden mountain kingdom.

In a fascinating essay, Thomas Richards describes the covert operations in western Tibet in the 1860s, of a team of surveyors disguised as Buddhist monks. Political complications had barred conventional British survey teams from entering Tibetan territory. Undaunted, however, the Survey Department (to this day considered an arm of the Indian Army's Intelligence Branch) resorted to a remarkable alternative strategy entailing the recruitment and training of a special task force of Hindu subordinates who would feign piety as Buddhist pilgrims in order to wander freely in the Tibetan mountains, all the while using their religious guise and rituals as a form of contextually appropriate low-tech instrumentation for gathering measured readings of the topography. Miniaturized surveying instruments were concealed in


10 Ibid.

walking sticks and false bottomed trunks, and Buddhist rosaries, which customarily have 108 beads, were modified into a decimal abacus of 100 beads which the surveyor/monks used as a form of pedometer to record their paces. Each hundredth pace they slipped a bead; each full circuit of the rosary recorded ten thousand paces. At a monkish average of 33 inches per pace, 27,500 feet or roughly five miles had been covered. The count was recorded periodically and formal readings were taken clandestinely when circumstances permitted, but the primary records were the mental maps each of the monk/surveyors methodically registered in their own memories. Workable route surveys were later worked up from the combined data which the surveyors had gathered with and largely in the instrument of their own bodies. Corrected versions of these same maps were used some forty years later in 1903 when the first official British "mission" was dispatched to Lhasa, on the military pretext that the Russian Empire was quickly advancing on the same object from the north and west.\(^{12}\)

Richards' interpretation of these particular technical and cognitive innovations in the practices of the Survey of India has interesting implications for our present interpretation of the technical undertakings of the British in India as a whole through the final century of their colonial administration. The ingenious improvisation of the survey officers of the 1860s, he proposes, broke the paradigm of cartesian fixity within which the great trigonometric survey of the subcontinent had been carried out earlier in the century. The gathering of knowledge, and the manner in which that might be used expediently to maintain or engineer political and cultural control, could thereafter be a more fluid, diffuse, fragmentary process.

Surveillance, as an official government activity, extended far beyond map-making as the imperial age reached its apex. The objective of charting the land, for which ethnographic knowledge had been deftly exploited as a means in the initial Tibetan surveys, became a means itself for compiling detailed demographic and cultural data. This was the era of the "Great Game" in Anglo-Russian super-power rivalry. Any and all information had potential strategic significance. But "knowledge" would

\(^{12}\) ibid., 110-111.
increasingly be sought in the shifting patterns and relationships between space and society, of which such information gave glimpses, beyond mere territoriality itself.

In Kipling's *Kim* for instance (as much a great "spy" novel, as it is the great "road" novel to which we referred earlier), social knowledge becomes fully coextensive with military intelligence. As Richards interprets it,\(^\text{13}\) the story is not so much a plot as a pattern of knowing ethnographic portraiture and the comings and goings of the pantheon of characters set in those various cultural molds. The conceit of the novel is the potential conflagration which lies implicit in this volatile conglomerate of humanity. The enemy is imagined to work in devious ways as an infiltrator and agent provocateur. The *Pax Britannica*—the "good" empire—existed to protect the status quo against such clandestine aggression through a multifarious exercise of covert surveillance: the secret service.

Kipling's embodiment of the benevolent all-knowing, all-powerful British regime is his character, Col. Creighton, simultaneously the head of the Ethnographic Survey of India and chief of the Secret Service. Creighton is aptly described by Richards as "perhaps the most cybernetic character in Victorian literature". He is a man of universal competence, fully cognizant of seemingly every fact and function of the colonial Indian state and the world in which it exists. Through his formal and covert networks of knowledge gathering operatives he surveys the roads and communications of the subcontinent, "...oversees justice, interprets prophecy, supervises the regiment, and superintends the Great Game—but, remarkably, he does not plan anything."\(^\text{14}\) The ultimate panopticon, "embodied" in a supreme archivist, Creighton *does* seemingly very little. But in receiving, classifying and correlating his all-seeing knowledge of the flux and flows of Indian life he keeps a firm hand on the balance of power; knowing India intimately to control it and, only if necessary, to adjust it as imperceptibly as possible to maintain its homeostasis.

By the final years of the Victorian era the project of the general material and technological development of India as a strategy of social

\(^{13}\) ibid., 119.

\(^{14}\) ibid.
reformation and political control had been superseded largely by the mentality and attendant strategy described in *Kim*. The modern infrastructure of transport and communications technology erected in mid-century by the PWD engineers had become the formal mask behind, which a higher project of "colonization through the mediated instrumentality of information" was being enacted. 15

Such cybernetic machinations were, however, hardly apparent to the majority of colonial technicians and scholars who undertook that cognitive conquest. From the middle of the century onward, the amassing and interpretation of such information were greatly facilitated—and to some extent motivated, it seems reasonable to conjecture—by new methods and techniques for gathering and representing social knowledge. The new science of statistics had a particularly important effect in constructing this knowledge base as a neatly categorized and quantified model of the colonial Indian society. Such a model was significant in the first place for representing patterns and contrasts in the social fabric, which might be identified as problematic. Secondly, it abstracted this demographic knowledge in quantitative terms commensurable with other statistical data. This entailed the possibility of viewing the social phenomenon in a more global, systemic relationship with other variables such as regional ecology, cultural environment, and politically determined economic policy. Furthermore, this systemic viewpoint suggested the possibility of "engineering" social change (or preventing it) through calculated manipulation of specific variables in this greater system. Finally, as we shall see below in our discussion of the sanitary reform movement, statistics enabled one to measure and control the results of such experimentation, which tended to enhance its political utility.

Photography was another novelty of this era which had an important impact on how knowledge of the colonial social environment was to be constructed and confirmed by the British in the second half of the nineteenth century. This new representational technology was introduced to India shortly after its invention in the 1840's. As had earlier generations of sketchers, etchers and painters, amateurs of the new medium and freelance professionals began avidly to record the natural

15 *ibid.*
scenery and the cultural landscapes of 19th century India, "native" and "European". From the start these photographers and their patrons (including various viceroys and even Queen Victoria herself) showed a particular enthusiasm for the making and collecting of images representing the racial, religious, cultural, and caste diversity of Indian society. This fund of images would have an important impact in enhancing and ostensibly confirming the ethnological taxonomy and theories of the colonial technocrats; a point of departure for the new social sciences of anthropology and sociology that emerged later in the century.  

The mastering of India’s architectural past:

The making of a photographic archive of India's material culture had also begun early on. The recording of the subcontinent's monumental architectural heritage was a significant facet of that effort; greatly encouraged from the outset by the independent scholarly initiative of the redoubtable Scotch historian of architecture, James Fergusson. With the powerful aid of such photographic surveys, Fergusson was almost single-handedly responsible for assembling and classifying the knowledge of historic Indian architecture from which "modern" Indian architecture in the later decades of the 19th century was to build (or detract). Hence, his particular contribution toward the consolidation of the cultural knowledge base of the British Indian regime, will merit a brief digression.

Fergusson's monumental ambition to rationalize the history of all the world's architectures began, in fact, with his own untutored, self-financed efforts—during his eight year residence in India as a merchant in the lucrative indigo trade—to "unravel the mystery" (as he described it) of India’s architectural past. 17 But it was not until 1842, when Fergusson returned to England, that he embarked on his task of compiling and classifying his observations and thereby bringing India’s

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architectural history "within the domain of science". This was a career-long project that produced several of his earliest books and essays as a critical historian and theorist of architecture, but which was to take him 34 years to realize in its definitive form with the publication of his History of Indian and Eastern Architecture in 1876.

Distanced as he was from the object of his study, Fergusson had been among the first to recognize the immense efficacy and power of the photographic image as a representation of knowledge and a tool for analytical research. His effort to assemble a coherent archive of such images from independent sources was greatly aided in the post-Mutiny era when the Government of India, under various auspices, determined to photograph India's monuments on a systematic and exhaustive basis. At the instigation of the East India Company, the Government of Bombay had in fact begun as early as 1855 to engage some of its military personnel in photographing architectural monuments in that presidency, as an economy measure over the relatively greater time and expense it had incurred in previous efforts to document historic buildings by conventional methods of measurement and delineation. In the aftermath of the Mutiny, however—with the newly recognized need to know Indian society and culture in depth—it was the objective accuracy and system of the photographic medium, rather than budget considerations, that encouraged its application. Over the course of the 1860s, photographic survey parties journeyed to every region of the subcontinent, methodically documenting all architectural monuments of historical or artistic significance, including sculpture and the rock-cut architecture of India's various cave-temples. The photographs were regularly supplied to Fergusson, whose authority as the premier scholar and taxonomer of Indian architecture was to be generally acknowledged well into the twentieth century. Among the newest "scientific" branches of the colonial service, the Archaeological Survey of India was Fergusson's most committed collaborator in this regard. Much of this wealth of new photographic data, which had been collected for the Archaeological Survey, was brought forth in joint publications with Fergusson.

By the time his *History of Indian and Eastern Architecture* finally went to press, Fergusson could confidently claim "to know" and to have "mastered" the subject of his exhaustive study, by virtue of his ostensibly objective documentary method alone. "No man," he asserted in the Preface to the first edition, "can direct his mind for forty years to the earnest investigation of any department of knowledge and not become acquainted with a host of particulars... I possess...more than 3,000 photographs of Indian buildings with which constant use has made me as familiar as with any other object that is perpetually before my eyes, and to recapitulate all the information they convey to long-continued scrutiny, would be an endless, if not impossible undertaking."\(^{19}\)

With the new commitment in this period to pragmatic forward-looking material development, however, the significance of such historical knowledge, and the importance of scientific method in its collection, were not necessarily appreciated. The Archaeological Survey depended largely on the expertise of photographers in the service of other "scientific" branches of the colonial service that were not always sympathetic to the scholarly objectives of the exercise.\(^{20}\) We learn from the FWD proceedings of 1864, for instance, that one Lieut. Waterhouse, a Royal Artillery officer skilled in photography who was then attached to the FWD, had been requested to serve on the staff of Maj. General Cunningham, the director of the Archaeological Survey. However, after protracted deliberation on the matter, the request was denied as the Government was not sufficiently convinced of the necessity of delegating funds and establishment for that purpose. There were sufficient private photographers at work in the country by this time that such an incidental


\(^{20}\) The Archaeological Survey was founded in 1862. Although it became a formal department of the Government of India, it was initially regarded as only a temporary institution with the singular mandate to "survey" and catalogue India's ancient monuments, and its activities were severely cut back in the later years of the 19th century as that basic recording function was accomplished. During Lord Curzon's viceroyalty at the turn of the century, this policy was turned around and the crucial agency to undertake active historic conservation was added to the Survey's mandate. G.H.R. Tillotson, *The Tradition of Indian Architecture*. (New Haven and London: Yale University Press, 1989), 37.
undertaking—as it was apparently regarded by the Government—could in its opinion be commissioned perfectly acceptably on an independent contractual basis.

It is interesting to note that General Cunningham insisted on the scientific nature of the proposed survey; the photographs were to be executed with a clinical objectivity, for maximum information content rather than any "artistic" pretense. Evidently the services of the PWD photographer—a military technical officer—would have fit his prescription admirably. Although Lieut. Waterhouse was to remain assigned to more prosaic tasks within the PWD, much of the Archaeological Survey's photographic work was in fact carried out by military officers and engineers (and even members of the Indian medical service). But independent commercial photographers such as Samuel Bourne were responsible for filling in the gaps with some of the finest and most evocative images of India's architectural past.21

Explaining Indian civilization: the role of scholarly knowledge in the colonial polity

"What the colonial ruler had explained, he of course controlled...", or so he may at least have believed. Printed and bound and filed in the labyrinthine stacks of the great Victorian libraries, it was powerful, lucid photographs such as Bourne's, coupled with the imperious assurance of Fergusson's classification and rationalization of the exotic architectural legacy depicted—among comparable contributions in other knowledge domains—which served to convince the British of their "mastery" of India's past. In terms at least of the evolving general belief system of the colonizers', the sense of cognate authority that the architectural historians, archaeologists, and ethnologists scrambled to confirm with the aid of statisticians and photographers, at the advent of the new Raj, was instrumental in framing a strategy for the further development and, as we shall examine later, the permanent control of

21 "Photography of Indian Buildings of Interest," PWD (General) "A" Proceedings, Jan. 1864, nos. 7-10; R. Elwall, "James Fergusson...," 398.

22 as Metcalf asserts in his reading of the relationships between British Indian architecture and imperial cultural politics in the later decades of the 19th century. T.R. Metcalf, An Imperial Vision, 52.
India. In the domain of architecture the British could act with confidence in their mastery of India's past building experience, as they sought to shape a contextually and technically rational new built environment.

I will proceed shortly to examine how this rationalization of colonial space and society was pursued through the design and planning agency of the Public Works Department, but we might conclude this preliminary discussion of British efforts to consolidate and rationalize their over-all knowledge of India with an interesting comparative illustration of the conceptual change observed over the course of the decade in question. In 1857, while the Mutiny was still raging, the Builder chose to publish one of the more shameful instances of its candour as a liberal organ of popular sentiment in the British building professions. We gain some measure of the overwhelming indignation and relative ignorance with which the British public viewed the events in India from the rhetorical appeal to British national honour penned by a contributor to the journal who earnestly encouraged his countrymen to loot India of its cultural riches as just retribution for the latter's heinous "rebellion" against its benevolent overlords:

It has always been the practice from the days of the Romans downwards, and, indeed from days long anterior to their sway, for the victors in war to carry off to their own country trophies and spoil from the vanquished...The English are more punctilious than their neighbours in such matters...[But], are we a little too squeamish in our dealings with the vanquished, and more particularly so in our late Indian wars? Now, if ever there was a time when we might justly remove, to our own country, some of the treasures of art with which that land abounds, now is that time.

We have talked of razing cities there to the ground, as a salutary example to the worst of the rebels, and there can be no doubt but that such a proceeding would impress these people with an idea, which they have difficulty in believing, that they have been actually conquered. Now, would not so desirable an object be equally well, if not better, obtained by the removal, before their eyes, of some of those truly elegant objects of art—the work of former sovereigns—that they have been for many ages accustomed to look upon with a sort of veneration?".

In the months that followed, the colonial officials actually pursued both of these lines of disciplinary action with a vengeance. But the raiding of artistic treasures—which Company servants and soldiers had been carrying on haphazardly over the preceding years of conquest, and which was eventually to form the basis of the huge Indian collection of the new South Kensington Museum complex (renamed the Victoria and Albert Museum in 1899)\textsuperscript{24}—served after the fact to stimulate a more sincere and informed respect for Indian art and culture. A new wave of scholars that emerged in the second half of the century were at least as intent on gaining a complete and coherent knowledge of this cultural legacy as they were on coveting its prized artifacts.\textsuperscript{25} With increasing official support they were also motivated to pursue their inquiries in the field.

An interesting indication of this shift in attitude in the post-Mutiny era was the marked new official enthusiasm for establishing "local" historical and archaeological museums in India itself. In the Annual Progress Report of Public Works in India for the year 1863-64, for instance, it was reported under the heading of "Scientific works" that construction was planned or in progress on several new government museums at different places about the country. These included Sealkote, Umritsar, Mooltan and Lahore; and the Central Museum at Madras which had first opened in 1854 but was now being doubled in size with the addition of a second storey.\textsuperscript{26} The great Imperial Museum of Calcutta was to be built a few years later.

Among the most novel and popular of the modern institutions introduced to India by the British colonizers, these museums were not so much repositories of dead fragments as they were laboratories in which knowledge of India's past and present was actively being constructed. With their immediacy to the culture itself—and their accessibility as popular public institutions to both Indian and European colonial communities—these museums were also to serve a didactic role.

\textsuperscript{24} Metcalf, An Imperial Vision, 144.
\textsuperscript{25} Metcalf, An Imperial Vision..., 142-145.
\textsuperscript{26} Annual Progress Report of Public Works in India for the year 1863-64, (Feb. 27, 1865). Enclosure to FWD Circular no. 20 of 1865.
communicating politically expedient theories, sanctioned by Victorian science, concerning the historical and social development of India in a global framework of social evolution in which the preeminence of European civilization was unquestioned. 27

The clarification of policy and priorities in the PWD:

In a similar if more prosaic manner than some of the other scientific branches of the administration, the Public Works Department began the new era of development following the restoration of British control in northern India with a concerted effort to consolidate its own knowledge base.

A key concern was to lay down a firm and explicit set of guidelines by which the Department's operations could be kept within some bounds of order and consistency. The need for a departmental code of regulations had been acknowledged soon after the PWD was formally established, and as early as 1856 a Code Committee had been convened to frame such a guideline and compile an appropriate manual through which it could be

27 For his part, James Fergusson made no pains to disguise his own cultural chauvinism in this respect, despite his exceptional scholarly commitment to the study of Indian architecture. In his introductory remarks to the History of Indian and Eastern Architecture he was quick to assure his readers that "...it cannot, of course, be for one moment contended that India ever reached the intellectual supremacy of Greece or the moral greatness of Rome." J. Fergusson, History of Indian and Eastern Architecture, vol. 1, 4.

Fergusson's attitude toward "modern" European architecture, particularly that which was then beginning to be built in India, was quite a different matter, however. He made a clear but strongly favorable distinction between Indian architecture and the building that had taken place in India as a result of its intercourse with Europe. The few examples of colonial architecture he discussed in the History were more or less dismissed for their debased historical or stylistic citationism of which, in his earlier writings, he had accused modern post-Renaissance architecture generally. Indian architecture, on the other hand, was perceived as a true style--of a kind, if not on a par, with the ancient and medieval architectures of Western civilization. But, much as his project of putting Indian and Eastern architecture into the history books was in part inspired by his conviction that the overly academic architects of the West stood to rediscover fundamental principles of authenticity and spontaneity in the substantially "unbroken traditions" of building in the East, it is significant that he held little apparent hope that such traditions could survive the shock of European development and progress.
made useful to the executive engineers in the field. But the work of this committee had been held up by the Mutiny, so it was with some concessions to urgency that the first edition of the Code was rushed into print in 1858. Certain policies had not yet been determined, including rules concerning powers of sanction and estimating procedures. These were to be added in the form of appendices and integrated with other new information and matters of protocol in later editions. Budgeting and accounting procedures were considered particularly inadequate as initially laid down in the Code. These were to be the focus of further rigorous rationalization a few years later which was to have an important impact on design procedures in the Department. But we will return to those developments when we discuss "standardization" in Chapter 8.

The most obvious concern in the immediate aftermath of the Revolt was to gather a complete and accurate overview of the work at hand and the priorities for the reconstruction effort. Somewhat belatedly, in August of 1860, a final damage assessment report was published in the PWD Proceedings, compiled on the basis of detailed surveys carried out by the provincial works departments of Bengal, the North Western Provinces and the Punjab. All civil and military works and buildings damaged or destroyed in the events of 1857-58 were accounted for, with estimated costs for their reconstruction. The manner in which this information was classified in the tabular statement—with regard to class and types of buildings, locality, and perpetrators of the damage—allows us to make a few observations on the apparent pattern of destruction.

Along with attacks on strategic communications links such as roads, bridges and the new network of telegraph lines, many public buildings had been destroyed by the mutineers and their various civilian accomplices.

28 PWD (Public) Bengal, Oct. 15, 1856, nos. 21, 23.
29 Code of Regulations for the Public Works Department, 1st edition. (Calcutta: 1858), 1. [IDL V3187]
30 PWD (General) "A" Proceedings, 31st August 1860, nos. 160-164.
31 For each documented case of damages, the authorities were careful to specify which particular category of malefactors were responsible. Civilian "rebels" were distinguished from "mutineers", but more and less organized criminal and anti-social elements—referred to as "budwashes" and "bad characters" in the official report—were also accused of involvement. Ibid.
These included all manner of basic buildings symbolic of the colonial regime such as dak bungalows, churches, and the quarters of the mutineers' commanding officers. A more calculated campaign of destruction had been directed at the talookdari offices (sub-district revenue offices), cutcherries (district collector and magistrates' offices), and the public records offices at major administrative stations such as Lucknow, in which the registers of the despised land tenure settlements and taxation rolls were kept. Further fury had been directed, somewhat surprisingly, at buildings and works of basic public utility such as the ice works at Allahabad, and the Jumna River bund, a dike-like embankment which had been under construction in 1857 to protect that city from endemic annual flooding.

The British troops and civilians had been responsible for their own share of destruction as well in their desperate attempts to convert the buildings in which they had been besieged in the early stages of the Revolt into defendable strong-points. At Berhampore in Bengal, for example, the presiding Chief Engineer had directed the partial demolition and alteration of the local European hospital, where the besieged had taken refuge, in order to secure its compound. Similar measures were taken by the Military authorities at Meerut and Benares.32

Altogether, a repair bill of some two and one quarter million Rupees was estimated for the three provinces hardest hit by the fighting, fully 96% of which was to be incurred in the North West Province alone. Not surprisingly, military buildings as a group accounted for close to half of this total damage estimate. The mutineers and civilian rebels had been indiscriminate in this regard, destroying all manner of structures: European barracks and officers quarters, magazines, commissariat godowns (warehouses), guard rooms, non-commissioned officers quarters, gun sheds, stables, hospitals, and in many cases even the "native lines"—the mutineers' own quarters.

The buildings of the Judicial Department had been the second most conspicuous target of the Revolt, largely at the hands of the rebellious

civilian population. As we have already observed, buildings symbolic of the authority of the regime such as court-houses and collector-magistrates' cutcherries were widely attacked. But this revolt against British Law and Order extended to the whole disciplinary system that had been established to uphold it. Thanas (police stations) and police chowkeys (outposts) had come under heavy attack all over the afflicted regions, and with the incitement and assistance of the rebels many of the jails, including some of the large high security central jails, had been over-run and substantially destroyed by rioting prisoners.33

The very substantial reconstruction which the Public Works Department was compelled to undertake on behalf of the Military and Judicial Departments in particular, in the wake of the Mutiny, was to provide an opportunity for some important re-thinking of the principles on which the architecture and planning of British India had evolved. It would not be the first time that engineers would attempt to rationalize the design of the most basic Anglo-Indian building types—namely, the bungalow and the barrack. But the unprecedented scale on which reconstruction and projected new development were contemplated in the short term, caused them to perceive the issue of rationalization from a more total perspective. The importance of general economy in design and building methods was accentuated both by the temporary deficit in Public funds as a result of the great expense of the recent conflict and by the exceptional volume of new construction and repairs anticipated. Meanwhile, the perennial quest for improved comfort and healthiness in the accommodation of Europeans in the hot, un-friendly climate of India, encouraged further innovations in the technical and architectural conception of the generic Anglo-Indian building envelope. But increasingly the design of a salubrious, let alone secure environment for the maintenance of an able and potent community of European administrators in India would be perceived and approached as a matter of environmental planning at the scale of entire settlements. Indeed, as the impact of rapid transportation and communications began to be appreciated with the accelerated development of the Indian railway system in the

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33 PWD (General) "A" Proceedings, 31st August 1860, nos. 160-164.
1860s, the engineers in the PWD were provoked to begin considering the logistics and rationale of their mundane design decision-making on a much broader basis; as the rationalization of the colonized space of the Indian subcontinent as a whole.

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In the subsequent sections of this chapter the preceding assertions will be grounded and developed through focused examinations of three illustrative cases of design rationalization on the part of the PWD engineers. In each case we will attempt to discern and interpret the rationale offered in support of design decision-making, and the particular modes of reasoning which underscored such arguments.

The first of these cases illustrates the comprehensive scope and criteria of design reasoning with regard to colonial settlement planning, in the aftermath of the Revolt. We will examine the post-Mutiny redevelopment of the important provincial "station" of Allahabad, referring specifically to the master plan proposed in 1858 by the PWD engineer, Major Richard Strachey, to which subsequent development conformed substantially. Through an informal analysis of Strachey's design argumentation I discern, partially, the apparent agency in this design case of both the professional conceptual system of the military engineer of the Indian PWD, and the evolving general belief system of the British colonial community in India.

The second discussion develops around the preeminent technical concern of the PWD engineers, in this period, with the "health" of the buildings they designed. Departing from the contemporary theories of disease and sanitary conservancy that deeply underscored colonial settlement planning, I proceed to the singular architectural issue of salubrious barracks design. Again, I offer an informal analysis of design argumentation concerning a specific case: the efforts of the PWD engineer, Col. W.H. Crommelin, in his capacity as Inspector General for Military Works, to rationalize universal design standards for modern Indian barracks. From the evidence of his published reports and plans, and departmental correspondence, I consider the contextually "limited" rationality of his design reasoning, particularly the pragmatic
application of prevalent social and ethno-medical beliefs to the problems at hand.

The third discussion, with which the chapter closes, examines a further "civil" application of such social and ethno-medical knowledge. I consider the prison design reforms prompted by the Judicial Department's need to substantially reconstruct and expand jail facilities in the aftermath of the Mutiny, consequent on both the heavy damage sustained by many of the existing buildings and the need to incarcerate many new prisoners. I interpret, in particular, the development by PWD engineers of a model plan for large central jail complexes for India. Both of these manifestations of the new paradigm of rationality in the design reasoning of the PWD engineers in the 1860s--as examined in the preceding discussions in the social engineering of colonial space, and the technical engineering of large institutional buildings, respectively--are seen to converge in this quintessentially rationalistic architectural brief; to design a model institutional facility to contain and control the deviants of a racially and culturally complex colonial society.

2. THE RATIONALIZATION OF COLONIAL SPACE

In this section I propose to analyze the manner in which shared social and professional belief systems prevalent among the British colonial community in the immediate post-Mutiny era were reflected in the sober, technically rationalized design-thinking of an individual PWD engineer. Major Richard Strachey's detailed prescription and rationale for the planning of the new capital of the North-Western Provinces, as recorded in his exhaustive planning report of 1858 on the proposed new civil and military stations at Allahabad, provide a singularly rich and substantial case for the purpose of this analysis. I argue, however, that this instance was typical of post-Mutiny colonial settlement planning in the general case, on fundamental points of principle and strategy.

Major Richard Strachey, B.E.:

Before entering into the case itself, we might ask what we know about the particular "agent" responsible for the re-planning of colonial Allahabad. It would not be plausible to insist that Richard Strachey was merely "typical" of the men who comprised the engineer’s establishment of the PWD. We know a good deal about him; not the least because his exceptional career was to earn him a place in Vibart’s hagiography of the "Heroes and Men of Note" of the Indian Engineers Corps.

The reader will recall from the discussion in Chapter 5 of the in-roads of the Utilitarian creed in the British Indian administration, that Richard Strachey was a son of Edward Strachey, J.S. Mill’s friend and colleague in the Home Judicial Department of the East India Company. Richard and his brother John—the most powerful member of the India Civil Service in the 1870s, as senior council to the Viceroy—were a direct and dynamic conceptual link between the philosophic radicalism of their father’s generation of colonial functionaries in the service of the Company, and the more pragmatic, technocratic vein of Utilitarianism that was ultimately applied forthright in the administration and development of India under Crown rule. The eminence of the Strachey Family in playing powerful supporting roles in the Indian administration went back a further generation in fact, to Edward’s father, Sir Henry Strachey, who had served as Lord Chives secretary when he went out to reorganize the Government of India in 1765.

Richard Strachey (1817-1908) opted for a military career in Indian service and enrolled accordingly at Addiscombe, from which he graduated in June 1836. His subsequent rise to eminence in the Engineers Corps and later in other senior administrative posts was aided, certainly, by his family ties. But the several major military events that transpired in India during the first two decades of his career were also fortuitous in this regard, putting him into positions of unusual responsibility and proximity to the upper echelons of the administration by virtue of

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exceptional war-time circumstances.

Upon his graduation from Addiscombe at the head of his class Strachey was selected for the engineers, as per tradition, and proceeded to Chatham for the further required course of technical instruction in "field works and practical architecture" which included surveying, architectural and cartographic drawing, fortifications and plans of attack. (see Chapter 6: "Practical Instruction: The Chatham Course". According to Col. C.W. Pasley, the commandant of the Royal Engineers Establishment of Field Instruction at Chatham, Strachey demonstrated a considerable and fastidious talent for drawing as a student. 36 Examples of his draftsmanship and his critical sensibility in matters of architectural taste and propriety, which have been preserved in the India Office Records Collection, indicate that Strachey maintained such skills in his maturity as well. 37

Strachey completed the course at Chatham in June of 1837 and proceeded sometime thereafter to India, initially to join the Bombay Engineers with which he was stationed successively at Poona and Kandeish. But in 1839 he transferred into the Bengal Engineers Corps, gaining a post on the Jumna Canal Project under William Erskine Baker in 1840. Three years later Strachey was promoted to the post of Executive Engineer on the works of the Ganges Canal under Proby Cautley, who entrusted to him the major responsibility for constructing the canal's headworks at Hardwar. Strachey continued to be involved with that extensive undertaking through the course of the 1840's. However his work was much interrupted, first by a call to active duty in the Second Sikh War (the Sutlej Campaign, 1846), and then by ill health which compelled him to spend increasing lengths of time up in the more salubrious climate of the Himalayan foot-hills.

While convalescing, however, Strachey was far from inactive. Encouraged to indulge a scientific bent for investigating the botany and


37 R. Strachey, Plans for a House at Roorkee (unbuilt). IOLR: MSS Eur F127/296. See fig. 4.6 in Chapter 4, above.
geology of the Himalaya, he eventually pursued that inquiry deep into Tibet—which was then still virtually unexplored by the British.\footnote{In fact, Strachey's perambulations predated the Survey Department's clandestine Tibetan expedition by surveyor-monks by almost two decades. See above, and T. Richards, "Archive and Utopia".} This incidental digression assumed preeminence in his career for several years as it turned out. Strachey returned to England from 1850 to 1854 where he was almost wholly occupied classifying his collection of some 3000 species of Alpine flora (gathered between 1848 and 1849 in collaboration with the naturalist, J.E. Winterbotham) and presenting papers on these and other scientific subjects to learned societies in England.

The second of Strachey's several brief but significant careers in India, commenced in 1855 when he returned to join the newly constituted Department of Public Works as head of irrigation works in Bundelkund. A year later he was deputed to Calcutta to act for Capt. Henry Yule (who was presumably away on furlough) as Under Secretary in the FWD. In this capacity Strachey was to work again under his old boss from the Jumna and Ganges Canals, Col. W.E. Baker, who had meanwhile become Dalhousie's appointee as the first Chief Engineer and Secretary for Public Works. This small world of fraternal patronage within the Indian Engineers Corps was to continue to advance Strachey's career.

At Calcutta Strachey gained the notice of J.P. Grant, a member of the Supreme Council, who subsequently invited him to serve as Secretary to the provisional government of the Central Provinces which Grant was to head up as Lieut.-Governor in the thick of 1857. This was a temporary solution to the disruption of administration in the North-Western Provinces whose western territories and political headquarters at Agra had been cut off by the Mutiny. Based first in Benares, and later in Allahabad after the fall of Lucknow, the two men exercised an exceptional responsibility and authority in all departments of government for a period of six months from July 1857 to January 1858. When peace had been restored to that region, and regular administration could resume, Strachey stayed on at Allahabad to lay down planning guidelines for the new civil and military stations which were proposed to be built at that place as the future administrative capital for the North Western Provinces. Agra had served that function previously but had proven too
vulnerable and geographically remote in the events of the preceding year.

The official planning report on the new capital, which Strachey produced in April 1858, is the document we will analyze presently. But first we might briefly conclude this overview of Strachey’s career as we will encounter him again later when we discuss the rationalization of the PWD bureaucracy—to which Strachey, among others, was to turn his keen organizational mind a few years later.

From Allahabad, Strachey returned to Calcutta to substitute once again for Henry Yule who had meanwhile taken over Baker’s post as Public Works Secretary to the Government of India. In the aftermath of the Revolt Governor-General Canning had taken Yule and the rest of his administration up-country to see directly to the appeasement and political reconstruction of the lately rebellious territories of the country. Strachey was to oversee the PWD at home-base, in Yule’s absence, from his substantive new appointment as Consulting Engineer for Railways. After a second bout of ill health which compelled him to return once again to England, Strachey came out at the end of 1861 to succeed Yule as Secretary for Public Works. He held that post for the next four years—among the most energetic in the history of the Department. In 1865 he tried to retire to England but appears to have suffered a financial crisis with the coincidental failure of the Agra Bank, in which he had invested his savings. This compelled him to return to India the following year to take up yet another post, this time as the Inspector General of the new Irrigation Branch of the PWD. This he retained until the end of 1869 when again he took on the office of Secretary for Public Works, though only in a temporary "acting" capacity for just one year (1870–71). Strachey was to return to India on other missions later in his long career, but his involvement with the PWD ceased at this point.

Of the various "hats" that Richard Strachey was evidently capable of wearing as a professional servant of the colonial administration, it was from a soldier’s point of view that he addressed the problem of colonial settlement planning. In his straight-shooting reasoning and recommendations for the post-Mutiny development of Allahabad, to which we will now turn, Strachey articulated a military engineer’s perception of the issues with clarity, and with an uncommon degree of conviction which had evidently been fortified by the lessons of the recent fighting.
Fig. 7.1. British Cantonments in India established under the Act of 1864 and subsequent legislation. Source: E. A. J. Johnson. The Organization of Space in Developing Countries. Cambridge: Harvard University Press, 1970.
Fig. 7.2. Allahabad c.1900. The new civil station ("cannington") and cantonment were laid out in close concordance with Major Strachey’s planning report of 1858. Source: Ballhatchet, K., and J.B. Harrison, eds., The City in South Asia: Pre-modern and Modern, London, 1980.
Secure, contain and control: the post-Mutiny planning of Allahabad

For the military establishment in India there almost seems to have been an element of triumph in the conceptual change brought about by the Mutiny. The seriousness of defense matters would not be questioned again for some time (fig. 7.1); nor would the urgency of the call for much improved professionalism and rationalization in all facets of colonial life and service. Within the corps of engineers and the Public Works Department, Strachey and influential colleagues such as Col. George Chesney were to stress such arguments and apply them ardently in reforms to departmental organization and procedures over the next few years. Meanwhile, his personal mandate to lay out the new civil and military stations at Allahabad was an opportunity for Strachey to impress these new norms more broadly, upon the colonial community as a whole.

Strachey’s methodical prescription for the correct displacement of the various segments of population—civilian, military, European, Native—indicates the reasoning of a clear-headed pragmatist guided confidently by a military compulsion to secure and contain all predictable scenarios for threat (or change) to the status quo. His detailed report is also a revealing document with regard to the conceptual renovation that had transpired with respect to strategy, planning policy and basic attitudes toward the business of empire-building. While the future defense and security of the European colonial community are his overriding concerns as a physical planner, such he suggests, would depend as well on new social norms of discipline, vigilance and sacrifice, which he assumes all servants of the regime would henceforward be prepared to uphold.

The choice of Allahabad for the provincial capital was obvious from a strategic point of view. As Strachey rationalized, “...the geographical position of Allahabad at the head of the navigable stream of the Ganges, and halfway between the eastern and western capitals, Calcutta and Bombay, mark it out as a natural centre of our government in Upper

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India."

Both strategically and symbolically, Allahabad sat at an auspicious point on the map of northern India. The city lies at the mid-point of the Gangetic plain, equidistant from Calcutta, the principal colonial port city and seat of the Supreme Government throughout the 19th century, and Delhi, the capital of the former Mughal dynasty, 500 miles to the North West. Bombay was actually more than twice as far to the South-West (to correct Strachey's somewhat wishful assertion) but was within a few years of being connected directly to Allahabad by rail. The North-Eastern line of the Great Indian Peninsular Railway was to reach Allahabad via Jabalpur in 1867. There it linked with the trunk line of the East Indian Railway, from Calcutta to Delhi and beyond. (fig. 7.1; see also figs. 5.4 and 3.2, above).

Meanwhile, the conceptual auspiciousness of Allahabad was equal to if not greater than its strategic importance. Since the very early history of the Hindus, the site of the town on the left bank of the Jumna River at the point of its confluence with the Ganges, had great religious significance. The original settlement, known as Prayag, was fortified and substantially rebuilt during the reign of Akbar, becoming a provincial capital of the Mughal Empire under its present name in 1584. Early in the British era, the treaty by which the Diwani (land tax revenue) of Bengal was first awarded to the East India Company, was signed at Allahabad. In 1858, ninety-three years later, it again played host to a diplomatic accord of great symbolic significance. Upon the final suppression of the Mutiny in November of that year (some months after plans for the new station had been set in motion), Governor General Canning chose Allahabad as the meeting place to stage the first of the great imperial Durbars (ceremonial assemblages) of the British Raj, at which the transfer of power from the East India Company to the British Crown was first announced.41

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40 The treaty was concluded at Allahabad in 1765 by the Mughal Emperor, Shah Alam, and Lord Clive. See P. Spear, A history of India, 81-92. However, the man who actually prepared the text of that fateful document may well have been Richard Strachey's grandfather, Henry, who was Clive's secretary. See biographical sketch of Richard Strachey in Vibart, Addiscoabe, Its Heroes and Men of Note.

41 L.F. Rushbrook Williams, ed., A Handbook for Travellers in India,
In his planning recommendations, Strachey sought to back up the political logic of the civilian bureaucrats who had elected to make their base at Allahabad, with an argument for the military role he saw that the new capital must play, and be designed for. The city's local capabilities for defence would, he believed, be found no less great than its geographical advantages for founding a capital. Before all else, he asserted,

...I conceive that our new capital of the North West should be looked upon as a great strategic centre, and should be made an important defensive position. In saying this I mean much more than that the Fort should be maintained and strengthened. I mean that the English quarter of Allahabad should be put beyond risk of popular insult, or of sudden destruction, and should be protected as a whole, from external hostilities by suitable defensive works. No one can say when the day of danger shall again come, but when it does come we should be prepared, and the expense attending to such preparation will, I believe, be found insignificant compared to the stake at issue. (3-4) 42

The new cantonment should be established west of the civil station, he argued, guarding the open flank of the city from the only possible route of large scale military attack. The openness of the terrain he also perceived to be ideal on grounds of salubrity for the construction of well ventilated barracks, and for the purposes of training grounds, and clear sight lines etc. for the purposes of defensive works (redoubts, trenches, barracks, etc.) that he proposed should be built across the four mile flank of the Doab between the Jumna and Ganges Rivers.

Strachey's next priority was less vested in military professional pride. This was the primacy of basic economics; his recognition of the prerogatives defined by a clear grasp of accounts. In his plans for Allahabad the inertia of the capital-intensive railway developments which had already been initiated in that vicinity dictated the starting point for his strategic and sociological reasoning concerning future urban

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42 R. Strachey, Report on the new Civil and Military Stations at Allahabad, 3-4. Unless otherwise indicated, all quotes in the following sub-section are cited from the above document with page references indicated in parentheses.
development:

In asking what exact locality we shall fix upon, our next step is to observe that the position of the Railway Station, with its costly and elaborate buildings, is already settled. To change this now, even if it were expedient, would practically be impossible. Now the Railway Station will evidently be the most convenient centre round which to group the European Settlement, if other circumstances admit of it. The road to all parts of the Upper Doab already lie through the Railway Station, for the line is already open to Futtehpour, progress is daily made on the works, and Railway communications with Cawnpour will be established by the rains. If the delay in the connexion with Calcutta will be longer, it is not less certain that the entrance to Allahabad for every Englishman, be he civilian or soldier, will, before many years are over, be through the Railway Station. It is therefore in the immediate proximity of the Railway Station, that I should desire to see the centre of our new capital. (4)

Evidently, Strachey still assumed that the European community would be the prime users of the new railway; for civilian travel, for commercial goods transport, and of course for tactical maneuvers of the military. But the unanticipated popularity of rail travel with the Indian populace was already proving enormously profitable for the Indian railway developers—a factor which was increasingly to compete with strategic criteria, and the personal convenience of the European officials, in the planning and design of the Indian railways.

Some facts and statistics concerning the status and returns of Indian railway development at the end of the 1850's, as presented in a talk to the Institution of Civil Engineers in London in 1860, will give us an indication of the economic forces and potential inherent in Indian railway planning in this period of dynamic development: Four thousand eight hundred miles of railway were projected in the first phase of development. This was ultimately anticipated to employ approximately 77,000 men. By 1859 the total numbers of men employed on the operating portions of the various Indian Railways were 590 English and 7,855 "Natives", an average of 16 men per mile. The total number of passengers

44 The speaker made no distinction between Natives and Anglo-Indians.
on all lines in 1859 was 2,822,382 of which fully 93% were third class "Native" passengers. Most passenger traffic was only for short distances averaging 32.4 miles, nevertheless the railways had operated with a healthy profit in the first few years of development. Passenger traffic revenues almost equaled freight revenues in 1859—i.e. £453 to £464 per mile—and operating costs were, to June 1859, only 44.1% of revenue. Meanwhile, goods traffic was expected to increase greatly in the future with the completion of the railway network enabling long distance cartage and the generation of new markets. As the speaker enthused, "the construction of Railways in India had awakened a spirit of enterprise; had caused the country to be examined for its more valuable products, of which iron and coal had been found; had induced designs for docks, and for the improvement of navigation and of irrigation; had given employment, on an average to 100,000 labourers; had led to an expenditure of fourteen millions of money, within a few years, chiefly among the native population; and had involved the delivery into the country of 700,000 tons of material, irrespective of contractor's plant, etc... costing about ten millions and a half of money." 45

Among the implications of exploiting the "native" market for railway travel was the necessity of furnishing extensive 3rd Class facilities such as waiting sheds, native latrines, and 3rd class carriages, which had not been provided for in the original designs and budgeting of the railways. The larger Indian railway stations were to be among the most elaborate sociological "classifying devices" in the catalogue of colonial architecture, as well as the most genuinely "public" of its common building types. But the railway tracks themselves were perhaps the most keen and effective of the classifying devices in the command of the colonial planners; the thrust of railway development upon the urban centres of Victorian India was with a double-edged sword. With their commercial will to avail the Indian populace at large of the services of the new transport system, the railway builders sought to penetrate to the very cores of the important Indian towns and cities. But this rending of the urban fabric with cordons of steel rail presented an alternative

45 "Indian Railways: Institution of Civil Engineers", THE BUILDER, 18, 903 (May 26, 1860): 329.
utility to the politically minded colonial planners, as a convenient and effective tool for social demarcation, containment and control.

This social impact of the railways has been considered to some degree in several previous case studies of colonial urban development in Victorian India. The dramatic, though by no means exceptional, instance of the post-Mutiny re-development of Delhi is an interesting case in point. There, as at many other places, retribution for the atrocities of the rebellion was exacted piteously. This technocritically channeled wrath was brought to bear on the old walled city of Shajahanabad through which a vast security cordon 500 yards wide was cleared to separate the new seat of local civil and military authority, in the fort-palace of the former Mughal Emperor, from the dense and presumably dangerous tangle of narrow streets and mohullas (inner courts) that comprised the "native city". This great swath of demolition was extended down the entire eastern flank of the city, which was redesignated—along with the Fort—as an intra-mural military cantonment. When the tracks of the East Indian Railway reached Delhi by the new Jumna River Bridge, completed in 1867, they literally straddled the ramparts of the Fort to traverse the security cordon to the new Delhi Junction Station beyond. This was laid out from east to west parallel to the principal market street, Chandni Chowk, thereby tearing a further great gash in the fabric of the old Mughal city. The Muslim and Hindu populace south of the tracks and west of the cantonment zone were thereafter explicitly segregated from the more Europeanized quarter surrounding the old Residency near the northern Kashmir Gate to the walled city, and the growing "civil lines" beyond. By 1900 four other railways had converged on Delhi Junction Station. These reinforced the spatial barrier between the native and European quarters with innumerable rail sidings and railway buildings, while hemming in the native city still further with a new cordon of rails and sidings that hugged the ramparts on its southern and western approaches, thereby

driving a wedge between the walled city and its growing suburbs. 47

At Agra the new railway lines were similarly cut directly through the dense fabric of the old city; the central station boorishly embracing the walls of the Jaama Masjid (Friday Mosque), the principal place of worship for that city's substantial Muslim community. Such incursions seem particularly perverse in the light of the mounting appeal for historic preservation that has come to influence public policy in the latter half of the present century, in many countries including India. But, of course, such was quite typical of "progressive" development throughout the modernizing world of the mid 19th century, wherever industrial technologies were making their impact. No doubt, sentimentality for the architecture and the urban integrity of historic Indian cities, and for the protection of their native denizen's rights and property, was at a particularly low ebb following the events of 1857-58. But the essential reasoning for such seemingly callous actions appears to have been logistical. In the hardened mood of that moment pragmatics were simply given sway, unhindered (for once) by any extraneous, sentimental compromises.

The central railway stations in both Agra and Delhi were built in the immediate proximity of the great city forts of those former Mughal capitals, allowing for the speedy mobilization and efficient provisioning of the garrisons billeted within those otherwise isolated inner-city keeps. At Allahabad, on the other hand, the same logistical considerations dictated different planning solutions. The existing fort and military establishment were sited some distance to the East and North of the old town, hence there was no reason to rend the existing urban fabric for purposes of communication. The rail line could be layed out relatively unobtrusively to skirt the "native city", affording direct and equal access to both the European and native communities, north and south of the tracks, respectively.

Strachey's redevelopment plan for Allahabad was, thus, not as overtly vengeful in its directives as those imposed upon Delhi and Agra, among other important towns that had swayed to the cause of the Mutineers. However, a cool distrust of the recently rebellious populace

was implicit in his virtual disregard for the historic native city, in his planning considerations. The requirements of the new European station commanded his attention almost exclusively. 48

Strachey’s preoccupation with military security encouraged him to direct the anticipated future growth of the city in a way that might consolidate its preparedness for local and strategic defence. The railway was central to that strategy:

Considering the vast increase of military power given by the rapidity of Railway communication, the protection of the great Railway Stations becomes a matter of the gravest military moment. It would therefore, under any possible arrangement of the Military and Civil Stations, be essential; to afford ample protection to the Railway terminus at Allahabad. This would be perfectly secured by its close proximity to the locations for the troops that I have thus advocated. (5)

In Strachey’s plan the new railway line was regarded as the umbilical cord of the settlement; its vital link to the rest of British India. It therefore assumed a logistical and strategic centrality in the spatial organization of the substantially expanded settlement.

It is instructive to compare Strachey’s design argumentation with respect to Allahabad’s strategic relationship to the railway with an instance of his reasoning regarding railways and military security four years later, as Secretary for Public Works to the Government of India. In that more powerful and broadly responsible capacity, unfettered by partiality for any local planning and economic interests, Strachey was redoubled in his conviction that the primary prerogatives of railway development in India were strategic.

In an exchange with the Secretary to the Government of Bombay for the Railway Branch of the PWD concerning the proposed routing of the GIPR

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48 The "discourse of silence" in architectural and urban planning, as in literature, can be seen as a potent ordering device, as Thomas Markus has argued in his studies of the architectural theory and institutional typology that emerged from the Enlightenment in Scottish society and culture in the late eighteenth century. What is ignored in the conception of the built environment is as potentially affected as that which is consciously made the object of planning. T. Markus, ed., Order in Space and Society: Architectural Form and Its Context in the Scottish Enlightenment. London: Mainstream, 1982. See also T. Markus, Buildings and Power (London: Routledge, 1993).
between Bombay and Madras, the issue was whether or not Hyderabad would be included on the mainline. The Railway Secretary for Bombay was of the opinion that this capital city of the Nizam of Hyderabad, the most powerful of the independent princely rulers under the aegis of British India, should definitely be included. But Strachey defended the already sanctioned plan for the line to pass through the minor station of Bellary, a shorter, more direct route by 150 miles.

The fundamental question from Strachey's point of view was whether political expedience should prevail over the laws of economic profitability in the joint venture of the Indian Government with private enterprise to build the Indian railway network. He was emphatic in establishing a point of policy on this matter:

It is essential that the fact should not be lost sight of that these Railway enterprises are carried out on the credit of the Government of India, and that the pecuniary interests of the Companies call for no further consideration than has been already given to them by the terms of their contracts with the Governments. To use the words of the late Court of Directors in a Despatch of 1853, the Companies are only the Agent of the Government for carrying out their views.

Contrary to commercial interests, important towns and cities like Hyderabad (and Allahabad for that matter) were ideally to be avoided as stops along politically crucial trunk lines such as that between the presidential capitals of Bombay and Madras. For, as Strachey reasoned, "...any excitement at [such places], when our troops might be engaged elsewhere, could not fail to cause serious anxiety to our communications, and at a time when the power of sending troops by rail with certainty from one part of the line to another might be of vital importance." The catch, of course, was that such big towns, with their potentially volatile populations, had also (ideally) to be accessible by rail in the event of a crisis such that troops might be transported rapidly to the locality and those in peril evacuated. With Strachey's backing, the Supreme Government's established plan prevailed, with the concession that

49 Despatch No.5091 from Lieut. Col, R. Strachey, R.E., Secy. to the Govt. of India to the Secy. to the Govt. of Bombay, in the Railway Department P.W.D., Fort William, 19th Dec. 1862. (IOLR: L/PWD/3/272)
50 ibid.
Hyderabad and the major neighbouring British cantonment of Secunderabad be connected to the GIPR by a branch line. That important link was finally constructed at the expense of the Nizam as the first leg of his own state railway.

Continuing with the case of Allahabad, Strachey proceeded from transportation and defence matters, to consider the subsequent development of the native town in relation to the much expanded European settlement. Strachey expressed a conciliatory attitude towards their co-existence, grounded on what he argues dispassionately is purely common sense. His comments on the climate of thought on these matters among the British community following the shocks of 1857, are so dead-pan that they almost mask the enormity of the punitive actions that had been contemplated:

"...I will here say a few words regarding the native town. I have heard two proposals made about it. The first is to abolish it altogether, the other is to remove it some miles off. My own idea is to let it alone.

As to the extirpation of the town, I am at a loss to appreciate the utility of such a proceeding. On the contrary, it seems to me certain that no large English community can exist in this country without a large native community in immediate contact with it. The thing seems to me too evident to require discussion. The necessity for a native town is the best proof of its utility. The desire to destroy the town is a sufficiently natural, but not very wise impulse, arising from a remembrance of the atrocities committed by a certain class of the inhabitants..."

"So far as fear of the inhabitants goes, this may give some tangible cause for desiring to remove the town to some distance from the European settlement. But still I must argue that this too is impossible. The native community, from their different habits, will naturally reside apart from the Europeans; but the distance cannot be greater than may be readily gone over in the course of the day's avocations. In these matters there are facts in the nature of things that will assuredly be found superior to any doctrinaire regulations we may strive to impose."(6)

But Strachey also argued that this mutual dependency allowed for an

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51 The alternative of distancing the European settlement by laying it out differently than already rationalized and determined on the drawing board, does not appear to have been considered.
important degree of supervision and control as well. To contain the
total potential rebel, and coerce him if necessary by appropriate policing and
actions of the civil magistrate, within the secured European settlement
was infinitely more reassuring, he suggests, than expelling him beyond
the walls to foment revolt, and screen and support the forces of an
attacker. It was quite essential, he conceived, "...that the native town
shall be behind any defensive works that may be formed, not beyond them.
A suburb within reach of any defensive work is at once an outpost
prepared before hand for the enemy." *(6)*

Strachey’s reasoning was quite progressive, in this regard, which
suggests he may have been keeping abreast of military issues in current
European urban development. The popular rebellions of 1848 in the
imperial capitals of Vienna and Paris had placed civil unrest high on the
agenda of city planners on the Continent. Baron von Haussmann was then
busy rationalizing the morphology and street pattern of Napoleon III’s
Paris to maximize mobility for troops and minimize opportunities for
barricading thoroughfares. *(5)* In Vienna, meanwhile, the Austro-Hungarian
Emperor, Franz-Joseph, had just appointed the commission that was to
undertake the demolition of that city’s medieval fortifications, and plan
and execute the famous Ringstrasse development in its stead. With its
string of public amenities and buildings embodying the cultural,
scientific, and governmental institutions of modern Liberal society, the
magnificent circular boulevard the planners laid out was conceived to
bridge the spatial and conceptual void between the imperial court and
elites residing in the old inner-city of Vienna, and the potentially
hostile proletariat in the suburbs and outlying districts. As in Paris,
however, military considerations elided with this conception of
cosmopolitan civic grandeur. The simplistic conventional logic of defense
by the spatial segregation and distancing of potential antagonists was
superseded by the principle of defensive superiority through tactical
mobility. The Ringstrasse was designed accordingly, as an excessively
broad artery surrounding the inner city which could facilitate the swift

*(5)* D.H. Pinkney, *Napoleon III and the Rebuilding of Paris* (Princeton,
See also Howard Saalman, *Haussmann: Paris Transformed*, (New York:
Braziller, 1971).
movement of horses, men and guns to any point of danger.\textsuperscript{53}

In general, British planning authorities in India subscribed to the conventional "spatial" logic for defensive urban planning. Where it was not feasible to construct or occupy buildings and facilities for the purposes of the European colonial community at a "safe" and respectable distance from existing native settlements, such spatial separation was created artificially—as with the demolitions undertaken within the walled city of Delhi. Perhaps the most draconian example of such was the corrective surgery carried out in Lucknow by Colonel Robert Napier of the Bengal Engineers (the same Napier of Punjab fame in the 1840s), following the relief of the town from its prolonged siege by the Mutineers. With the intent of reducing "dangerous overcrowding" and securing a handful of strategic strongpoints in the heart of that populous city, Napier justified the destruction of no less than two-fifths of the built-up area of the town.\textsuperscript{54}

Strachey's more tolerant and synthetic approach to colonial urban development, as pursued at Allahabad, was less typically "British"—at least as the French perceived the mentality and planning practices of their imperialist rivals. In his study of French colonial urbanism and social planning, Rabinow\textsuperscript{55} discusses the urbanist, Guillaume Tarde's, defence of the segregationist planning principles of the French in protectorate Morocco in the early part of this century. These Tarde compared favourably to the far more "radical separation" of European and indigenous urban space in British colonial policy. The latter, he believed, indicated a "contemptuous attitude toward the native city". When surveillance and domination became the major function of separation, the principle became nefarious. The English model of separation only reinforced a dangerous paucity of social contacts. Upon reading Kipling, de Tarde had come to much the same conclusion as Richards, in the essay


\textsuperscript{54} V.T. Oldenburg, \textit{Lucknow}, 33.

discussed above, that British colonialism was essentially a "structure of police intelligence." The British citizen wanted distance, and therefore required police information, whereas the Frenchman "loved the excitement of social life, thanks to which he knows what's going on." 56

If Strachey was somewhat more perceptive (or in his own view, merely more commonsensical) than some of his colleagues in his appreciation of the social interdependence of the various colonial communities, he was nonetheless committed to the maintenance of no uncertain a degree of public order and propriety, by which such social intercourse could be controlled. The new civil and military station at Allahabad was necessarily to be a tighter ship, more orderly and disciplined all round, in his view, from the standards and practice that had prevailed in European stations in India prior to the Mutiny. The members of the military establishment, especially, would have to be prepared to revise their expectations concerning comforts and liberty and make the personal sacrifice to duty they had accepted in adopting their profession. This had significant ramifications regarding his planning policies for the cantonment:

As to the general arrangements of the Cantonment, I am strongly disposed to think that no private house property at all should be permitted within it....I am of opinion that our old Cantonment system was most slatternly, and...somewhat typical of our extremely lax military system. Regimental officers should surely live in barracks, probably most Staff Officers too. A certain number of separate houses might be allowed for married Officers, or special quarters with more ample accommodation. Persons accustomed to the old Indian way of doing things will, I dare say, object strongly to this. It will not be nearly so luxurious I admit, but as I conceive that the essence of true discipline is habitual restraint, so it seems to me that a man who accepts the profession of a soldier has no right to expect to live in the luxurious freedom from all restraint that is proper enough for a Civilian.

But those civilians who elected to live among and serve these military professionals would, similarly, have to bend to the discipline and propriety of the reformed cantonment:

As I would prohibit private dwelling-houses for Officers, so I would carry out the same rule as to shops and bazaars. Whatever is essential for the requirements of the troops—and some shops and houses will no doubt be necessary—ought I think to be provided by Government. A perfect command over the occupants of the bazaars could thus be secured, which is quite impracticable where every one has his own house with which he does as he likes. No one should be permitted to occupy a house in the military bazar, who could not show vouchers for his respectability...

For the Civil Station itself, Strachey suggested a "suitable" layout with all the strategic logic and the academic formalism of the battle-plans he might have designed as a cadet at Addiscombe. His scheme can be interpreted as an almost anthropomorphic diagram of the hierarchical relationships between the various components (services, departments and functions) of the newly consolidated colonial administration.

If the railway station represented the "navel" (umbilicus) of the greater urban settlement, the Governor’s House, the symbolic "head" of the provincial socio-political structure for which Allahabad was to serve as the new seat of government, would crown the whole at the end of an axis running due north of the railway station to the banks of the Ganges. The Cantonment comprised the "right hand" of the anthropomorphic schema, straddling the whole 4 mile breadth of the Doab west of this NS axis, defending the open flank of the city. The Civil station would extend to the East. The old native town lay south of the Railway station at the "foot" of the proposed European settlement. All commercial activity and service trades and industries—the "guts"—would be zoned for the immediate vicinity of the Railway station to facilitate access to transport and minimize its disruptive incursion into the residential areas further north. The Anglican cathedral was to be built at the "heart" of the European settlement on the axis between the railway station and Government House. Finally, Strachey specified that the various public buildings pertaining to the Government of the North-Western Provinces—corresponding to the brain stem, the lower-executive node of the nervous system, to push the analogy still further—were to be grouped together on a square straddling the N-S spine of the settlement in the immediate vicinity of Government House.
Strachey was particular about how these Government buildings should be grouped. The first ensemble would comprise the Secretariat, the Offices of Account, the Board of Revenue, and the Commissioner of Customs. A second group, not necessarily lower in status but distinct in his taxonomy (to be situated on an opposite corner of the square, perhaps) would comprise the Sudder Court, the Inspector of Jails, and the Administration of the Police. Yet another group of ostensibly equal but autonomous status would include those departments or their agents concerned with communications, information and development: the office of the Chief Engineer (the PWD was supposedly to be located in the Secretariat), the Department of Education, and the principal Post and Telegraph Offices. Finally, a guard-room would be incorporated in this group of public buildings to provide appropriate local control and protection for the government and gubernatorial complex as a whole.

The offices of the Allahabad District and Divisional administration would be kept distinctly apart to clarify the autonomy of the local and provincial governments. These, along with the District Commissioner's Office, he advised, could be grouped around the existing Collector's and Judge's Cutcherries in the old civil lines area to the east of the proposed development. A police corps, small jail and civil hospital might also be set up in that locality, much more conveniently placed as such, he insists, than in the center of the new civil station.

Strachey's security concerns convinced him that the large existing Central Jail in the immediate vicinity of the new railway station should be abandoned as a penitentiary, and converted possibly into a covered market. But a large new central jail for Allahabad was to be built at nearby Arail in the following decade, on a much improved standard plan which was replicated at several other important provincial stations as well. (The rationalization of penal architecture and planning in British India in this period will be discussed in more detail, below.)

As for the native settlement, Strachey's recommendation was to contain and control the status quo, and tidy it up where the exigencies of "progress" provided an opportunity:

...the Kuttra Bazar, and its appurtenances, should be maintained as a Bazar for the native community. But it should be sharply defined. Streets should be marked out beyond which no extension should be permitted, and the place should be
brought into a compact mass, and be well looked after by the Police and Conservancy Departments. The greater part of the other bazaars between the old 6th Native Infantry lines and the Railway have already been destroyed. Some huts however still remain and it is questionable whether they should not be removed, the occupiers being provided with ground elsewhere in exchange, or any now being put together in one block, in streets regularly disposed in straight lines and of reasonable breadth. It has to be borne in mind that several villages will be destroyed to make room for the new station [the "civil station" as a whole, one presumes], and that ground must be provided for the inhabitants somewhere...

Strachey suggested a suitable patch of land inside the precinct of the native town of Allahabad, neatly bounded between the railway and the Jumna and the old and new military stations to the East and West, respectively. He was confident that the native population was not likely to thrive and grow to exceed this delimitation, in the near future. He was emphatic, however, that should there be any need of expansion this should in no case be permitted north of the Railway, but taken to the opposite bank of the Jumna south of the existing city.

Strachey concluded his proposal with the recommendation that government maintain strict control of the civil station's development through the prior purchase of all the territory that would eventually be required. Redefined plots could then be leased out rather than selling them back into private hands. Such a means of controlling land-use, along with additional authority to vet sub-lease arrangements to weed out "objectionable persons", would, he argued, empower the administration "...to maintain the integrity of the design for the general arrangements of the station, and to secure the general convenience of the community..."

I have dealt at some length with this blue-print for post Mutiny Allahabad as it offers us a revealing portrait of both the physical order and the conceptual "pattern of intention" to which the building efforts of the British administration in India conformed with evident solidarity following the crucial juncture in its colonial polity, of 1857-58.57

57 The actual outcome of Strachey's planning recommendations for Allahabad, in the new civil station and municipal improvements carried out in the 1860's under Commissioner Thornhill, is described in J.B. Harrison, "Allahabad: A Sanitary History", in K. Ballhatchet and J.B.
An anxiousness to take control and to rationalize the process of development and change that colonial rule was bringing to bear upon India, is clearly manifested in Strachey's recommendations. As a military professional, matters of security were obviously of the first order in his technocratic reasoning. Although this was to include the construction of new defensive works, it was now presumed that more fundamental safeguards against future challenges to the security of the colonial regime and its European officials would have to be designed and built into the spatial structure of colonial settlements as a whole. Where new buildings or urban development was anticipated, this entailed the need for clearly worked out plans and principles to which such would be geared. It also entailed the need for clear and binding regulations through which conformity to such designs could be compelled. The need for a legal framework in which to act was all the more evident when it came to the colonial redevelopment of existing towns and cities—generally through the forced expropriation and demolition of previously built-up real estate. This legal framework depended in turn on the agency of the Police to ensure its enforcement and to keep a firm grip on civil order in the face of the inevitable discontent such measures provoked.

These various technocratic frameworks and compulsions were to comprise a dynamic force for change in the first few years following the restoration of civil order in Northern India. But such change, or "improvement", was now regarded (it would appear) as the product of specific acts of design and problem solving: dependent, as such, on technocratic initiative and ingenuity. Belief in the possibility (or desirability) of spontaneous "improvement" of a more fundamental nature, on the part of the subjugated Indian society, had waned greatly in the time since the idealistic efforts at social reform through the diffusion of the English language and legal ethics, earlier in the century. The new "top-down" tyranny of expertise tended to focus its sights on more

Harrison, eds., The City in South Asia: Pre-modern and Modern, (London: Curzon Press, 1980), 167-196. Harrison is concerned specifically with the perceptions and responses of the colonial authorities to issues of sanitary engineering in the colonial development of Allahabad—a facet of the over-all project of colonial social and environmental engineering that was to take increasing precedence in this period, as we shall discuss in the next section.
clearly delimited problems of a physical or material nature which were amenable to technical solutions.

So far, we have considered the manner in which the problem of security was defined and addressed in the physical planning of colonial settlements and through their integration into the strategic network of roads and railways which burgeoned dramatically in the years following the Mutiny. The rationalized spatial order of the typical colonial settlement served to contain and control both the colonizers and the colonized in a manageable and moderately secure symbiosis. Those that digressed from this tenuous polity through criminal or seditious acts outside the law, presented another important technical problem for which appropriately disciplinary yet humane solutions to their incarceration had to be engineered. We will discuss that facet of the rationalization of colonial space in the final section of this chapter.

In the next section, however, we will focus on the other paramount anxiety of the European colonial community in India, apart from their own vulnerability to popular revolt. This was their mortal fear of the enervating tropical climate and the endemic diseases of the Indian subcontinent. To the technically minded engineers of the Public Works Department, these problems presented themselves as matters of physics and physiology for which effective solutions could conceivably be engineered through appropriate innovations in architectural and environmental design. The cleansing of the built environment was an obvious and urgent cause in this regard, for which aggressive conservancy measures and sanitary surgery were increasingly to be prescribed. Although contemporary theories concerning the communication of diseases such as malaria were still highly imprecise, the crusade against filth and contagion prosecuted by sanitary engineers in Victorian India offered the seemingly more ethical and altruistic rationale of medical science to legitimize the controversial demolitions and restructuring of the Indian cities which the colonial administration was determined to carry out for strategic purposes. Disease theory furnished useful arguments for the purging of insanitary overcrowding in the close-knit urban fabric of the old "native cities", and for the systematic segregation of Indian and European populations in the planning of future colonial urban development.
3. SANITARY REFORM

Straining climate and disease had always been regarded among the most formidable impediments to the European domination of the Indian subcontinent. However, it was only after the major conceptual and institutional changes instigated by the Revolt of 1857 that the colonial administration was forced out of its fatalistic complacency in this regard, to make its first significant interventions in the area of health. The preamble to the important sanitary measures carried out from the mid 1860s onward was the gathering of comprehensive knowledge of the sanitary state of the colonial built environment by various military and civilian sanitary commissions established in the period of conceptual and institutional consolidation that followed the suppression of the Revolt.

The probing, systematic inquiries of these commissions served to channel to India, in the 1860s, some of the popular and professional fervor for sanitary reform which had swept Britain in the preceding three decades. But, as some scholars have argued, there was little ostensive altruistic motivation to this essentially self-protective intervention into public health and the sanitary state of the environment, on the part of the British colonial authorities. In this respect, the application of sanitary science to the colonial context has been sharply distinguished—both in principle and in practice—from the metropolitan sanitary reform movement from which it evidently drew much of its initial theory and impetus. 58

In the present account, however, I wish to shift emphasis from the inevitable circumstantial differences in the cases to what I would suggest are their still more significant parallels. In the light of its technocratic colonial ramifications, the metropolitan movement for sanitary reform may itself be seen as less genuinely altruistic than has been supposed. In either case public health measures served effectively to contain and control the threat to the power elites of the potentially overwhelming, poor and disfranchised masses of the modernizing social

58 V.T. Oldenburg, Colonial Lucknow, 142-144; and Radhika Ramasubban, "Imperial Health in British India, 1857-1900", in R. Macleod and M. Lewis, eds., Disease, Medicine, and Empire: Perspectives on Western medicine and the experience of European expansion, (London: Routledge, Kegan and Paul, 1988).
structure.

This section examines the complex of mediating relationships between the metropolitan and colonial contexts of sanitary reform in an effort to discern the rationale with which engineers of the military and civil branches of the Indian Public Works Department engaged in this most "scientific" of their technical assaults on the colonial social environment. I will begin with a brief overview of the origins and rationale of the sanitary reform movement in England in the first half of the nineteenth century, and of the state of knowledge concerning the communication of disease and environmental hygiene with which such was promoted. I will then consider the experience in British India, commencing with a discussion of the context and rationale of the official sanitary inquiries of the early 1860s. In particular, I shall consider the findings of the Royal Commission on the Sanitary State of the Army which was prompted by the reorganization of the Indian military establishment following the Mutiny and the consequent need to devise healthier standards of accommodation for the much augmented force of British troops that was thereafter to be stationed in India.

The metropolitan sanitary reform movement, and its immediate impact in India through the Royal Commission on the Sanitary State of the Army and other civil commissions in that period, have both been well studied previously. However, these developments will merit further attention in the present case study of the various institutionalized and tacit modes of design reasoning of the colonial builders for the contentious political dimensions of the sanitary reform movement caused the various design professionals implicated in that effort, to explicitly define and defend their social, technological, and professional systems of beliefs. Such were particularly well articulated in the professional debates and design efforts of British military engineers concerning the rationalization of planning and construction norms for salubrious modern barracks and other military buildings, both in England and the overseas colonies; a mode of reasoning which we will see was narrowly constrained within a "mechanical" paradigm concerning environmental design.

In the concluding portion of this discussion I will consider those issues at closer range through an analysis and interpretation of an original design discourse—in the form of design drawings, departmental
reports and deliberations—produced by Col. C.W. Crommelin, the PWD engineer who was personally mandated to rationalize and define the design standards for the major reconstruction and expansion of military buildings and infrastructure that was undertaken throughout British India in the later 1860s.

Sanitary Reform in Victorian England:

The Industrial Revolution had, among other factors, contributed to the dramatic urbanization of Britain. This precipitous concentration of population had predictably grave consequences for the health and general well-being of the rapidly augmenting mass of rural-urban migrants. Communicable diseases such as dysentery, typhoid fever, and tuberculosis were endemic in the burgeoning working class tenements of London, and the other important ports and mill-towns of northern England and Scotland, in the early decades of the 19th century. However, the libertarian principles of English society and government in that period—with which private capitalists were encouraged to pursue profits in the construction of both factories and tenement housing—went against the notion of any omniscient sanitary regulations which might infringe on individual slum-lords' rights to do what they chose with their own property. This flagging political will on behalf of sanitary reform was further undermined by a lack of consensus among medical experts on the theory of disease and its propagation. However, the problem was less one of technique than of organization. As long as the upper class urban elites felt immune from the squalor of the working class slums, the imperatives of sanitary reform were difficult for those in power to agree upon.59

The catalyst to assertive action in this regard was the first outbreak of cholera in Britain, in 1832—which, significantly, had been imported to Europe from India as a by-product of colonial intercourse. As McNeill explains, when the rich found themselves succumbing to this dreadful disease as quickly and piteously as the poor, "...the old debates and stubborn clashes had to be quickly resolved by public bodies

acting literally under fear of death." 60 Beyond consciousness raising, however, the amateurish initial efforts of unpaid, locally elected boards of health, in the 1830s and 1840s, were largely ineffective in terms of hard technical achievements in public sanitation. The reappearance of Asiatic cholera in Europe in 1848 (and again in 1861 and 1865) provoked a far more consequential and far-reaching reaction. Advance knowledge of the dreaded approach through continental Europe of this second epidemic spurred the British Parliament to finally undertake a coordinated initiative in public health, through the establishment of a Central Board of Health. This omniscient new regulatory body was already in place by the time the first English cases of cholera were reported in that year. 61

The conspicuous alacrity with which the politicians and elites had leapt to the cause of sanitary reform during the cholera epidemic did not escape the cynical derision of thoughtful professionals and activists who had been campaigning for years for more assertive collective action on public health matters. One such plaintiff, writing in The Builder in 1850, minced no words in his conjecture as to the motives of the sudden fashionable compassion of the advantaged classes for the perilous living standards of the poor:

Public attention has been steadfastly fixed on the sanitary condition of the humbler classes, and inquiries have been directed into the haunts of poverty, which are but too frequently the purlieus of filth. Possibly the origin of the movement is not deducible from that pure benevolence which is founded on the basis of Christian charity, and is rather owing to that tendency to self preservation which is the instinct of nature, seeing that the recent scourge of the cholera has stimulated the sympathies of the higher classes to a more active regard for the cleanliness, comfort and health of their toiling neighbours... 62

Regardless of its motives, the author warned, such conspicuous

60 ibid. The Cholera outbreak had much the same indiscriminate social impact in France, setting the stage for a new understanding of social conditions, in industrializing Europe as a whole. Rabinow, French Modern, 30.

61 ibid.

affectation and concern would not resolve the calamity without an appreciation of the real scale of the problem and a true resolve to invest in its correction. In that engineer’s view, this entailed a major public commitment to build effective new sanitary infrastructure in all British towns and cities, including (in order of priority) modern sewer systems and fresh water supplies, and the provision of ample lighting and ventilation through new technologies for artificial environmental control as well as appropriate planning regulations. However, as if to avoid accusations of false altruism on his own part through such an obviously self-serving endorsement of sanitary engineering, the author chose to back his argument on the same base Utilitarian grounds for action of which he accused his fickle social peers. The public expense of such works, he asserted, would be "...amply requited in the increased energies of the producing classes..." 63 He was quite right.

Within just a few years, the implementation of sanitary policy and improvements along these lines had begun to reward the reformers with encouraging indicators of both the economic and "moral" propitiousness of such undertakings. The "Common Lodging Houses Act" of 1852 had brought into force new minimum standards for plumbing arrangements in working class tenements. These were now required to have closed sewage systems with water-closets and stoneware pipes with "traps" to prevent the emanation of noxious gases (which, as we shall discuss below, were then believed to be a prime cause of disease). A pamphlet published in 1854 by Dr. Southward Smith, M.D., 64 presented impressive statistics to illustrate the success of the Act in improving the well-being of tenement dwellers. In various instances described, where the previous norm of cesspools and "dry", flat-bottomed brick-drains had been up-graded as per the Act, mortality rates had dropped as much as 80%. In one typical group of dwellings at Lambeth Square in South London, for example, the rate had plummeted from 55/1000 per annum to just 13/1000.

63 ibid.
But the economic good news was evidently considered to be at least as important as the encouraging medical statistics. Before all else, Dr. Smith reported that the lodging reforms were bringing a good return on investment! Buildings for families erected by housing societies according to the new standards had afforded a return of nearly five percent, in the preceding year.65

The sanitary reform of housing standards was also perceived to be effective in the Victorian battle against "moral pestilence". As Smith trumpeted, "...the intemperate have become sober, and the disorderly well conducted, since taking up their abode in these healthful and peaceful dwellings."66

Dr. Smith's pamphlet concluded with a passionate if pragmatic agenda for the (by then) clearly rationalized social project of bringing up the downtrodden labouring masses. Smith's paternalistic, condescending perception of the living conditions, mentality and ills of these "other" countrymen—so apparently remote from the privileged world of middle-class decency and comfort in which he dwelled—might easily have passed for contemporary descriptions of the contextual and constitutional iniquities of Britain's "native" subjects in India:

There must be provision for the supply of better-ordered dwellings for the industrious classes: dwellings accessible to air and light, and no longer producing that malarious depression which resorts for relief to the fatal stimulus of ardent spirits: dwellings compatible with cleanliness, comfort, and those decent observances which are necessary to self respect, and which must become habits before there can be respect for the happiness, property or life of others. Until such dwellings are within the reach of these classes, they cannot be raised out of the physical debasement which has lately been so painfully depicted, and which has been shown to be the portion (the unnecessary portion) of large masses of the people. The physical improvement of these masses, it is now admitted, must precede their intellectual and moral elevation. When the house ceases to be a sty, and possesses the conditions which render it capable of being made a home, then, but not till then, may it receive, with some hope of benefit, the schoolmaster and the minister of religion.67

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65 ibid.
66 ibid.
67 ibid.
At "Home", as abroad in colonial India, idealistic belief in the power of knowledge and reason to transform society for the better—from "within", as it were—had been superseded, if not altogether abandoned, by an ever stronger belief in the potential of technology to accomplish the same end by transforming the environment in which society was nurtured.

The battle for professional turf in the Sanitary Reform Movement:

Notably, medical doctors such as Southward Smith were the conspicuous leaders in this campaign for improved measures of public hygiene, though engineers and architects were equally anxious to capitalize on the pending sanitary revolution. As Annmarie Adams has elaborated in her study of the subsequent impact of the sanitation movement on the households and women of the middle classes, in the late 19th century, sanitary reform opened a new space for cognitive imperialism (if one might call it that) by the professions, in which doctors in particular played a dominant and expanding role at the expense of the building professions. As hygiene was founded on the notion of health as an issue of public concern, this implied that the definition of disease applied not only to the individual, but to the collectivity as well. Doctor-hygienists were no longer inclined to limit their study and professional authority to the space of the human body, but were compelled to explain how disease was communicated in the space between bodies. Their field of study expanded, therefore, to encompass the body in the physical space of the dwelling, and thereby logically the street, neighbourhood and city itself, as further dimensions of the pathological environment. Applying their knowledge of physiology to this expanded space of the body, medical doctors defined a new domain of architectural expertise—the "health" of the building—which was increasingly to be valued in the later decades of the century. Self-styled doctor-architects functioned as diagnosticians of the ills of conventional dwelling

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construction, in particular, prescribing corrective "treatments" in the way of planning alterations and technical improvements, and instructions for the long term "care" of a healthy home.

This new found authority of the medical profession was consolidated by directing criticism at the traditional building professions and their ignorance of sanitary science. By the 1870's doctor-architects were commonly presenting such arguments by conceiving and publishing their own model plans for salubrious dwelling types, proving that they were quite capable themselves of delivering the technical product of an architect's labours at the drafting board, while combining that service with a superior comprehension of the "scientific" design problems at issue. 69

Among the building professions, architects were the decided losers in the contest for influence and patronage in the Sanitary crusade. Engineers stood in better stead for it was the "science" of the matter that held sway in that epoch of unprecedented technical progress (although, as we shall discuss later, there was considerable discord within their ranks as to how well equipped and committed to the scientific application of technology was the military faction of the profession). If the doctors were the diagnosticians, engineers were the surgeons and scrub-nurses who could carry out the necessary sanitary operations on the built environment, and attend to its future maintenance. This instrumental collaboration was recognized and promoted by reformers such as Sir Edwin Chadwick, who held less of a personal professional stake in the issue:

The great preventives, drainage, street and house cleansing by means of supplies of water and improved sewerage, and especially the introduction of cheaper and more efficient modes of removing all noxious refuse from the towns, are operations for which aid must be sought from the science of the Civil Engineer, not from the physician, who has done his work when he has pointed out the disease that results from the neglect of proper administrative measues, and has alleviated the sufferings of the victims.

In important respects, this was a radically new attitude to health. As

69 A. Adams, op. cit.
70 Headrick, Tentacles of Progress, 156.
Headrick suggests, "disease was no longer a personal matter to be dealt with by one's physician, but a social and environmental problem to be solved through technology."\textsuperscript{71} The shifting frameworks of professional performance were indicative of the more fundamental shift in the underlying relationship between scientific knowledge and technique as conceptually privileged professional domains. The professional tensions and rivalry that strained this collaboration were often incited by the lack of consensus between doctors, engineers and policy-makers concerning the actual scientific theory with which the sanitary assault was to be guided and legitimized.

**Contemporary disease theory:**

By 1854 there were signs that England's second cholera epidemic was finally abating. But professional concern to understand the phenomenon and bring science to account for it continued to generate heated debate, not only amongst physicians but in the pages of professional journals such as the Builder as well where engineers were intent on tying down the theoretical bases for continuing public commitment to sanitary engineering.

An illustrative instance of such theoretical contention, that appeared in The Builder in 1854\textsuperscript{72}, concerned the then prevailing belief in the causal relationship between deficiencies in atmospheric ozone and the incidence of cholera. A new theory had been posited by a chemist named Mayhew which implied the opposite; that is that ozone itself was the cause of the disease rather than a deterrent. This was based on Mayhew's observation of a consistent rise in ozone levels in periods of endemic cholera which would ostensibly negate the deficiency theory. Mayhew had gone on to promote the notion that sulphurous acid, in the form of burning sulphur fumes, was an effective neutralizer of ozone (by depriving such a deutoxide of hydrogen of its excess of oxygen) and hence an effective "anti-choleraic weapon". Mayhew supported this claim with

\textsuperscript{71} ibid., 155.

\textsuperscript{72} "The Atmosphere and Disease; the ozone theories" THE BUILDER 12, 607 (Sept. 23, 1854) 497-498.
the empirical proof of his own purportedly successful trials, and the traditional medical practices of both China and India.

This reference to India—where cholera was endemic and from where many believed the disease had emanated globally—was obvious. More intriguing and controversial was the admission of the possible validity of certain traditional (i.e. non-scientific) medical knowledge of that civilization. However, what seems of most relevance to our present discussion of the rationality of the beliefs and intentionality of sanitation minded professionals in this period was the earnestness and thoroughness with which such theories were expounded (no matter how spurious in hindsight). The Builder devoted an inordinately long and detailed article to the extra-disciplinary topic of Mayhew’s theory, in the effort of the editor’s to discern an applicable, intelligent-layman’s explanation for the disease. The predilection of engineers for a mechanical model to understand such biological phenomena was apparent—every input to a system had to have an equal and opposite reaction of some sort. Fallacious analogical thinking on these lines appears to explain (in part) how such erroneous theories could be rationally believed and applied.

Cognitively therefore—at a more fundamental and pervasive level of reasoning, that is, than any consciously articulated motive of self-interest—British engineers were not predisposed in the main to accept the less intuitively obvious “contagion” theories that the medical profession began to posit at that time, and which were ultimately to lead to the identification—one by one, through the course of the second half of the century—of the precise vectors of infection by which the major diseases of the age were actually communicated.

The most widely held explanation for disease up until the mid-nineteenth century was the so-called “miasmatic” theory. This had been put into currency close to a century earlier in a classic text concerning the endemic diseases of the British Army, by Dr. Sir John Pringle (1707–1782), the physician general of the British Forces. Pringle’s extensive empirical observations of military camp life and the carnage of battle had convinced him that there was a strong link between the contraction of disease and the malodorous emanations, or “miasma”, of
decaying organic matter such as rotting corpses or dead plants. The enigmatic nature of this hypothetical disease-causing medium indicated, alternatively, an obvious and concrete strategy for disease control, through strict and thorough environmental cleansing. This was promoted unquestioningly by most reformers—not the least because it could be defended cogently on the basis of common sense in appeals to policy-makers for public commitment to the cause.

The staunch adherence of the engineering community to the paradigmatic model of environmentally determined disease (of which the miasmatic theory and its progeny, such as Mayhew’s ozone theory for the cause of cholera, were tokens) is illustrated in yet another instance of The Builder’s editorial pugnaciousness on the issue of sanitary reform. In 1858 the journal’s advocacy of the sanitary up-grading of towns and dwellings reached a new peak as yet another epidemic ravaged London; this time scarlet fever. Through several issues in the month of November 1858, the journal conducted a heated debate with a respected London physician, Dr. Greenhow, who wished to temper the false expectations he felt the journal was promoting with regard to sanitation as a general cure-all for the epidemic spread of disease. Greenhow concurred that the movement was undoubtedly doing much good in the general case in improving the basic salubrity of the urban environment. However, he begged to explain that medical evidence had been quite conclusive in the case of several major diseases (of which scarlet fever was one) in describing a phenomenon of infectious transmission of disease from one sufferer to another. It had become empirically evident that insanitary environmental conditions were neither a necessary nor a sufficient causal factor in the spread of such "contagious" diseases, as the medical profession was then beginning to categorize them. 74

What was later proved to be an essentially correct empirical description of such diseases, was nevertheless indignantly rebutted at


this time by the editor of the Builder as irresponsible bunk that was sure to reinforce the parsimonious resolve of the guardians of the public purse, let alone private speculators at large, who were all too anxious to derail the costly short term fiscal commitment to continuing sanitary reforms. But, temporarily at least, anxiety on both sides of the issue were allayed, as we observed earlier, by the powerful statistical evidence in favour of broad-based sanitary intervention that was then beginning to be furnished on the basis of the first decade or so of serious public undertakings in this regard.

The role of statistics in the sanitary cause:

Regular statistical reports were regarded as essential to any systematic endeavour in the area of public health. Moreover, public commitment to the collection and compilation of such data (if not to sanitary works per se) was forthcoming early on in the era of sanitary reform, encouraged by the rise in statistical thinking generally in England and Europe that occurred in the second quarter of the nineteenth century with the inroads of political economy in government and public administration.\(^75\) From 1836 onwards, sanitary statistics were collected steadily by the office of the Registrar-General of Births, Deaths and Marriages; established with the initial wave of public health consciousness following the first British cholera epidemic.\(^76\) But such information had not necessarily been thoroughly analyzed and disseminated publicly by the authorities, much less acted upon.

Early sanitary reformers such as Edwin Chadwick, had favoured a bold and direct exposition of empirical knowledge, in the manner of latter day investigative journalists. Chadwick’s influential Report on the Sanitary Conditions of the Labouring Population in Great Britain (published in 1842) is credited for having shocked many complacent Victorians to

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\(^76\) R. Ramasubban, "Imperial Health in India". In R. Macleod and M. Lewis, eds., Disease and Empire: Perspectives on Western Medicine and the Experience of European Expansion, (London and New York: Routledge, 1988), 43.
recognize the plight of the poor for the first time. This he achieved by forcefully and precisely relating facts he had gathered by the Benthamite method, through detailed personal investigation of working-class living conditions and interviews with the inhabitants themselves. But it was his skillful use of comparative statistical data that shored up and clinched his arguments for sanitary action. Data available through the new office of the Registrar-General of Births Deaths and Marriages and the Bureau of Medical Statistics—which Chadwick himself had set up in the office of the Poor Law Commission, on which he served—allowed him to make shocking and, thus, politically effective correlations. Endemic typhoid, for instance, (the "annual slaughter" as it was known) claimed an annual average of more than fifty-six thousand lives in England and Wales; more than twice the total number of fatalities of the allied armies at the battle of Waterloo. 77

Florence Nightingale—among the most ardent and respected of the second generation of British sanitary crusaders—was particularly cognizant of the potential of such statistical representations of the facts to sway the skeptics and sustain the momentum of the movement that had finally lumbered into action by the late 1850's. In a letter read to one of the first major meetings of the International Statistical Congress, which convened in London in 1860, Nightingale beseeched that scientific body to exercise its influence on the governments of the civilized world to make public the growing mountains of statistical data they were accumulating in their respective record offices concerning changing rates of mortality, and cost-savings realized directly or indirectly through sanitary improvement where such had been carried out. Broad, consistent and unequivocal accounting of the general cost-effectiveness of sanitary reform, which she was convinced the statistics would confirm, could go a long way to further popular support for the movement and overcome resistance to the large cost of such sanitary schemes. But such knowledge had to be effectively communicated. Nightingale appealed to the Congress to correlate this data

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internationally for presentation at their subsequent general meeting, and to abstract those findings appropriately for popular dissemination in the press. 78

Florence Nightingale had, herself, been a singularly influential activist in instating both the scientific and the moral imperatives of public hygiene in the general belief system of the privileged classes of mid-Victorian Britain. But her campaign—which had begun quite remarkably for an English gentlewoman, in the army field hospitals of the Crimean War (1854-56)—was truly international, indeed imperial in scope. With the ever growing flux of humanity within societies in change, and between nations and continents around the globe, the implications of the mounting evidence for the theory of the contagious transmission of disease were ominous. This emphasized all the more the urgent need to compare and correlate public health statistics internationally, to keep track of the progress of infectious diseases, and isolate and contain them through cooperative measures of disease control such as quarantine. Nightingale evidently regarded her campaign for public hygiene, along with her pioneering reforms to the practice and ethics of nursing, as an appeal for the recognition and transcendence of minimum standards of health and decency, by all the European nations with any pretense of civility and modernity. This extended to those other distant parts of the world which global powers such as Britain held in their imperial possession—if not for the well-being of their “native” subjects, certainly for that of the European colonial communities, especially the European troops on whom they depended for their security. 79


79 These are, admittedly, my own inferences. Nightingale did, however, have cause to deliberate on the sanitary issues of India, at least, as a consultant to the Army Sanitary Commission. cf. F. Nightingale, “Life or death in India” and “Life or death by irrigation, 1874”, Annual Report of the Sanitary Commissioner with the Government of India, 1873–74, Appendix 49. In the context of those consultations she became an appreciative acquaintance of Col. William E. Baker, the first Chief Engineer of the Indian Public Works Department who, in his later capacities as Military Secretary at the India Office (1857–1861) and subsequently as Member of the Council of India (1861–1875), served for many years as the representative of the India Office to the Sanitary Commission. H.M Vibart, Addiscombe, Its Heroes and Men of Note.
Largely due to Florence Nightingale’s battlefront nursing and consciousness-raising, the ill-fated adventure of the British expeditionary force in the Crimea had drawn attention to the deplorable sanitary norms and medical practices that then prevailed among the enlisted men of the British Army. As many as ten times the number of men who actually fell victim to the Russians’ weapons in that war, had succumbed to dysentery in the camps and hospitals behind the lines.  

However, not all such facilities were deadly. Amidst the more general debacle of the Crimean campaign, an exception to the rule was the quite remarkable system of prefabricated hospital structures which were erected at Renkioi in Turkey, to the designs of Isambard Kingdom Brunel. As we shall discuss below, similar prefabricated structures were to prove useful in the subsequent expedition of British forces to India to quell the Mutiny. It was, in fact, many of the same British soldiers who had managed to survive the trenches and the hospitals of the Crimea, once that conflict had come to an end in 1856, who had the poor fortune to be shipped onward almost directly to India to cope with the emergency of 1857. With no time for hindsight or any significant improvement in sanitary practices, however, they continued to die like flies from dysentery and other communicable ailments.

The Consolidation of the Cognitive basis for Sanitary Reform in Colonial India:

The rationalization of the Indian military system, following the Mutiny, was the essential catalyst for the significant sanitary reforms in the building and planning norms of the British Indian administration in India.  

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82 V.T. Oldenburg, Making of Colonial Lucknow, 96.
India, which were to be adhered to in subsequent decades. Diseases endemic in India—such as malaria, enteric fever, dysentery, and cholera—were a perennial threat to the health and effectiveness of the European community. To the extent that these had regularly killed and disabled an alarming proportion of the European military force in India, disease constituted a very real security threat as well. Back to back with the Crimean debacle, the shocking mortality figures due to illness of the British troops sent out to quell the Mutiny raised serious concern in England and India over the evident inadequacy of existing knowledge and practice in the domains of climatic and sanitary engineering for the tropics. The decision to maintain a much augmented European force in India, with the imposition of direct crown rule (the largest concentration of British troops outside the United Kingdom, in the second half of the 19th century), precipitated, therefore, a vigorously renewed assault by the military on this ignominious killer within its ranks.

Consistent with the general concern of the moment for coherent and rational new approaches to the familiar problems and challenges of colonial rule in India, the first line of action on the sanitary issue was to consolidate and enhance the knowledge base upon which any effective new action would necessarily be supported. For that purpose a Royal Commission was convened by Parliament in 1859. According to the methodology already well established by sanitary reformers in England, this body was mandated to conduct a thorough empirical inquiry into the prevailing sanitary practices of the Indian Army, backed by detailed comparative statistical data on the actual status of disease in all of the different localities and environmental conditions in which troops were accommodated. (In this latter regard the Army was inherently well organized to provide a wealth of dependable data, systematically and efficiently). The various patterns of the propagation of disease, and their correlations with environmental and behavioural factors, could thereby be discerned and appropriate remedial action prescribed.

As with the sanitary movement in England the concerted inquiries which were finally carried out on a centralized basis by the Royal Commission on the Sanitary State of the Army in India, had been preceded

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83 Ramasubban, "Imperial Health in British India", 38.
by a long preamble of consciousness-raising and criticism by
reform-minded individuals and lobbies that sought to draw attention to
the deplorable standards of health and life-expectancy that the European
colonial community in India had resigned itself to accept. Among these
agitations was the aggressive campaign of the British engineering
profession to bring public indignation to bear on the poor performance
record in the domain of military architecture of their counterparts in
the corps of Royal Engineers (as discussed briefly in Chapter 6). Incensed initially by the perfidious living conditions under which
British troops were compelled to live in barracks in London itself, the
civilian critics had extended their recriminations, upon further
investigation, to the entirety of the Royal Engineers’ operations,
including the already notoriously poor sanitary status of the Indian
Army, for which the Royal Engineers’ brethren, comprising the Indian
Engineers’ Corps of the Company regime, were deemed responsible. But such
assaults on the pride of the British Indian engineers were not taken
lying down.

In 1858, even while the Mutiny was still being suppressed in upper
India, The Indian Engineers’ Journal (the first home-grown organ of the
profession in India) was sufficiently peeved to take up cudgels in
defense of the substantial progress on the sanitary front that it claimed
engineers and military planners in India had been making for some time.
"INot content with confining itself to the question of Home barracks," the
editors protested, their respected metropolitan counterpart, The
Builder, had "...gone out of its path to call attention to the state of
Indian barracks, and, with the usual ignorance of facts that all persons
in England seem to possess and be unable or unwilling to cast off..." had
published several spurious allegations which the Indian journal was
compelled to reproach.84 "Home" readers of the Indian Engineer’s Journal
were assured by its editors that awareness of the need for sanitary
reform in India was well advanced and that the majority of British
soldiers serving in the subcontinent were now located at new stations

84 Confident of its case, on the other hand, The Builder reprinted
these criticisms in its own pages; with an inevitable rebuttal. "Sites
and Arrangement of Barracks in India", The Builder 16, 813 (Sept. 4,
1858): 608.
laid out within the previous ten to fifteen years on modern sanitary
guidelines. The buildings of older stations had meanwhile been
up-graded—"...altered, added to, furnished with extra verandahs,
etc..."—as thoroughly as could be hoped for in any effort at reform. In
the original article, these remarks had been accompanied by a
reproduction of a standard plan for permanent masonry barracks which was
purportedly to be adopted by the Public Works Department as the new
all-India design norm.85 The average cost of such typical barrack
structures in India in the 1850's was 11 to 12 lakhs of Rupees (110,000
to 120,000 pounds sterling at the prevailing exchange rate). This was
"...no trifling sum...," the Calcutta based journal begged to emphasize,
determined to contravene the image of small-time, slipshod
professionalism that British Indian engineers had garnered back Home.86

Unconvinced however, the Builder picked up the same story in a
subsequent issue with a defence of their initial assertion that sanitary
progress in the barracks of the Queen's and the Company's armies in India
had been shamefully slow.87 Fresh evidence was gleaned in this instance
from a recent report by one of the most ardent and respected advocates
for sanitary reform in India, Dr. J.R. Martin; a military man himself.88

Martin presented some disconcerting statistics. In a forty year
period between 1815 and 1855 the two armies had lost approximately
100,000 men to non-combat related ailments "...the greater proportion of
whose lives might have been saved had better localities been selected for
military occupation in that country." Moreover, the estimated monetary
loss to the nation, assuming the investment per soldier at 100 pounds,
was in the area of 10,000,000 pounds for the dead men. Meanwhile, the
number of barrack buildings and entire military stations rendered
obsolete by their poor design and unhealthiness was colossal. One

85 Unfortunately, I have not located a copy of the original article,
and hence cannot comment on the above mentioned plan itself.
86 "Sites and Arrangements of Barracks", op.cit.
87 "Barracks and Health in India", The Builder 16, 815 (Sept.18,
1859): 637.
88 Martin served for twenty-two years as a medical officer of the
Bengal Army, and later as Physician to the Council of India. He was to
play a key role on the Royal Sanitary Commission of 1859. Ramasubban,
"Imperial Health in British India", n.7., 56.
authority estimated that the East India Company had expended over the years a combined sum—strictly for the accommodations of their European troops—equivalent (when compounded at the prevailing interest rates) to the entire national debt.

But Martin's report was not only an admonishment; it offered constructive insights and recommendations as well. In keeping with the methods and argumentation strategies of metropolitan contemporaries such as Edwin Chadwick, Martin made use of the expanding knowledge base of statistical and historical data concerning the propagation of disease that medical professionals and governments (at least those within the commonwealth of the British Empire) were then beginning to share. The recent tragedy of the Great Famine in Ireland had produced suggestive evidence that the crowded communal conditions of the workhouses and hospitals to which the homeless masses had flocked had proved far more conducive to the communication of Typhus, and its deadly consequences, than had the open road, hedge-rows and drafty huts to which the presumably least fortunate had been forced to take shelter. For the case of military buildings in India, Martin extrapolated predictably from the Irish experience: "...of so much more avail is pure air towards the restoration of health than a fine building. The thorough ventilation through the openings and crevices of huts supplies the sick with what they do not obtain in our ill-constructed barracks and hospitals—namely pure air." 89

The military engineers in India evidently had much still to learn about appropriate environmental design. On the other hand, this was a deficiency which (again, as in the case of the metropolitan sanitary reform movement) Dr. Martin was confident the medical profession could go a long way toward rectifying, given the appropriate means and authority. Among his recommendations, Martin proposed the appointment of permanent medical officers to the military establishments of each presidency to oversee the sanitary state of the army, in conjunction with the functions of the Quartermaster-general's department. It would be the job of these "scientific" officers (rather than the mere brick-and-mortar-minded

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89 As excerpted from Martin's original report, in "Barracks and Health in India", op cit.
engineers of the FWD) to determine and prescribe the design standards for the salubrious new military buildings that would be required by the Indian Army in future. A particular virtue of a doctor's professional judgment in such matters, Martin appeared to suggest, was his capacity to compare and synthesize precedent knowledge with objectivity, unfettered by (presumably) irrelevant considerations, from a scientific standpoint, such as architectural style and cultural or historical design conventions. In his ecumenical vision of technically rational design practice, he proposed that each such senior medical officer would "...preserve in his office, for the use of the scientific persons concerned, plans and models of the best barracks and hospitals which may be from time to time approved by the military powers of Europe, in order that the most recent improvements may be rendered available wherever buildings of the nature indicated may be found necessary."

Martin subsequently had an opportunity to translate certain of these recommendations into policy and practice, as a member of the Royal Commission of Inquiry convened in 1859.

Findings of the Royal Sanitary Commission (1859):

The investigations of the Royal Commission on the sanitary state of the Army were exhaustive, and took a full four years to complete. The findings of the Commission were officially reported to Parliament in 1863 but were not published for general information until 1865, occasioning considerable delay in the diffusion of that knowledge. 90

The inquiry substantiated in detail three broad observations which I summarize as follows:

1. By far the larger proportion of mortality and inefficiency in the Indian army had arisen from endemic diseases—fevers, diarrhoea, dysentery, cholera, and from diseases of the liver

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(usually due to alcohol).

2. The predisposition of European soldiers to these diseases was partially attributable to endemic "malaria" in conjunction with extremes of temperature, moisture and the subjection of the troops to frequent dramatic variations in these climatic conditions through maneuvers to different regions of the country.

3. The more familiar causes of ill-health and mortality among troops serving in colder climates--attributable to artificial factors, both environmental and behavioural--were also very active under the prevailing service conditions of European troops in India.

The Commissioners found that military stations had been constructed, generally "...without reference to health." They were frequently situated in low, damp and improperly drained localities, "...or on river banks, close to unwholesome native cities or towns." The latter were condemned, generally, for their over-all filth and lack of dependable fresh water supply and even minimal drainage; their overcrowding; and for the chaotic irregularity of their layouts which afforded no possibility for proper ventilation.

In the case of the older European stations it was found that much the same conditions prevailed as in the native settlements, with haphazard building layouts and no sub-soil drainage, run-off and sewage tending to collect in any low-lying hollow or borrow-pit (from brick-making, erosion etc.), causing much "nuisance" when the wind blew the wrong way.

The contemporary explanation for "malaria"--literally mal-aire or 'bad air'--came under the class of miasmatic theories. Up to the very end of the 19th century, sound empirical evidence supported the belief that the intermittent and remittent fevers characteristic of the disease were caused directly by unwholesome exhalations from damp soil and marshes. 91

91 The identification of the protozoan parasite of genus Plasmodium as the actual cause of the illness was made in 1880 by a French
Hence, the Commissioners noted critically that virtually all existing barracks and hospitals in Indian Military stations were built "at or close to the level of the ground without any through draught between the floors and the ground." The men were thus "...exposed to damp and malaria from this cause, as well as from want of drainage."

On the other hand, they were not convinced of the prevailing wisdom that large volumes of air were necessary to preserve health in communal spaces. The typical barracks and hospitals of military stations in India in the 1850's were overly tall and airy in their opinion. Large quantities of cubic space were relatively useless with regard to salubrity, or even hurtful if draughty, when the actual floor surface was cramped and overcrowded, as was frequently the case:

There are often four, or even six, rows of beds between the opposite doors or windows, increasing greatly the already existing difficulty of ventilation and exposing the inmates to foul air.

The greater proportion of the force is lodged in barracks in such large numbers per room as to be very injurious to health; many of these rooms being several hundreds of feet in length, and some of them containing from a quarter to half a regiment each!

Military hospitals in India were typically constructed on the "same general plan" as barracks and therefore suffered from the same deficiencies of design from the point of view of healthiness and sanitation.

Clean water supply and provisions for bathing were considered to be very deficient in general; one of the "cardinal defects at Indian stations", in the opinion of the Commissioners. (Among the conspicuous new design items that was to feature frequently in budget sanctions for

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scientist, Alphonse Laveran. The *Anopheles* mosquito was indentified as the necessary vector of infection in 1897 by Ronald Ross, an officer of the Indian Medical Service. Headrick, *Tools of Empire*, 65.

Without that specific knowledge it was easy to confuse the symptoms of malaria with entirely unrelated instances of fever. Hence, in the mid 1860's, a senior military engineer with the PWD was prepared to stick out his neck in defence of certain design proposals that ran counter to the Commissioners' recommendations, on the assertion that "malaria from the power of the sun emanates apparently from the driest soil." G. of I. to S.S., No.14, 15th Jan., 1866. PWD (Military Works) Proceedings, Feb. 1866, No.9, NAI
the Military Works Branch of the PWD in the following decade were so-called "plunge-baths", a form of common bathing pool for the troops not unlike present-day "sheep-dips" in form and purpose.) The "dry" system of waste management for privies and urinals (i.e., hand-removed by "sweepers", the outcast "untouchables" of the traditional Indian social hierarchy) was also denigrated as a glaring source of disease. (However, the general shortage of water in most regions of the country conspired against substantial change in this practice; even to a large extent today.)

The sanitary conditions of the Indian troops of the Army were a concern of the Royal Commission in so far as these were believed to affect the health of the British soldiers quartered in their proximity. In general, the very limited range of buildings and facilities normally provided for native troops at military stations were considered worse still, in all sanitary regards, than those intended for Europeans. Among these, the construction of separate hospitals for Indian soldiers had evidently been regarded as a matter of necessity in the struggle to maintain the vitality of the troops. All the same, the Commissioners found these to be "...almost altogether wanting in means of personal cleanliness or bathing, in drainage or water-supply, in everything, in short, except medicine." (see fig. 4.7, above)

Unlike their European counterparts, the indigenous troops were usually responsible for the construction of their own quarters. The Army only provided the land for these "native lines" (and those of the civilian "followers" as well, including sweepers, tailors, syces, etc.), and a small though relatively unregulated budget for the purpose. As such, Indian soldiers lived for the most part in culturally congenial, traditionally constructed "huts" of straw or bamboo, rather than barracks. Moreover, they tended to live together with their wives and children. Despite the perceived sanitary depravity of such conventional "native" living conditions, the mortality rate was in fact much below that of the European troops, at an annual average of just 18 deaths per 1,000 as compared to 69. Even the elite community of European civil servants, living in their spacious bungalows, could not claim a better survival rate. When Indian troops were compelled to live in conventional barracks, however, they were found to die with the same rapidity and of
the same diseases as the European soldiers. 92

Although these facts were duly recorded, it was indicative of the metropolitan derived, environmentally oriented system of medical beliefs with which the sanitary inquiry of the Royal Commission was conducted, that no significant explanations appear to have been offered for this theoretically contradictory finding. King 93 has noted that less than 5% of the 900 pages of evidence published in the Royal Commissioners' report related to the mores and behaviour of the indigenous troops. In believing that so-called "zymotic" diseases (endemic diseases caused by multiplication of germs introduced from outside 94) "...have always been the chief causes of mortality in uncivilized or imperfectly civilized countries", and convinced by the credibility of their own cultural explanations, the metropolitan reformers and technocrats comprising the Royal Commission were evidently inhibited from paying more attention to the cultural context of indigenous behaviour. From an internal, cognitive level of analysis the complex nature of the man-environment relationship in that instance, might have been better comprehended. What made the indigenous soldiers of the Indian Army more robust, as King suggests,

were culturally learned behavioural factors, for example, mores which determined that defecation be performed at a distance from living and eating quarters, strict caste rules governing the handling and consumption of food, as well as the interaction between castes engaged on 'unclean' activities and the rest of the community, the use of separate hands for eating and perineal cleansing. Physiological factors were also important such as the development of relative immunity from bacteriological infection through constant exposure to risk. Finally, cognitive factors explained the ability to accommodate what members of other cultures perceived as excessive sickness or mortality, and explain these as part of a totally different world view which held that 'life-on-earth' was, in comparison to the world view of the metropolitan culture, a transitory experience.

The significance of behavioural and cognitive factors in the susceptibility of different populations to disease were quite clearly

92 Ramasubben, "Imperial Health in British India", 41.
93 A. King, Colonial Urban Development, 121.
94 The Concise Oxford Dictionary. s.v. "zymotic".
recognized, on the other hand, when it came to the unhealthy habits and
distractions of British soldiers in India. Even before the inquiries of
the Royal Commission had begun, the Indian Military Department ventured
to defend the earlier design efforts of its engineers with the lesson of
experience: that the passive coercion of a rationally devised, salubrious
environment was not itself sufficient to cure the ills of the indolent
British soldier in India:

Beyond a certain limit it is not the indefinite increase in
height or space in Barracks that is required to improve the
health of the soldier. It is not even in the first degree the
improvement of drainage and Barrack offices, essential as these
are, but the right internal economy of the Regiment, the
reformation of the habits of the men, and the provision of
healthy employments as well as of amusement.

The excessive consumption of alcohol, and the rampant incidence of
sexually communicated diseases, were considered major causes of morbidity
and mortality among the troops. These were necessarily to be combated, in
the Commissioners' reasoning, by a combination of environmental and legal
coercives, and strong doses of moral persuasion.

The gravity of the problem was clearly revealed in the statistics.
At the age of 20, the life-expectancy of British troops in India was just
37.7 years, whereas at "Home" they could expect to see their sixtieth
year. In the worst localities in India, up to 11.5% of the troops were
dying each year of non-combat related causes. The most salubrious of the
Indian military stations were still losing 2% per annum. It was the
opinion of the sanitary commission that the latter would be the lowest
possible rate of mortality the Indian Army could expect to attain on
average, once general sanitary reforms were implemented. This was,
nevertheless, still close to double the annual toll of military stations
in Britain that had undergone sanitary up-grading.

Apart from their shock value from a humanitarian point of view,
these abysmal statistics lent themselves to hard-core economic

96 G.G. in council to S.S., Fort William, 28th July, 1859. Military
(PWD) Letter No.17 of 1859. [NAI]
97 Royal Commissioners' Report, 15-18. As cited in King, Colonial
Urban Development, 103.
calculations which the authors of the Royal Commission report didn't hesitate to consider in their arguments for the urgency and the essential efficacy of sanitary reform. They reasoned that a reduction of mortality also promised increased physical strength and greater fitness for duty in the army generally, as well as a smaller portion of "constantly sick" in hospital; and hence a greater effective numerical strength. Fewer recruits would be required to supply the losses from disease, a point of very great importance. On average 69 European soldiers per thousand were dying each year in India,\textsuperscript{98} or approximately 5,000 out of a total contingent of 73,000. The up-shot of this was that over 5,000 new recruits had to be enlisted, trained and shipped out to India each year just to maintain the status quo. This placed an additional burden on the budget of the Indian administration to the tune of half a million pounds sterling at the estimated cost of 100 pounds per recruit. A tolerable rate of just 20 deaths per thousand would reduce the annual recruiting obligation by approximately 3,600 soldiers; a very substantial total savings of 360,000 pounds, or almost 1,000 pounds per day that could be redesignated for other more constructive expenditures.\textsuperscript{99}

The Recommendations of the Royal Commission:

The Commissioners tabled a long series of recommendations for remedial action and improved sanitary standards for future design and planning, based on an analysis of their findings. In its review of the Report, upon its general publication in 1865, The Builder cited those it regarded as most relevant and useful for its readership of engineers and architects: \textsuperscript{100}

- Works of water supply and drainage were to be built without delay in all stations. Any existing works were to be thoroughly

\textsuperscript{98} This figure evidently accounted for battle casualties as well. Elsewhere in the Royal Commissioners' Report a figure of 58/1,000 non-combat related deaths is given. Royal Commissioners' Report, 15-16. ibid.


tested for purity and proper function.

- In future, all barracks and hospitals were to be erected on raised basements permitting free circulation of air beneath the building; to be arranged en echelon to receive the benefit of prevailing winds; to be provided with single verandahs only; to be planned for no more than two rows of beds between opposing walls and windows; to be designed to provide sufficient ventilation independently of doors and windows; to be provided with sufficient glazed window space to light them by day, gas to be introduced where practicable to improve lighting by night.

- Barracks were to be constructed to hold no more than a quarter company, or no more than a half company in one building, in two separate rooms, having no direct communication with each other; detached cottages were to be erected for married soldiers; 1,000-1,500 cu.ft. of contained air space and 80 to 100 sq.ft. of floor area, varying according to the "airiness" of the specific locale, to be provided for each man residing in a barrack, space use of existing barracks to be re-allocated in conformity with this decree; wall space in all new future barrack buildings to be made sufficient to allow a clearance of minimum 3 feet between beds while not exposing any bed to direct draughts from windows or doors; sufficient ablution and bath accommodation to be provided, with a constant water supply; drinking fountains furnishing filtered water to be provided; water-supplied latrines and urinals were to be provided wherever possible (presumably still as separate out-buildings), and, where impracticable, earthen-ware or metal vessels, to be removed and washed out twice daily, were to be introduced to the "dry" system to improve the standard of cleanliness.

- Hospitals were to be constructed in detached pavilions containing no more than 20-23 beds; 1,500 cu.ft. was the
minimum recommended quota of contained volume along with 100 to
130 sq.ft. of floor area per bed; a minimum gap of 8 feet of
wall space to separate each bed from the next; constant supply
of filtered water, and drainage, to be provided; every hospital
to have accommodations for bathing, easily accessed from the
wards, with fixed basins and bath-tubs fed directly with hot
and cold water; water closets, directly accessed from wards,
with running water supply and drainage to be provided wherever
practicable, and dry "privies" in existing hospitals to be
converted.

- Hill-stations: a third of the army's forces were to be
stationed at any one time at hill-stations, or stations (such
as Poona) on more salubrious "elevated ground". A number of new
ones were therefore required to be developed. Troops were to be
rotated through such convalescent postings on a regular basis.

Finally, the report included specific proposals for various sanitary
works in India including water supply and drainage, and improved plans
for barracks and hospitals. The latter were prepared jointly by the Royal
Commission and its metropolitan counterpart, the War Office Barracks
Commission, and were subsequently sent out to India. However, these were
largely superseded by a further home-grown set of standard plans for
military buildings in India which the Public Works Department was to
develop directly, beginning in 1863, in collaboration with the Indian
Military Department. I shall discuss that process presently, with
particular regard to the rationalization of military barracks design on

101 henceforth, Barracks Commission. This commission had been convened
by Parliament in the aftermath of the Crimean War, and the embarrassment
over the fatal neglect by the Royal Army of the service conditions of its
enlisted men which that campaign had brought to light. This Barracks
Commission examined and reported in detail upon every barrack in the
United Kingdom (which were all pronounced defective in matters of primary
importance). E. Ingress Bell, "The Modern Barrack: Its Plan and
commission of inquiry was also a direct precursor and model for the Royal
Commission on Sanitary State of the Army in India, with which it
evidently shared its findings as well as several of its committee
members.
the basis of the Royal Commissioners' recommendations.

But first, we shall consider (briefly) the application of the broader findings and recommendations of the Royal Commission concerning public health policy and practice for the country as a whole—particularly as these applied to sanitary conditions in the native towns and the civil stations.

**Civilian sanitary reform in British India:**

The investigations of the Royal Commission on the sanitary state of the Army were to have significant consequences for the various civilian components of the colonial society as well. But these were generally delayed, relative to the sanitary reforms implemented by the Army. The Commissioners’ Report itself was not made public, in printed form, until 1865.\(^{102}\) Meanwhile, however, the inquiry process had provided a stimulus and model for several similar commissions which focused more directly on the sanitary status of the civilian population, both Indian and European.

The first systematic investigation in that vein was prompted (as in England in 1848) by the outbreak of a major cholera epidemic which swept northern India in 1861. While the Army’s concurrent inquiries were focusing narrowly on the health of the troops and their immediate European co-dependents, the Cholera Enquiry Commission of 1861 (headed by John Strachey) served to expose the poor state of knowledge regarding disease conditions in the country as a whole. With some delay pending completion of the exhaustive inquiries of the Royal Commission on the Sanitary State of the Army in India, the implications of these parallel military and civilian investigations were followed up by the governments of the three Indian presidencies, each of which established its own sanitary commission in 1864. These were given a mandate to transfer the technology of public hygiene and disease control which sanitary reformers had developed in the metropolitan context, to appropriate applications in India. Again, however, this was essentially an information technology, consisting primarily of further systematic statistical surveys of the

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spread of epidemics. It did not necessarily entail significant physical intervention on a broad scale.\textsuperscript{103}

These various investigations in the 1860's raised official awareness and concern regarding the declining state of the health and welfare of the greater Indian populace. But this knowledge was never effectively translated by the colonial administration into a sufficiently systematic and committed public health policy (with local exceptions, most notably in the large metropolitan port cities) that could materially improve the prospects for better health and longevity of a huge indigenous population that was steadily increasing in size while descending further into poverty, under the social and economic conditions created by colonial rule.

Recent scholarship on the role of medical science and technology in European imperialism has invariably compared and contrasted sanitary reform in the metropolitan societies with the experience in the tropical colonies. However, as I have already indicated, there were essential similarities between the English and colonial Indian cases, as I see it, with regard to the "vested interest" and, more fundamentally hence comprehensively, the conceptual system of "mechanization" with which sanitary science was promoted in each case. While they differed in many respects, the complexes of empirical and theoretical knowledge and purposive intention that framed the respective metropolitan and colonial sanitation campaigns were closely related, in a dialogical manner.

The moralistic humanitarianism of sanitary reformers in England was to some degree, as we have discussed, a mask for the basic self-interest of the English upper-classes in controlling the threat of disease at its endemic source among the poorer masses. There was political capital in such efforts as well as it presumably won the gratitude of the downtrodden; a check against the perennial threat of revolution from below. In India the mask of the humanitarian reformer was deemed unnecessary, indeed politically ill-advised, in the explicitly segregated and hierarchically stratified colonial society of European conquerors and Indian subjects. In that tacitly authoritarian political context medical knowledge (along with other forms of scientific knowledge and technique)

\textsuperscript{103} Ramasubban, "Imperial Health in India", 42-43.
could be applied (or withheld) at will as a basic tool of power. Inevitably political interests weighed heavily in the balance. Quite self-consciously, as Ramasubban relates, the politically reconstructed Raj of the post-Mutiny era intentionally declined to enforce any major reforms in public health as in other areas of social policy with potentially disruptive implications for the traditional social life, customs, and beliefs of the native Indian populace.

On grounds such as these, Oldenburg has argued that there was a "profound difference" in the attitudes and strategies with which sanitary reform was undertaken in England, and the experience in British India. In the metropolitan instance, she explains, squalor and pauperism were recognized as the root cause of the endemic spread of disease among the lower urban classes of the newly industrialized Victorian society. "The drive to make the physical environment more salubrious was supplemented by progressive legislation that eventually saw the emergence of the welfare state. Concern for the quality of life of the people was preponderant, and the state spent an ever increasing proportion of its revenue on systematic relief to the needy."

In India, on the other hand, the science of hygiene was much more narrowly applied. Sanitary engineering and regulations were, in effect, an auxiliary technical bulwark in the defenses of the small and vulnerable population of resident Europeans. The suburban civil lines and cantonments were the beneficiaries of the greatest direct investment of expertise and public revenue in sanitary works, while the conservancy of the indigenous inner cities was a half-hearted affair which was generally left to private contractors. There was no broad, "ecological" basis for these operations, and (at best) only feeble political will to sustain them, despite the often dogged commitment of the individual medical and engineering professionals involved. In the case of the populous city of Lucknow, as Oldenburg describes, "...(the municipal committee remained

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104 Ramasubban, "Imperial Health in British India", 50-51.
105 V.T. Oldenburg, Colonial Lucknow, 142-144. For a more general articulation of the "counter-discourse" to the received account, by colonial apologists, concerning "the benefits bestowed by modern medicine", see David Arnold, "Introduction: Disease, Medicine and Empire," in D. Arnold, ed., Imperial Medicine and Indigenous Societies. (Manchester and New York: Manchester University Press, 1988.)
afflicted with a curious myopia that prevented it from devising a comprehensive long-range plan to drain and cleanse the city; it was driven instead by the urge to get limited results cheaply and quickly. "Meanwhile, areas beyond the jurisdiction of municipal and cantonment committees remained virtually untouched by the "sanitary idea." 106

The direct benefits of British sanitary engineering in India, as indicated by the experience of Lucknow, were generally neither far-reaching nor long-lived. 107 As such Oldenburg challenges one of the most proudly cherished claims of the colonizers (for all the other more dubious virtues of Britain's imperial exploits in India). This notion—of the unimpeachable virtue of the British Raj as a bearer of tools and knowledge for the betterment of the health and well-being of the Indian people—was staunchly maintained in the uncritical assessments of imperialist historians, and in later nostalgic memoirs of the Raj as well (an opinion still readily expressed by some in India today). But, this was a belief which was already deep-seated in the general belief system of the technically and morally self-assured Victorians, which engineers and technocrats within the British Indian administration did apparently endeavour to fulfill, even at cross-purposes to the more calculated policies of imperial political strategists.

While the energetic developments of the 1860s saw major progress in military works and communications in India, public works of a more prosaic nature, at the level of municipal water supplies and sewers, etc., lagged far behind in most places. The following passage appeared in the Builder in 1870, in an article concerning the critical imperative of engineering better water supplies for India's growing towns and cities:

In the future history of the world the facts and incidents connected with British power in India most dwelt upon will not be of armies, generals, governors, and conquests; of battles, suppressions of mutiny, or of human slaughter in any form. The memory of these may remain, breeding feelings of revenge, or of shame, or of sorrow, in proportion as the hearts of those who read are hardened or have been civilized by Christian teaching. The true and enduring fame of Great Britain will be connected with the permanent establishment of works and regulations of the most simple character; namely, those works which have

106 ibid., 143.
107 ibid.
tended to promote social comfort, and those regulations which have best insured human happiness, and are a means of securing health to the greatest numbers. 108 Ironically, Oldenburg concludes, the legal framework of regulations and coercives designed to enable sanitary measures to be efficiently undertaken and maintained, was ultimately the more potent cause of significant social change. The impact of the partial and unsystematic sanitary operations and planning that were actually carried out, was comparatively negligible.

The bottom-line to sanitary reform in the particular colonial context of India was the great cost of such a necessarily vast public undertaking; an investment which had to be weighed against its unpromising odds for success when it came to providing sewer systems, water supplies and better ventilation for an "Oriental" Public presumed to be culturally (and cognitively) indisposed to cooperate in accruing the benefits of European sanitary science (and its attendant aesthetics). 109

Concerted, if incidental, interventions did take place, however, with British efforts to combat the catastrophic epidemics of disease with which both Europeans and Indians had been plagued with increasing frequency and severity over the preceding century of colonial conquest and consolidation. To the extent that such large-scale epidemics affected agricultural production and the internal economic activity of the country, and hence the international trading interests of the British, the living conditions of the general Indian population assumed increasing importance.

Cholera in particular was the bane of British imperial enterprise. The era of rapidly increasing and accelerated global transportation, which brought the British Empire to its zenith by the second half of the nineteenth century, had also enabled the cholera bacillus, with its short incubation period, to escape the bounds of its "natural home" in the Indian subcontinent. The series of international cholera epidemics that had subsequently scourged England and its European neighbours—in 1831–32, 1848–49, 1853–54, 1861, 1865–66, and 1873 110—had stimulated waves

109 Headrick, The Tentacles of Progress, 146–147.
110 Ramasubban, "Imperial Health in British India", 43–44; Headrick,
of public health agitation and reform on each occasion; though initially, as we have discussed, these were confined to the efforts of individuals and local government administrations and had achieved little effect in dampening the impact of such epidemics. The call of reformers such as Florence Nightingale for broader, international cooperation was eventually heeded, however, with the convening in Constantinople in 1866 of the first international sanitary conference. This and three further conferences staged over the following two decades (in 1874, 1875, and 1885 respectively) attempted to work out a systematic approach to the compilation and application of existing knowledge about cholera and other diseases, and an international protocol for their prevention and control—measures which were ultimately brought to bear restrictively on British trade.

The causal connection between sewage, water, and cholera was not demonstrated conclusively until the 1880s. In the meantime, the statistical correlation of the incidence of the disease with the increasing movements of people internationally (as had also been observed with the massive internal migration of pilgrims within India on the occasion of certain major religious festivals), offered suggestive evidence for a "contagionist" explanation of its mode of transmission. The most obvious and effective measure for controlling the spread of cholera, that the international community could conceive of in the light of this theory, was to enforce rigorous and lengthy quarantine of travellers and their effects at seaports. This alone was sufficiently irksome for Britain, which had the largest volume of international maritime trade of all the European powers as well as the most frequent troop and naval movements to and from its colonies. But the additional onus was placed on the British in India to combat the disease at its

Tentacles of Progress, 155. Dates cited in these two recent accounts differ slightly. Ramasubban places great emphasis on the significance of the epidemic of 1861 in spurring on important developments in international disease control policy. However, Headrick does not mention that date at all. In this account I emphasize the evident combined effect of both local epidemics and international "pandemics" in raising consciousness of the need for governments to act in the area of public health.

111 Headrick, Tentacles of Progress, 156.
"primary sources", which the delegates of the Constantinople conference had determined lay "naturally" in the Indian subcontinent. 112

Compliance with international pressure in this regard entailed further cumbersome restrictions on the movement of goods and people within India, which the colonial administration greatly resented. As Ramasubban relates, the recognition of this conflict of interest, by both the British colonial and metropolitan governments, stimulated an explicit and concerted effort to contravene the wisdom of the international sanitary body. 113 British interests stood squarely with the established common-sense opinion of the majority of sanitary reformers and technocrats in India and England who argued that cholera was of the miasmatic class of diseases. This belief entailed a unilateral course of remedial action consistent with the sanitary improvements the colonial administration had already committed itself to on behalf of the military establishment. Not only did this free British imperial administration and trade from the obligation to submit to the obstructive checks and controls prescribed by the international sanitary authority; it provided a robust explanation for the spontaneous occurrence of the disease, applicable in any region of the world. This diminished the stigma that the contagionist theory for cholera inevitably attached to the human and material resources that the British needed to circulate in and out of India and around the globe in the course of their imperial business.

While understating the necessity of rigorous quarantine measures, a committee appointed by the Government of India to review the recommendations of the Constantinople conference had concurred in the view that the only far-reaching solution to the spread of cholera was a complete system of sanitation and town planning for cities, towns and villages, along with the military cantonments. 114 However, this still

112 Ramasubban, "Imperial Health in British India", 44-45.

113 Ramasubban gives an incisive account of this particularly revealing episode in the evolution of imperial health policy in India, which we can only afford to summarize in the present discussion. ibid., 44-53.

114 Cholera Committee, 1867, "appointed to report upon the arrangements which should be made to give practical effect in the madras Presidency to the recommendations of the International Sanitary Conference", Report of the Cholera Committee (Madras, 1868). Cited in
constituted a far greater commitment to sanitary reform in the general civilian sector, than the colonial government was prepared to undertake. To make a case for the more expedient, palliative manner of sanitary intervention envisaged, Parliament once again resorted to the salve of an in-depth empirical inquiry that might definitively establish the facts concerning the specific origin of cholera and its modes of transmission in India. It was indicative of the prevailing confusion between contesting theories and strategies for disease control, however, that even as this further scientific investigation got under way in the late 1860s, the administration intensified its technical assault on the insalubrious built environments of India, resorting simultaneously to both practical measures of sanitary engineering and conservancy, and the principle of quarantine, to keep cholera in check. The still very limited impact of the first of these strategies on the indigenous population consisted in further isolated if sometimes ruthless instances of sanitary surgery of the sort Oldenburg has described in the case of post-Mutiny Lucknow, and the introduction of organized refuse removal and provision of filtered and piped water supplies in urban settlements to overcome the pollution by defecation, bathing and laundering of exposed existing water sources. In the second half of the nineteenth century, enclosed water-borne systems for sewage removal and drainage were only introduced, and implemented incrementally, in the largest urban centres. Calcutta opened the first phase of its sewer system in 1868. Typically, however, it was the European quarter which was first served, and the vast native sections of the burgeoning metropolis were only gradually incorporated into the scheme between 1870 and 1914.

A more generally significant impact of sanitary policy on the indigenous populace in this period was felt in consequence of the selective application of the principle of quarantine, by medical and planning authorities. In routine circumstances, formal quarantine measures were reserved for checking the export of cholera and other

ibid., 44.

115 see chapter 4: "The city must be clean" in Oldenburg, Making of Colonial Lucknow.

116 Headrick, Tentacles of Progress, 157-158.
diseases beyond India's ports and borders. But the more insidious corollary of quarantine, the principle of isolation, was to be widely employed in colonial efforts to plan and regulate the movements of the native population, and its contacts with the European community in India. The most overt and aggressive controls and isolation measures of this sort were imposed on pilgrims and other native travellers congregating at pilgrims centres and the sites of major festivals, which had been targeted in the findings of the Constantinople conference as a key source of cholera in India.\textsuperscript{117} The contribution of the new railways to the phenomenon of pilgrimage, and the attendant spread of epidemics, attracted special attention in this regard. Among other more obvious sanitary measures which this served to encourage, it reinforced the racist premises for strict segregation in trains and all railway facilities.

Meanwhile colonial urban development as prescribed by the rigid new cantonment planning codes and regulations that came into effect from the 1860's onward, and municipal planning norms for civil stations and towns that were frequently modeled thereon, were to isolate Europeans from Indians systematically, and vice versa, on both environmental and contagionist grounds of medical argument.

4. RATIONALIZATION IN THE MILITARY WORKS BRANCH OF THE PWD

Logistical improvisation during and following the Mutiny:

The investigations of the Royal Commission on the sanitary state of the Army took four years to complete. Meanwhile certain of the Commissioners' recommendations had already begun to be applied by the time its findings were officially reported to Parliament in 1863.\textsuperscript{118} With the need to accommodate the much expanded contingent of European troops in India

\textsuperscript{117} As late as the second decade of the twentieth century, however, these measures were still found to be woefully inadequate in controlling the communication of diseases at such events. Ramasubban, "Imperial Health in British India", 50.

\textsuperscript{118} "Sanitary State of the Army in India", op. cit.
during and immediately following the Mutiny, however, considerable temporary accommodation had of necessity been hastily erected with no serious attempt to conform to the emerging new norms, nor even to the previous design standards of the 1850's.

The Public Works Department under its incumbent Chief Engineer in that period, Henry Yule, had come under criticism from Parliament and the home press for this compromising approach. But architectural and sanitary shortcomings notwithstanding, the major logistical challenge Yule and his staff had met in getting such a large force under cover, and within budget, in such extraordinary circumstances was staunchly defended by the Government of India.  

Tight constraints on resources and operational conditions during and

119 see, for instance, "Barracks and Health in India", The Builder 16, 815 (Sept.18, 1858): 637; and the allegations of J.R. Martin published a few months earlier in the same journal, The Builder (March 27, 1858).

120 66 in C to SS, Fort William, 28th July 1859, Military (FWD) Letter No.17 of 1859. [NAI]; FWD (General) "A" Consultations, March 7, 1862, Nos. 14-16. [NAI]; "Minute by his Excellency Sir Robert Napier, K.C.B., President of the Council of India", FWD (Mly. Wrks.) Proceedings, April 1865, No. 46. [NAI]

Yule was one of several quintessential Victorian gentlemen of means, good breeding, and wide-ranging intellectual interests and achievements who served in the Indian Engineers Corps. A contemporary of Richard Strachey, the two advanced shoulder to shoulder through many of the same posts in the irrigation and railway branches of the FWD, from Addiscombe in the 1830's to the head of the Public Works Department by mid-career. Yule's tenure in that post, from 1858 to the beginning of 1862, was one of the most dynamic and stressful periods in the history of the Department, a factor which appears to have encouraged his early retirement from Indian service at the age of 41.

Yule went on at that point to a second career in letters. Among his publications, including many shorter essays and articles published in the learned journals of the day, he was the joint author-compiler with A. Burnell of Hobson-Jobson, a monumental scholarly "glossary of Anglo-Indian terms...", which was first published, towards the end of his life, in 1886. Of more universal significance to the world-view of Victorian England, Yule produced an annotated translation of the Travels of Marco Polo in 1871. This was his first offering as a scholar-writer, authored in Italy during his extended residence there between his India years and his ultimate return to England in 1875. Yule's connection with India was renewed at that point with his life appointment to the Council of India. He was also a member of various scholarly and geographical societies in his later years, serving as president of the Royal Asiatic Society from 1885-87. H.M. Vibart, Addiscombe, Its Heroes and Men of Note, 487-490.
immediately following the Revolt had also been the mother of some modest technical ingenuity. For example, Yule’s simple prescription of "safe and suitable construction" for temporary barracks, as described in an official letter to Major Richard Strachey at Allahabad during the special operations of 1857-1858, established a new proto-functionalist design norm for utilitarian structures of all kinds, which was to have a long-term impact on building practices in India as well as elsewhere in the tropical world. As Yule described them, such structures were to

...consist in the erection of substantial piers of brick laid in lime mortar for the support of the roof trusses or principal rafters, the intermediate spaces being afterwards filled with walling of sunburnt brick, safe provision however for the use of wet tatties being made on the western side of the buildings.

Within the constraints of this simple, cheap, spatially and technologically flexible post and panel building principle, superintending engineers were afforded a "...large discretion as to the style of the buildings..."; whatever could be most rapidly completed at each locality,"...provided the construction be secure and the cover sufficient." However, with the inaccessibility of timber and shortage of labour to make bricks, during that period, even such minimalist specifications had been difficult to meet in many instances.

The artificial shortage of conventional building resources had encouraged a further, more radical departure from Anglo-Indian building norms, in the experimental substitution of prefabricated "skeleton frames of iron" for traditional timber roof trusses and load bearing masonry walls. A shipment of such frames had arrived from England in March of 1858 while the pacification of the Revolt was still in progress. However, this initial time lag in delivery from the factory was compounded by the logistics of local surface transport. With the East

121 H. Yule (Officiating Sec’y, to G. of I.) to R. Strachey (Sec’y, to the G. of the Central Provinces), PWD Proceedings, 20th Nov., 1857, No. 179. [NAI]
122 ibid.
123 86 in council to SS, Fort William, 28th July, 1859. Military (PWD) Letter No. 17 of 1859. [NAI]; PWD (MIL) 65-66, 8th July, 1859. [NAI].
Indian Railway not yet connected with the cities of upper India the material had to be hauled up-country from Calcutta by bullock cart, a process which evidently took several months. When these frames finally arrived at Allahabad in the final stages of the pacification effort, they were used to erect temporary barracks for troops in transit to trouble spots further west, as well as for temporary hospital structures. Once in hand however, this iron frame construction technology proved most useful to the PWD in the immediate period following the end of the fighting. Despite the renewed availability of labour and conventional building materials, the speed of erection inherent in this alternative building system was much valued in the scramble to get the augmented British force under some form of adequate provisional shelter.

Such ephemeral frame structures were never considered an adequate long term solution for the accommodation of the troops. But, with few exceptions, construction of permanent new facilities was delayed until a rigorous and universal new policy for the design and construction of military buildings in India could be developed on the basis of the complete recommendations and detailed evidence presented in the final report of the Royal Commission. The Government anticipated an exceptional budget outlay on such military works and was therefore anxious, as Robert Napier explained, to take full advantage of "...all the improved conditions that experience has shown to be required for [the] physical and moral well being" of the European soldier in India.

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124 PWD (Mil.) Proceedings, No.5a, Feb.18, 1859; ---, No.101, Mar.11, 1859; ---, Nos.47-49, Mar.4, 1859.

125 PWD (Mil.) Proceedings, Nos.65-66, July 8, 1859; ---, Nos.45-47, Sept. 9, 1859; ---, Nos.31-33, Nov. 18, 1859. [NAI].

In her recent study of French colonial urbanism, Gwendolyn Wright illustrates a very similar prefabricated iron construction system which the French military engineers employed in very similar and concurrent circumstances in Saigon, after its conquest in 1859. Gwen. Wright, The Politics of Design in French Colonial Urbanism, (Chicago: Chicago University Press, 1991), 168.

As we have seen, the principle of prefabricated construction systems for the rapid erection of provisional shelter overseas, had already been well tried by this time. However iron construction was still relatively novel. Brunel's prefabricated hospital structures for the Crimean campaign, four years earlier, had been constructed entirely of wooden components. See Herbert, Pioneers of Prefabrication..., 75-96.

126 "Minute by his Excellency Sir Robert Napier, K.C.B., President of
The consolidation of design agency and precedent knowledge:

By 1863, when the Commissioners' report was finally tabled, Richard Strachey had succeeded Henry Yule as the PWD Secretary to the Government of India. With the decisiveness and utilitarian rationality he had earlier demonstrated in his capacity as planner for the new civil and military stations at Allahabad, Strachey took immediate steps to get the long-awaited design and construction process rolling. By contrast to all the protracted deliberations by collective committees, in which the sanitary barracks issue had been absorbed up to that point, his utilitarian predilection as a military technocrat was to delegate to a single expert the entire responsibility for the ensuing exercise of translating all that accrued wisdom into design. Further to Strachey's recommendations, the Government of India proceeded accordingly to appoint Lieut.-Col. W.A. Crommelin for this special task.127

The assignment was broadly, if rather simply stated, to "consider and report on the numerous important questions involved in the construction of barrack buildings for European troops in India."128 It was certainly not the first time the Army had tried to address such questions

the Council of India", PWD (Mly. Wrks.) Proceedings, April 1865, No. 46. [NAI]

127 Ibid. Crommelin had come to the attention of his superior officers and the Government as an engineer of exceptional ingenuity and organizational abilities. As a captain on active duty with the Bengal Engineers during the Mutiny, he had been commended by no less than the Governor General for what Canning characterized as "one of the most remarkable operations of the kind that Military History can show." This had consisted in twice engineering the "passage" of the entire Oudh Field Force across the Ganges in near flood conditions, during the relief of the besieged garrison at Lucknow. These crossings (presumably by temporary boat-bridges) had both been achieved in a matter of hours, in the second instance with the enemy "in full possession of the opposite bank", whereas an earlier such operation (without Crommelin's assistance) had taken a full week to achieve. Military (PWD) Letter No.1 to Court of Directors of 1858, Allahabad, May 1, 1858.

Crommelin had earlier attracted attention with his detailed investigations into the problems of spanning the Indus at Attock, one of the most strategic bridgeheads on the North-West frontier. GG to SS, Camp Hooshearpoor, March 30, 1860. Selected Letters, Public (PWD - Communications) No.8 of 1860. [NAI]

128 Proceedings of the GG in C (PWD-Mil.), Fort William, 16th Dec., 1864. PWD Circular No. 89 of 1864. [NAI]
squarely. But Strachey and the Government evidently had confidence, from Crommelin's past performance, that he would be able to take the technical and logistical issues in hand with some independence of mind, by which the fundamental problems might be redefined and satisfactory long term design solutions resolved upon, at last. While Crommelin was to pay close attention to the mass of empirical evidence, and design recommendations, presented by the Royal Commission and its local colonial counterparts, he was also expected to make his own professional assessment of the precedent knowledge long accumulated in the building norms and experiments of the Indian Army in the past. Workable design solutions to the need for healthier barrack accommodation would reasonably derive from a synthesis of the engineers' accrued practical knowledge of the problem with the latest science of the medical experts.

To make a sufficiently thorough and systematic survey of such precedent knowledge, however, was another whole task in itself. Fortunately Strachey had already begun the process. In 1862, after taking over as the head of the PWD, he had called for the compilation of a complete series of plans and explanatory records of all existing military buildings in India to remedy, as he explained, "...the incomplete state of the records of Barrack accommodation and the difficulties and inconveniences that often arise from want of the means of ascertaining readily and certainly the nature and extent of the buildings, and the amount of the accommodations they afford at the several military stations." 129 The plans were to be small scale "block-plans" that could show "at a glance", on a single foolscap sheet, the full extent and disposition of all the buildings pertaining to each Regiment or Detachment of Infantry, Artillery or Cavalry, at each station. (fig.7.4).

Analogous, smaller scale station or cantonment plans were also to be prepared to indicate the precise relationship of these military buildings to the immediate settlement patterns and communications. Such plans, with accompanying registers of pertinent data, were to be prepared for every station in India where there were military buildings. Instructions, with precise graphic guidelines for the submission of plans and data, had been

issued to all executive engineers and other relevant military officers with a view to publishing the material in a series of bound folios and registers, presumably both for archival purposes and to serve as a convenient reference tool for better comparing, critiquing, and exploiting such precedent design knowledge.

The compilation of this comprehensive index had apparently not progressed very far by the time Crommelin set to work. However, as the duly drafted plans and tables were gradually received they inevitably contributed to Crommelin’s in-depth knowledge of the subject, and furnished a base—a veritable palimpsest—for the decidedly conservative new designs he was to propose.

Within a few months of taking up the task, Crommelin had come up with detailed proposals, including design guidelines and specimen plans, for Barracks (for single and for married men), and for Hospitals (for European and for Indian troops)—the two most significant categories of military buildings in India from a health point of view. He did not have carte blanche, however, to push his proposals into immediate action. According to a protocol imposed by both the Home and Indian Governments, he was obliged beforehand to lay down these “principles" in a series of memoranda, which were then circulated through the PWD to the attention first of the Sanitary Commission for Bengal, and subsequently to each of

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130 Three years later the process was still in hand. A critical mass of plans and information had been compiled by then, however the data had diminished considerably in its utility as renovations of existing structures and major new construction were already significantly changing the face of many Indian military stations. The original concept of a comprehensive register was therefore abandoned, though it was decided ultimately to publish a slimmer compendium of those plans that had already been prepared for press. Prior to printing these were updated to reflect the state of new construction and renovations in 1865, although the revision process delayed publication still further. PWD Circular No. 26 of 1866, re. "Block plans and registers of all military cantonments". PWD (Mil. Wks.) Fort William, March 26, 1866. [NA1]


132 Memo. No.1 by Lieut. Col. Crommelin, R.E., upon some of the principles which should be attended to in designing Barracks for unmarried soldiers in India, October 29, 1863; Memo No.2 by Lieut. Col. Crommelin, R.E., upon barrack accommodations for married soldiers in India, February 16, 1864.
the Local Indian Governments and their respective sanitary commissions. Ultimately the proposals had to be forwarded to the Army Sanitary Commission in England as well. This process was inevitably protracted as, one after the other, each authority offered its approvals and criticisms; Crommelin in turn rebutting these remarks in additional formal memoranda, and incrementally revising his evolving proposals as he saw fit. It was not until two years later, in 1866, that definitive guidelines were finally resolved upon and circulated in the department for general information and guidance. In the meantime, he extended his inquiries to consider the sanitary issues pertaining to most of the other typical buildings and utilities of Indian military cantonments.

Crommelin's initial mandate, though ambitious, had not been conceived of as a permanent undertaking. By 1865, however, the full magnitude of the projected new works had been more clearly established. Strachey was shortly to give up his post as PWD Secretary and was anxious to ensure continuity in the process he had delegated to Crommelin, and concerned as well to reward the latter's efforts with a greater degree of job security and authority in the task. In a note of January 12, 1865, Strachey emphasized "...the importance of giving complete stability to the progress of the revision of the designs for barracks and to the execution of the buildings in a satisfactory manner." To ensure this, he argued, "...it is essential to maintain unity of plans and ideas for a reasonable period."133

Although the translation of this appeal into a strategy for action was ultimately to rely substantially on the standardization of designs and design methods, Strachey's emphasis was clearly on the need for the conceptual coherence of a single reflective practitioner, rather than the prescription of rigid design specifications per se.

The Government of India had by this time resolved to outlay ten million pounds sterling within the remainder of that decade to, as Strachey explained, "...put the Military Buildings in India on a footing consistent with what is now thought right and proper for the health of

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133 Quoted in "Minute by his Excellency Sir Robert Napier, K.C.B., President of the Council of India", PWD (Mly. Wrks.) Proceedings, April 1865, No. 46. [NAI]
the troops." More than two thirds of that sum was to be spent in the provinces under the direct administration of the British (that is, on the Government of India's own budget rather than those of its princely vassals who supported the facilities of the imperial army within their borders). Hence, he argued, the government had a special obligation "...to ensure, as far as possible, an efficient result from the expenditure of this large sum of public money." The surest strategy, in his view, was to continue to give this important and costly undertaking the "undivided attention of a specially qualified officer" directly responsible to the PWD, namely Col. Crommelin. Accordingly, in September of 1865 the new post of "Inspector General of Military Works" was created by the Government of India, with Crommelin as its first incumbent.

This new title served to institutionalize the functions Crommelin had already been performing as the de facto authority in all matters concerning the design and sanitary improvement of Indian Army buildings. The creation of this post can also be seen as a convenient tactic by which the military engineers of the Public Works Department, by then a minority, managed to entrench their claim to exclusive responsibility for all military works and buildings, and thereby retain a very substantial handle on power within the department. The appointed officer, who was naturally required to be an officer of the Royal Engineers, was to assume the direction of the new Military Works Branch which had been officially established within the PWD the year before. In this role he was to operate with the virtual powers of a Chief Engineer, although official correspondence in this regard was still to be directed nominally to the attention of the PWD Secretary who continued to play a supervisory role in this branch of works. Exceptionally, by comparison to the other technical branches of the Department established in this period, the Inspector-General of Military Works could also consult directly with his military superior, the Commander-in-Chief of the Army, circumventing normal channels via the PWD Secretary and the Governor-General's Council. Furthermore, he had the authority to confer directly and finally with the

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134 PWD Despatch to SS, No. 3 of 1865. [NAI]
135 PWD (Mil. Wks.) Proceedings, April 1865, No. 47. [NAI]
136 Military Department, Resolution No. 277, Sept. 18, 1865.
executive cadre of the PWD on any matters concerning the construction of military works and buildings. 137

Rationalization of the principles of modern barrack construction:

Apart from the raft of new buildings they caused to be constructed in the subsequent half decade, the convoluted design deliberations and debates of Col. Crommelin, with the various governmental councils and sanitary commissions on whom he was dependent for sanctioning his schemes, generated a particularly revealing discourse from the point of view of our present interest in the specific rationality of design argumentation in that historical context. With the mechanical thoroughness of the colonial bureaucracy, this was all dutifully recorded in exhaustive detail.

The substance of these deliberations, on the all-important issue of barrack construction specifically, were summarized conveniently, for our purposes, in comparative note form in a PWD Circular of 1864 in which the Government of India announced its penultimate conclusions on each point, prior to forwarding the lot to the Army Sanitary Commission in England for final consideration. 138 A similar point/counterpoint accounting of the state of discussion on these proposals was drawn up in 1866, following receipt of the latter's remarks from England. In that further Circular, Crommelin finally had his chance—some two years after tabling his first proposals—to rebut his critics and make his closing arguments. 139 In the next few pages I would like to scrutinize those documents closely to discern, in the discrete instance of design argumentation they represent, the apparent conceptual parameters with which design decision making was

137 PWD (Mil.) Proceedings of the GG in council, Simla, Sept. 29, 1865. PWD Circular No.93 of 1865. [NAI]
constrained, particularly the cognate authority of contemporary sanitary science.

In the case of most other Indian military buildings, Crommelin's design proposals offered only modest improvements to the established norms, responsive to the most important objections the Royal Commission had raised; rather than any revolutionary new prototypes. But the paramount concern of the sanitarians with the deleterious effects of "malaria" appears to have been the impetus for his quite significant departure from established precedent in the case of basic Barracks. These, he proposed, might henceforth be multi-storey structures wherein the principle dormitory rooms would be raised a full storey above ground. The rooms of the ground storey were to be used for daytime activities, designated to functions such as gymnasias, storerooms, offices, school rooms and Regimental libraries. (fig. 7.3). Crommelin evidently proposed this strategy with hesitation, on account of the substantial additional cost such a standard would entail, and he indicated in his initial proposal that single storey barracks should normally be preferable where "special reasons" did not apply. However, the grander principle was unanimously embraced by the various authorities consulted, though not all agreed on the necessity of excluding dormitories from the ground floor. In its conclusive statement on the matter, the Government of India determined that barrack buildings of as many as three storeys could be constructed in conditions where ground area was restricted, as in hill stations, or where efficient ventilation of the lower floor was likely to be obstructed, as for instance by the immediate proximity of a rampart or a hill-side. In such structures the upper two storeys were to be used for dormitories. (Examples of multi-storey barracks of this type were subsequently constructed for the troops garrisoned within the fortresses at Delhi, Calcutta and Madras, among other places.

The general scale of barrack buildings and the specific capacities of their contained spaces were other questions to which sanitary

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Crommelin cannot be credited for inventing the two storey barrack prototype. A standard plan for such had been issued in 1858, but few exemplars had yet been constructed pending the deliberations of the Sanitary Commission and Crommelin's own design appraisals. See: PWD (Mly. Wks.) Proceedings, March 12, 1858, Nos. 152-154.
DETAILED PLANS OF LOWER FLOORS OF CAVALRY BARRACKS

SHOWING THE ARRANGEMENT OF THE AUXILIARY AND DAY ACCOMMODATION.

FOR A

Regiment of European Cavalry

Each upper floor ward contains 16 beds.

No. 1.

No. 2.

No. 3.

Fig. 7.3. Standard upper storey dormitory plan, and Detailed Plans of Lower Floors of Barracks for regiments of European cavalry. Source: Enclosure to PWD circular 7, 6th Feb. 1868. Large, two and three story barracks of this type were multi-functional buildings. Note the integration of accommodation for married sergeants in the stairwell cross-blocks, with separate private stairs for wives and children.
Fig. 7.4. Standard Block plan of Barracks for a regiment of British Infantry. Source: Enclosure to P.W.D. Circular No. 61, 1866.

Fig. 7.5. Barracks for a company of European Infantry, at Nowshera. Lient. E.S. Taylor, R.E. Source: The Professional Papers in Indian Engineering, vol. 1/3, May 1864.
Fig. 7.7. Prototypical design for a Barrack in Upper India. J.G. Medley, R.E. Source: The Professional Papers in Indian Engineering, vol. II/7, 1865. Note the ox-driven "thermaitidote" in basement; for mechanically driving out warm air; and the "kennel" like partitioning of the dormitories.
authorities had drawn special attention. Crommelin determined that the new barracks should generally be built to accommodate "half companies" of troops, or between 40 and 50 men per building. However, there was a wide range of differing opinions on this matter expressed by the other local governments and military authorities. Older, convention-bound administrations such as Madras and Bengal expressed a preference for buildings large enough to accommodate a full company, or even a full Regiment, as such were considered more suitable to Reglemental organization. At the other extreme the government of the frontier province of Punjab advocated the more progressive "cottage system", from the point of view sanitarians, of small buildings each capable of containing no more than sixteen men. The Supreme Government concurred in Crommelin's "moderate" strategy, with the arguments that discipline could be more efficiently maintained in half company barracks than in very small buildings; that such allowed a sufficient though not excessive sub-division of the men, and better ventilation than large or even very small buildings; and finally because such would not necessitate the occupation of an undue extent of ground area.

With regard to the interior scale of accommodations, Crommelin opted similarly for a "moderate" course. The incommodiousness of too great a mass of men assembled in one space accepted, he nevertheless argued against too much compartmentalization. Accordingly, he designed his various specimen plans to accommodate from 16 to 20 men per room. Most of the other authorities agreed with Crommelin on this matter, with the exception of the Commander-in-Chief of the Bombay Army and the Government of Punjab who advocated a still greater subdivision, "mainly on moral grounds", to as few as four men per room. Evidently the critics in this instance believed that a modicum of privacy might assist the more conscientious and good-hearted majority of the men from descending to the lowest common denominator of indolence and lechery, to which some were always prone. On the other hand "discipline" was considered easier to maintain when the men could be held more directly and collectively under the gaze of their commanding officers. The Government of India deferred ultimately to the precise recommendations of the Royal Sanitary Commission and concluded that as many as 24 men per room would be acceptable.
It should be noted that Crommelin himself did not refer directly to the authority of the Royal Commission, or any of the other Sanitary commissions, in stating his proposals. Therefore, one of the Government of India's purposes in recapitulating these, and the subsequent commentaries of the various other authorities, was apparently to account for, and correct if necessary, the concordance of the proposals with the recommendations of the Royal Commission, before decreeing its final conclusions on the matter.

A further sanitary point of concern that had a particular architectural bearing, was the matter of dimensions. Crommelin's specifications in this regard raised no serious objections from the various sanitary commissions and authorities in India. If anything they were regarded as generous, and a somewhat diminished scale of edifice for hill stations was ultimately settled on by the Government of India. In the Plains, barrack dormitories were to provide 90 superficial feet per man in double-loaded wards of 24 feet in width with a wall height (to the base of the roof structure, or spring-line of ceiling vaults in the case of lower storeys) of 20 feet. This was to give 1,800 cubic feet per man. In the Hills barracks were to provide 77 superficial feet per man and the overall dimensions were to be reduced proportionately to provided between 1,408 and 1,232 cubic feet per man depending on the altitude of the station.

In the opinion of the Army Sanitary Commission in England, however, the allowance of 90 superficial feet per man would not prove enough "for low malarial districts, especially close to river banks." The Royal Commission had recommended 100 superficial feet per man for barracks in the Plains, and they felt that standard might better be applied in such insalubrious districts. Crommelin raised no serious objection to this suggestion, although he was skeptical as to whether such "malarial" localities could be accurately defined. As he explained (somewhat disingenuously) in his initial reply to the remarks of the Commission: "It would be difficult to specify the stations which should be considered as specially malarious; indeed, it is well known that, except on the summits of certain hills, all stations in India are, to a certain extent, malarious from July to November, and that malaria from the power of the
sun emanates from the driest soil."  

If more spacious barracks were to be built at some stations, Crommelin was anxious to prescribe how the specimen plans he had prepared could be sensibly adjusted without detriment to the general spirit and principles of his designs—which he did in his final remarks on his proposals, in 1866. However, one senses he had no fundamental faith in the nit-picking calculations of the sanitary pundits and their naive belief that such subtle quantitative differentiations in environmental parameters could actually have a direct impact on the incidence of disease.

A further instance of Crommelin's apparent skepticism with respect to innovation and, alternatively, his faith in common sense and the empirically accrued knowledge of precedent, was his response to the Army Sanitary Commission's suggestions regarding ventilation. It was a cardinal point, in its view, "...that ventilation, as far as possible, be independent of doors and windows..." It seemed only obvious to Crommelin, however, that the multiplicity of door and window openings from interior rooms to peripheral verandahs in barracks and other conventional Anglo-Indian building types had evolved as such with good reason:

During the cold season, ventilation may be effected without the aid of doors and windows by means of properly placed openings in the walls and roofs, and by extracting air shafts; but during the hot and rainy seasons, these independent means of ventilation will not, I believe, prove satisfactory, and the movement of the air through doors and windows appears to me to be essential.

A final decision on this and like matters was to be left open, however, for the deliberations of yet another body of experts—the Committee on Barrack Ventilation—which had recently been convened by the Government of India. (Its report did not appear, however, until five years later.)  

Crommelin concluded his list of "principles" with the stipulation that barrack rooms were "to be kept free from anything that is likely to affect injuriously the purity of the air." The barrack room unit was to

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141 PWD (Mly. Wks.) Proceedings, Feb. 1866, No. 9, G of I to SS, No.14, Jan. 18, 1866.

comprise only the dormitory, a mess room, the quarters for the sergeant (and his wife), and a water-room. Latrines, cook-houses, laundry rooms, etc., were all to be housed in detached out-buildings adjacent to the dormitory blocks, although the Government concluded that small closets containing a few "close stools" (commodes) and urinals could be attached to each upper storey dormitory for the use of the men during the night. These were to be locked in the daytime. Within the standard sergeant's apartment of two rooms (18' x 12', and 12' x 12', respectively) the sergeant's wife was also to be provided with a small bathroom, there being "...no suitable outbuilding in the neighbourhood of the single men's barracks to resort to."

This protracted exchange of proposals, remarks and criticisms was the most specific, and defensive on Crommelin's part, where it focused on the series of "specimen plans" he had prepared to illustrate the proposed new principles of barrack construction. Whereas there was a generally good degree of agreement between the various authorities consulted on these principles, "in principle", when it came to their explicit parameterization in actual plans, consensus was much harder to achieve. The Government of Madras objected altogether to the adoption of standard plans while, relative to Crommelin's plans, the Governments of Bengal and the North Western Provinces desired larger buildings, and the Government of Punjab smaller ones. Only three of the seven barrack plans Crommelin had presented with his initial memorandum were ultimately approved by the Government of India—each with required modifications.

The concerns of the Army Sanitary Commission in this regard centred, not surprisingly, on perceived deficiencies in ventilation inherent in some details of these schemes. One criterion which they felt Crommelin's plans had to be revised to meet was the principle of complete independence of ventilation. Each dormitory ward and sergeant's quarters should only be accessible from the exterior verandah, they felt. Internal communications between spaces were to be avoided, even indirect connections such as the end-doors Crommelin had provided to access the central stairwell from the two upper-floor wards in his double-storey barrack proposal. Crommelin, for his part, felt that common-sense practicality clearly outweighed such dogmatic hair-splitting on sanitary points of principle:
I cannot think that these small doors, which do not face the prevailing wind, can have any material effect with regard to the ventilation, and I am of opinion that, on the whole, it will be best to leave them open, as access by them to the stairs will be more convenient than by the verandahs, particularly when the side doors happen to be blocked up by tatties during the hot season.

With the crucial significance they placed on external verandahs for both ventilation and circulation, the commissioners also objected to Crommelin’s projection of the sergeant’s quarters into the space of the verandah, in his double-storey barracks prototype. This they thought would "...interfere with the free play of the outer air over the surface of the block..." Crommelin countered that these projections were "too slight to be really objectionable". The stripped down alternative plan the commissioners had suggested, on the other hand, presented significant other problems which were more effectively tackled in his own scheme, he felt. Primary among these was the need for privacy, which his design of the sergeant’s quarters had taken into account. The presence of women in the barracks environment presented special considerations in this regard. Crommelin had provided not only private in-house bathrooms for each of the two sergeant’s quarters incorporated into the standard barracks block, but private staircases as well. (see fig. 7.3) The election to preserve the modesty and respectability of European women in that preponderantly male social environment, in this cloistered manner, reflected a concept of the place of women in the colonial society—on the part of Crommelin at least—that was evidently sympathetic to the traditional "purdah" system of belief in the parallel but unequal worlds of the two sexes.

143 "A screen of mat made of the roots of fragrant grass...with which door or window openings are filled up in the season of hot winds. The screens being kept wet, their fragrant evaporation as the dry winds blow upon them cools and refreshes the house greatly, but they are only efficient when such winds are blowing..." Hobson Jobson, s.v. "tatty", 903.

In his critical impressions of British India at the beginning of the nineteenth century, the touring aristocrat, Lord Valentia, drew some perceptive conclusions on Anglo-Indian building practices from his observation of the use of tatties: "Our style of architecture is by no means adapted to the climate, and the large windows would be insufferable, were it not for the tatties which are easily applied to a house one storey high."—Id. Valentia, i.104, Hobson Jobson, op.cit.
which was enshrined in the customs and the domestic architecture of the upper classes of Indian society. Crommelin believed that this criterion of privacy would always outweigh any conflicting sanitary considerations in the day to day use of the building, and therefore had to be designed in if the latter was not to be compromised. In other words, the designer had to be as prescient as possible in his rationality, to build-in effective physical constraints and conditions for a healthy and socially functional environment, for the users could not be expected to behave entirely rationally themselves. Furthering his objections to the Royal Commissioners’ alternative plan, Crommelin pointed out that there would not be so much privacy for the Sergeant as in the specimen plan, nor, practically [his emphasis], would his quarters be so well ventilated, for instance there would always be a thoroughfare, opposite the front doors, to the stair-case, so that these doors would generally have to be kept shut when the quarters are occupied by a family. In the specimen plan, the quarters are as private as they well can be, and there is a through ventilation in each room independent of the front door. It was to obtain this that the quarters were so much projected.

Among the three different specimen plans for barracks that the Government of India had selected from Crommelin’s various proposals, and approved for general information and guidance within the PWD, was his design for a Whole-Company Barrack. In its critique, the Army Sanitary Commission had drawn attention to a seemingly superfluous narrow passage that separated the two halves of the scheme, suggesting alternatively that this double capacity barracks—which was roughly twice the length of the Half-Company Barrack plan Crommelin had recommended as the general standard—might more sensibly be conceived of as two spatially separate blocks, either in line or staggered, linked by a short stretch of open verandah. The latter configuration had already been employed with some success at Nowshera in the Punjab, a decade earlier. (fig. 7.5). But Crommelin responded by clarifying his evidently misunderstood intention that such whole-company barracks were to be built only when necessitated by restricted space, or when a long continuous building was required for particularly large auxiliary accommodation on the ground floor such as a school or general recreation room. "The passages", he explained, "were built for two purposes; 1st, to give a place for punkah-pullers or punkah
machines, and 2nd, to admit of end clerestory windows being given for purposes of ventilation." For the most part, Crommelin's designs indicated no expectation that novel new technologies could transform the basic parameters of building in India. However, if the punkah-mallah's big toe could be replaced by a more dependable mechanical contraption, he was at least willing to make space for such and give it a try. 144

Crommelin had also prepared a memorandum and plans for barracks for married British soldiers and their families. Each married man and family were to be allotted a unit comprising two rooms of 16'x 14' and 14'x 10' respectively. These were normally to be grouped in single storey ranges of between 8 and 10 units, to suit the Troops or Companies to which the soldiers were attached. (fig. 7.6) However double-storey blocks were not ruled out where circumstances dictated. (Good examples of the latter are still extant in Fort St. George, Madras.) Crommelin proposed that these ranges be fronted by a twelve foot deep verandah, with a shallower 8 foot verandah behind. He was not supported in the latter recommendation, however, and a deeper 10 foot rear verandah was to be adopted as the standard. Each unit was to be separated from the next by a full height wall to afford privacy. Latrines, bath rooms, and cookrooms were to be placed in outbuildings separated from the main block. Covered passages could be extended to these but were required to be discontinuous with the outbuildings by a minimum of ten feet, evidently for fire protection. Privies for women and children were to be under separate cover from those intended for the men.

There was no significant disagreement on these points, and Crommelin's original specimen plans for married quarters were approved with only slight modifications.

Crommelin's fundamentally conservative design strategy was extended

144 In their report of 1870, the Committee on Barrack Ventilation gave detailed specifications for a mechanical punkah-driving mechanism ideally suited to barracks constructed in this manner. Standard punkahs hung at regular intervals from the roof structure of the dormitories were to be linked together in a "train" by rigid members relaid to a rocker mechanism driven by a heavy pendulum. The latter could be hung quite efficiently in the narrow central space Crommelin had provided in his Whole-Company barrack plan. See: FWD Circular No 47 of 1870, (Buildings & Roads—Military) Simla. Aug. 19, 1870.
to the problem of military hospitals as well. 145 As had been the norm in the Company era, he proposed that separate hospitals should be provided for every Regiment or Detachment of British soldiers serving in India. Only in special cases did he think General Hospitals should be admissible. This opinion ran contrary to the recommendations of the War Office Barracks Commission in London, but was supported by the Government of India. The scale of such Regimental hospitals was to be determined by the provision that there be sufficient bed space to hospitalize an average of 10 per cent of the standing force at any time. (Military wives and children were not necessarily to be provided with bed space, as it was expected they could be treated in their own quarters.)

Hospitals in the Plains were to adopt the same double-storey configuration as the new barracks, with sick wards relegated to the upper storey; subordinate staff quarters, day-rooms, offices, dispensary, stores, etc., on the ground level.

Crommelin rejected the principle of breaking down and distributing the various wards on the pavilion system then rapidly gaining acceptance in England and Europe, due in part to Florence Nightingale’s endorsement. 146 In this decision he expressly ignored the recommendations of the Royal Sanitary Commission. The simpler "cottage system"—which was widely adopted in India later in the century—was also rejected by Crommelin on account of cost and the apparent inconvenience such would entail for the attending staff. For that matter Crommelin was not even convinced of the need for special isolation wards for contagious cases of illness. It was his impression that military hospitals were rarely full, hence patients considered contagious could be distanced adequately from others within larger wards, or relegated temporarily to auxiliary rooms within the same building.

These notions of Crommelin’s concerning heuristic efficiency in the actual use of space in practice, versus theoretically prescribed

145 Unless otherwise noted, the following observations on Crommelin’s proposals for hospital design are based on PWD Circular No. 19 of 1866, "Principles of construction of Hospitals for European and Native Troops". PWD (MProjects.) Fort William, March 5, 1866. (NAl)
146 For a standard account of the development of the pavilion principle—what came to be called the "Nightingale Ward"—see Thompson and Goldin, The Hospital..., 155-169.
optimums, may have deliberately echoed remarks of the Quarter Master
General of the Indian Army, Col. J.S. Paton, which had been communicated
in PWD Circular a few months earlier.¹⁴⁷ The issue of overcrowding in
Barracks had been the subject of several previous PWD Circulars in 1865.¹⁴⁸
One resolution on this issue was to strictly enforce the new standard of
90 superficial feet that Crommelin had recently proposed. But the Army
had already begun to balk at the implications in cost and time-consuming
undertaking to expand its barrack accommodations to the new standard. In
his memorandum the Quarter Master General acknowledged the wisdom of the
new space standards, but reasoned that only very little additional space
would actually have to be built if one was truly rational about it and
differentiated between the official standing of a company of soldiers, on
paper, and the reality that at any one time approximately 7% of its full
complement would be hospitalized and hence accommodated according to
other logistical provisions. This was not to mention the permanent quota
of men who would be regularly doing guard duty out of barracks. If one
company proved to be exceptionally "healthy", and thus short of the
requisite 90 superficial feet of space per man in barracks, the Quarter
Master General saw no reason why a little accommodating heuristics on the
part of other companies, more normally "under the weather", could not be
anticipated. Certainly no exceptional and wasteful permanent expansion
measures were likely to be required, he felt.

While the views of Cols. Crommelin and Paton with regard to design
reform were essentially conservative, their mode of critical pragmatism
was sympathetic in some regards to a quite radical line of
proto-Functionalist design thought that had gained some currency among
military technocrats back Home. Adherents to this progressive,
essentially Liberal conviction—such as the Royal Artillery medical
officer, Dr. Combe¹⁴⁹—felt that the profusion of sophisticated and

¹⁴⁷ PWD Circular No.77 of 1865. (Mly. Wks.) Simla Aug. 16, 1865.
¹⁴⁸ see for instance PWD Circular No. 14 of 1865, (Mly. Wks.) Fort
William, Feb.15, 1865; PWD Circular No. 22 of 1865, Proceedings of the GG
in C, Fort William, March 17, 1865.
¹⁴⁹ Dr. Combe followed the lead of colleagues such as J.R. Martin, and
their civilian counterparts in the medical profession, in brow-beating
the building professions at their own game. Combe aired his unsympathetic
views on conventional military hospital planning through an article and
powerful modern armaments, and their accessibility to virtually all the advanced nations of Europe, was bound to reach some definitive climax in the not too distant future. Wholesale destruction of all existing military facilities was one possibility; or the obsolescence of war itself, another. In either case, to outlay vast sums on military buildings of any sort did not seem to be an economically sound policy.

In Dr Combe's view there was nothing particularly sophisticated nor necessarily expensive about building a sound and serviceable military hospital:

...I humbly conceive it to be practicable to obey all the most important and imperative laws of health, and, at the same time, to build a cheap hospital. Hitherto, military hospitals have been costly as well as bad, because money has been spent in carrying out the worst principles. It is worth while to try if we can project one in which sound principles can be given effect to without great expense. 150

Combe was surely aware of Brunel's temporary field hospital design, which had proved so successful in the Crimean War. He might also have approved of the temporary barrack and hospital structures that Col. Yule and his departmental engineers had thrown up with such alacrity. A proper hospital building, in his opinion, had only to be raised sufficiently from the ground on a solid impermeable foundation, but "the walls need not, as far as health considerations go, be much more than a screen of brick sufficiently strong to support themselves and a light high-pitched roof."

However, no such short-cuts were seriously considered in the case of India. The sheer inertia of the ponderous consultation process by which the new "improved" designs for military buildings had been arrived at, was alone sufficient to insure against any radical departures from the groove of convention. Moreover, the Indian military establishment had few doubts about its future mandate; the new Raj was digging-in for good.

an alternative prototype plan of his own design which were published in the Builder in 1860. "Plan Proposed for the Hospital of a Regiment", The Builder 18, 920 (Sept. 22, 1860): 606-608.

150 ibid.
Progress in barrack construction and "improvements" in the late 1860's:

Once consensus on the principles of hygienically sound barrack construction had finally been arrived at, the Government of India launched whole-hearted into execution. By the end of 1868, just three years after the projected sum of ten million pounds sterling had been sanctioned for the prosecution of the new buildings and "improvements" Crommelin had planned, he was able to report that in the preceding fiscal year (1867-68) alone, "...projects to the extent of six and one half millions had been dealt with by the Government of India—three and a half millions by sanctioned estimates and three and a quarter millions by approved rough projects." And a further three and three quarter million had already been outlaid on the works in progress. 151

The four million pounds that had been specifically budgeted for "new buildings" was expected to be exceeded by actual expenditures, although this would be compensated for by savings under other heads such as "improvement of existing buildings" and "general cantonment works" both of which categories of works generally fell under the budgets and prerogative of local government administrations. Further savings in practice over the original programme of expenditures projected in 1865, were being realized under the heads of "Temporary Accommodation", of which none had been required in the preceding year, and of "Officers Quarters" and "Accommodation for Native Troops", neither of which was yet regarded as a direct concern of the government, in regular circumstances. 152

On the other hand "Military Works", properly speaking, promised to exceed initial estimates considerably. The most significant undertaking in this regard was the building of new "fortified posts" at all major

151 "Note by Col. W.A. Crommelin, C.B., R.E., Inspector General General of Military Works, on the progress to the close of the year 1867-68, in providing barrack accommodation for European Troops throughout India on the present improved scale, and in the execution of other general military works." PWD (Mly. Wks.) Proceedings, Nov. 1868, Nos. 60-61. [NAI]. Hereafter: Crommelin, Progress Report, 1867-68.

152 Crommelin had, nonetheless, prepared three alternative plans for standard barrack accommodations for Native infantry, exemplars of which were recommended for construction at Alipore in that same year, 1868. PWD (Mly. Wks.) Proceedings, Nov. 1868, No. 91. [NAI]
military stations, specifically to provide the civilians and non-combatant military personnel of the colonial community with secure places of refuge in the event of siege. Further, certain stations on the North-West frontier were having extensive new defensive field works built round them, which had not been provided for in original budget projections. This marked rise in security mindedness had further ramifications for the PWD in works under the head of "Ordnance and Commissariat Buildings". Among these, Crommelin's report mentioned a new gunpowder factory at Ishapoor, and a gun-carriage factory at Allahabad. Works of this sort were also expected to exceed the estimates originally approved.

Col. Crommelin (by the mid 1870's, Major-General Crommelin) remained steadily at the helm of the Military Works Branch of the Public Works Department throughout this dynamic decade and more of military rationalization and reconstruction. Along with his firm control of that enterprise—throughout that exceptionally extended tenure, for a military officer in colonial service—Crommelin appears to have preserved his fundamental skepticism with regard to new-fangled scientific wisdom that was any less than intuitively obvious to his common-sense engineer's frame of mind. An interesting coda to our discussion in the preceding few pages of Crommelin's particular and inevitably partial rationality as a designer of buildings and building policy in this important period of colonial development, is provided by a PWD Circular of 1876 through which Crommelin attempted emphatically to indicate to his colleagues and subordinates the necessary discrimination they were to make between hypothetical scientific theories concerning the causes and workings of disease, and the empirically tried rules of sanitary practice which they, as PWD engineers, were called upon to apply with rigour and system. To make this point, Crommelin circulated an extract from the Memorandum of the Army Commission on the report of the Sanitary Commissioner for Bengal

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153 PWD Circular No. 52 of 1865; to Local Governments and administrations, from PWD (Mly. Wks.) Simla, June 1, 1865.
154 Crommelin, Progress Report, 1867-68.
155 PWD Circular No. 60 of 1876; (Mly. Wks.) Simla, Oct. 6, 1876.
for 1873,\textsuperscript{156} which compared and contrasted critically, the differing
opinions of the Civil Surgeon and the Local Magistrate of Howrah District
on a sanitary matter of mutual concern—that is, the local practice of
burying excreta in collective cess-pits. The medical man had objected to
that practice on the authority of a theory that fever "germs" were
thereby dangerously concentrated. The Bengal Sanitary Commission had in
turn decided that this was not the doctor's own professional opinion so
much as the theoretical bias of others:

It was one of the cases where hypotheses regarding disease
causes, which are very proper subjects of discussion in their
own place, but form no part of sanitary doctrine at all, are
intruded into sanitary practice much to the detriment of
progress in public health.

The local magistrate was, by contrast, a man of practical and
conservative bent who had interjected that "...opinions of men science
are so various and contradictory on a point like this that, do what we
may, we are sure to have a medical opinion opposed to our plan..." having
observed over time "no evil results" from the conventional practice of
dry earth conservancy which was at issue.

The Bengal Sanitary Commission had sided clearly with the common
sense empiricism of this magistrate, (and evidently Crommelin as well),
insisting rather rashly however that theory had no place in the work of
the professional sanitary engineer who had "...to do simply with observed
facts and experience bearing on the production of disease." Precedent
knowledge would suffice, as long as it was applied wisely, with diligence
and judgment.

Crommelin's attention had by this time been turned largely to such
questions of maintenance and management. The building boom had peaked in
the late 1860's, and by the middle of the following decade his original
mandate had been substantially accomplished.

The end of the boom was precipitated by a reduction imposed on the
annual budget outlay for new works for 1870, by approximately 25% from
the rate at the height of military and "public" building activity in

\textsuperscript{156} Memorandum of the Army Commission on the report of the Sanitary
Commissioner for Bengal for 1873 (para. 7, 25th April, 1876).
1868-69. That retrenchment in spending had been compelled incidentally, by an unanticipated drop in revenues in that period. However, the Government found this a convenient opportunity to reevaluate the budget policy in this regard, and determined to retreat permanently from the "extraordinary" rate of expenditure on military buildings that had been assumed necessary in the 1860's. Although a large volume of projected new construction still remained to be carried out at that point, tighter fiscal constraints were looked on as a needed tonic. Indeed, rather than curtail completion of the project, it was hoped these constraints might, of necessity, cause certain designs and methods to be further rationalized. Already, the experience of constructing and using barracks and military buildings modeled on the approved new prototypes had begun to indicate inconsistencies in the ostensive operational and economic rationale with which they had been designed. As was made clear in the Resolution by the Governor General in Council on the policy of reduced grants for Public Works expenditure, it was hoped that a leaner, keener program of works might actually be accomplished with greater speed and efficiency on all counts:

The Governor General in Council has no intention of permitting any diminution of the care required for meeting all really important sanitary conditions, or any reduction of the extent of accommodation that experience shows to be necessary for the true comfort and health of the soldier. But, in the light of the knowledge that has now been obtained of the new style of construction, both as regards its financial consequences and its sanitary results, His Excellency in Council has little difficulty in adopting the conclusions, that some costly superfluities may be rejected in the future without any loss of comfort to the soldier, and that by more closely limiting the accommodation to what is really necessary, much economy could be effected, and real convenience in no way sacrificed.

Practical deficiencies of the new barrack design standards:

For all the careful and exhaustive efforts of Col. Crommelin and his various sanitary consultants to arrive at a consensus on a sensible and technically sound set of guidelines for barrack construction, their

deficiencies in practice (to which the Government had alluded in the above mentioned budget Resolution) became immediately apparent once soldiers had lived through one or two seasonal cycles in barracks built to the approved new specifications.

The new double-storey barrack blocks proved to be a particular disappointment. At Jullunder in the Punjab for instance (as was reported in a detailed critique by the Public Works Secretary to the Punjab Government, in 1870\(^{158}\)), new barracks of this type were found to be less comfortable than the decrepit old "lines" they had replaced, at great expense. In the extreme semi-arid climate of the upper Plains, the new buildings had proved to be excessively hot in the summer months and, alternatively, far too drafty for comfort in the "cold season" from November to February. Further, the stacking of the barracks caused those men delegated to the lower floors to be greatly disturbed by the noise transmitted through the ceilings from the wards above (the stipulation that only upper floor rooms were to be used for dormitory purposes having evidently been ignored). Meanwhile, those lower storey spaces designated for daytime recreation were allegedly so unattractive to the men that they were virtually unused.

The principal technical defect of the barracks in question was thought to be the choice of materials employed in the roofs and floor which were too thin and dense to provide insulation. Moreover, the slate roof and pointed brick walls were very dark in colour and thus additionally heat absorbing. Another conundrum was caused by the plethora of apertures throughout these buildings which had been prescribed to admit light and dispel foul air, but which obviously rendered the buildings equally permeable to heat and cold.

The performance of the new barracks with regard to "healthiness"—the principal agenda of its designers—could not be immediately evaluated. But their evident failure on the score of comfort, while frustrating in the short term, was to be productive of further innovations of modest but lasting significance for Indian building technology. Some of these were basic; for instance the practice of

finishing the exterior of brick buildings with a thin coat of lime-plaster to reflect the heat of the sun. Others were more ephemeral; many of the picturesque appendages which were to characterize Anglo-Indian buildings of the late Victorian era, such as iron louvers, chajjas, and clerestory window shades—which I have described elsewhere as the "prosthetic dimension" of European tropical architecture—were inventions of necessity by the engineers of the PWD as they tinkered away at the expensive new white elephants Crommelin had begotten from his drawing board, in an effort to make them at least moderately commodious.

Noteworthy, as we leave this discussion of Crommelin's legacy, was the fact that a "civil" member of the Public Works Department, Mr. W. Purdon, C.E.—a Superintending Engineer in the Punjab PWD—was responsible for the diagnosis of the failings of the new barracks at Jullunder. Purdon also prescribed the various technical remedies that subsequently enabled those buildings to perform more effectively, and which were evidently adopted widely thereafter. Not only were civil engineers gaining powerful positions of influence in the Public Works Department, by this time; they brought with them a more openly innovative and mechanically oriented professional frame of mind, by comparison to their convention-bound military colleagues.

Crommelin's attempt to rationalize the spatial typology of Anglo-Indian military architecture, though imperfect, established the norms which were to prevail well into the twentieth century. Before architects had their go at a new formal language for the imperial builders in India, further improvements would be largely technical, in the prosthetic dimension of devices and machinery for the artificial tempering of the built environment.

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159 V. Bhatt and P. Scriven, After The Masters, 141.
The mechanical rationale: Major Medley’s counter-proposal for a technologically well-tempered barrack prototype

The defective performance in practice of the new double-storey barrack type came as no surprise to at least one of Crommelin’s fellow military officers, who had an intimate knowledge of both the norms and the technicalities of building in India. Major Julius George Medley, the principal of the Thomason Engineering College at Roorkee in the mid 1860’s, had duly recorded his reservations concerning the new design in 1865, when he had scrutinized the proposed specimen plans as a member of the Committee on the Ventilation and Cooling of Barracks. 161

In an editorial article on the barracks issue in the Professional Papers on Indian Engineering 162—an engineering journal which he published periodically at the Thomason College Press 163—Medley politely contested the wisdom of Crommelin and the sanitary pundits. The new double-storied prototype would be eminently suited to more universal humid tropical conditions in the West Indies, in Bengal or in Bombay, he felt, but it was patently inadequate for the Indian Plains. Medley had been caused to devote considerable thought to the problem through his deliberations with the Barrack Ventilation Committee, and he used his journalistic vehicle to describe and promote a proposal of his own for a sensibly designed and serviced “modern” barrack.

161 J.G. Medley, “Indian Barracks”, Professional Papers on Indian Engineering 2, 7 (May, 1865). Medley mentions that these were plans accompanying a report of the “Barrack and Hospital Commission in England”; presumably the remarks of the “Army Sanitary Commission” on Crommelin’s proposals, which could indicate however that he examined that Commission’s alternative plans rather than Crommelin’s original designs.

162 ibid.

163 Medley had launched this journal in 1863 in answer to the perceived need to retrieve, circulate, and preserve in a current and accessible medium, the collective technical knowledge and field experience of engineers in Indian service. As Medley explained in a proposal for the journal, circulated within the FWD, both the inadequate access to technical literature from Home, and the inapplicability of much conventional European know-how to the “peculiarities of Indian engineering”, strongly recommended the publication of an Indian journal directly (although he declined to mention the Indian Engineer’s Journal which had been published independently in Calcutta since the 1850’s). See: FWD Circular No.2 of 1863: (FWD), Simla, April 13, 1863.
By contrast to his colleague Crommelin's emphasis on the parameters of spatial dimension and configuration as the key to a "healthy" and comfortable building, Medley clearly had greater sympathy and enthusiasm for the mechanical branch of the profession. (Notably, though a member of the Royal Engineers' Corps, he also chose to cite his Associate membership in the British Institute of Civil Engineers, in official correspondence.) In his view, the standing problems of the typical barracks that had been constructed for European soldiers in Upper India in the past (and which were to a significant degree to be perpetuated in the new standards) were: no proper system of ventilation to cope with the huge temperature swing from summer to winter; no privacy for the men; and "exceeding ugliness" and expense. Perceptively, he attributed the irrational propagation of this operationally ill-suited building type in the hot dusty plains of the north, to its acculturation as "fashion" in the earlier phase of colonial presence in India when these norms were devised—more sensibly—for the environmental conditions of the humid coasts further south and east.

Medley offered his proposal for a new, improved barrack prototype for the plains as a basis for further discussion and possible reforms with regard to the barracks issue. His was a far greater departure from precedent than anything Crommelin had proposed; a scheme we might describe as a "machine for surviving" the harsh climate of Hindustan. The design synthesized a variety of innovations in building technique and environmental control that Medley had learned of primarily through articles he had published in earlier issues of the Professional Papers on Indian Engineering, along with other technical publications he had edited for the Thomason College Press.  

164 A catalogue of the holdings of the Thomason College Library, published some years later, lists several titles on sanitary engineering published in the first half of the 19th century which may also have been available to Medley. These include: W.S. Inman, Ventilation, Warming and Transmission of Sound; Abstract of Parliamentary Report (London, 1836); N. Arnott, On Warming and Ventilating (London, 1839); C. Tomlinson, Warming and Ventilation of Buildings, Mines, and Ships, etc... (London, 1850); C.J. Richardson, On Warming and Ventilation of Buildings, 3rd ed. (London, 1856); A. Morin, Etudes sur la Ventilation, vols. I and II (Paris, 1863). See: Catalogue of the Central Library of Thomason Civil Engineering College (Roorkee, 1913), s.v. "sanitary engineering".
Medley illustrated his proposal with an engraving of a partial plan, with sections and details. (fig. 7.7). This made explicit the technical innovations of the scheme. One principle was insulation, a key factor in climatic control which had rarely been exploited effectively in conventional Anglo-Indian building practices. Medley proposed a self-insulating system—described earlier by a fellow PWD engineer-officer, Lieut.-Colonel Fife—of vaulted construction employing hollow ceramic voussoirs in lieu of the standard timber trussed gable roof, or the still relatively costly and, moreover, heat-conducting iron trusses and roofing material which had recently been introduced to India.

Fife, a PWD engineer of some experience, had submitted his lengthy technical article in response to a description of "Syrian" roofing technique which had been published in the Roorkee Papers (the ad hoc syllabus for the courses taught at the Thomason Engineering College). Fife reported that he had been experimenting successfully for several years with a technique derived from that traditional Syrian method for light-weight vaulting. The technique had proved to be valuable and above all easily adapted to the building norms of the PWD, as it made no significant impact on the conventional spatial organization of the common building types the Department was in the habit of constructing while enabling their erection in regions of the country where the lack of quality building timber made conventional construction either not affordable or (a more common and serious impediment) dangerously unreliable due to undermining by white ants and other environmental factors promoting rapid structural deterioration. The Syrian spanning technique consisted essentially of thin clay cylinders turned on a basic potter's wheel at nominal cost, combined with a lot of mud or lime mortar to make a composite vault of relatively little weight per strength. Fife had tried to rationalize the form and manufacture of the prefabricated tile element so as to improve its basic strength and eliminate, if possible, the expense of centering usually required in the construction of heavy unstable vaults. This he had managed to do, he claimed, after much trial and error and patient perseverance, by devising a hexagonal

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module for the tiles, which were formed of clay in specially designed moulds, then fired. Following a prescribed sequence of erection, small teams of masons could erect small span structures of 12' to 20' by this method in about half the time usually required for conventionally constructed masonry vaults of the same scale.

Medley proposed to carry over the principle of Fife's hollow vaults to the vertical structure of his barrack prototype as well. The thick bearing walls were to function as a thermal mass. To increase their insulation value, while keeping construction within the bounds of economy, they were to have an internally porous structure built of basic brick—a technique he had seen illustrated a few years earlier in *The Civil Engineer's Journal* (1862). Medley was optimistic that economies realized through such savings in building material—in the hollow walls and roof vaults, and the elimination of costly roof structure and tiles—would reduce the cost of his prototype to less than 70% of that for equivalent standard barracks.

By contrast to the conventional Anglo-Indian building construction principle of maximizing the free-flow of air, through multiple apertures—which the new official guidelines had confirmed on sanitary grounds—Medley envisaged a hermetically sealed building envelope.

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166 It is not clear how widely this rather delicate and sophisticated cottage technique in standardized prefabricated building materials/systems was employed. When Fife's paper was published, the technique was evidently not employed or even known of outside the Upper Sind, where he had developed it beginning in 1851. It may have been adopted more generally subsequent to his description of the technique, but I don't believe I have seen any extant examples in India in my recent survey. In the 1860's and 1870's a variety of patented hollow brick insulating systems were marketed in England, including Parr and Strong's hexagonal cellular bricks in which the hollow center was intended to be filled with concrete once placed. See John Summerson's discussion of such innovations in the Victorian building world in J. Summerson, *The Unromantic Castle*, (London: Thames and Hudson, 1990), 157-???.

Within another ten years concrete vaults would be widely constructed in India, superseding whatever gains Fife's technique had made. However very recently, it is interesting to note, a further variant of the original Syrian technique has been revived with excellent effect by innovative Indian architects such as Balkrishna Doshi who have tried to overcome the relative expense and poor insulation value of reinforced concrete. See discussion of Doshi's work in V. Bhatt and P. Scrivener, *After The Masters: Contemporary Indian Architecture*, (Ahmedabad and New York: Mapin, 1990).
External doors and windows were to be reduced in size and number to a functional minimum, with at least 8 to 10 feet between openings. Verandahs, surprisingly, were to be dispensed with altogether. It was Medley's firm conviction that these were actually quite unsuited functionally to the climate of the plains, in spite of the time-honoured preconception to the contrary. As he explained:

The principal use of verandahs is undoubtedly to shade the doors, but it is proposed to dispense with most of these; they do certainly defend the lower part of the walls from the sun, but it is only the lower part; and as for convenience, it is well known that in the hot weather they are far too hot to be used.\(^{167}\)

Medley conceded, however, that the advisability of eliminating verandahs altogether would have to be determined by practical trial if any buildings were to be modeled on his prototype. (Hence the seeming ambiguity of his specimen plan and elevation in which he appears to be indicating—partially and simultaneously—different versions of the scheme, with and without verandahs appended.)

For ventilation purposes the main floor plinth was to be raised on arches above a low ground-storey with a basic earth floor that Medley suggested could be partially excavated for the sake of cooling (although this was not indicated in his specimen plan and sections). His idea in this regard was borrowed from what he referred to as the "tackhanahs" or dungeons of traditional Indian forts, which he had observed to be wonderfully cool. These cellar-like spaces could be used, practically, for store-rooms as well as for washrooms and latrines he suggested (much as such would have seemingly compromised his principal concern for ventilation, not to mention the perceived connection between dampness, foul odours, and diseases such as malaria). In the centre of the basement a "thermantidote", a form of large fan, was to be placed, "...by which a continuous current of air (would) be forced up through perforations in the floor, the foul air being allowed to escape through the domed roof, or by a perforated cornice at the springings, aided if necessary by ventilating shafts with furnaces or exhaust fans." As his drawings

\(^{167}\) J.G. Medley, "Indian Barracks", 108.
indicate, this mechanism was to be propelled by a team of bullocks. 168

That was not all. The air itself was to be tempered by technology (much as this seemed to render redundant the whole effort of raising the building over a "naturally" cooled basement): "Of course the fresh air will be cooled, when necessary, by passing it through tatties, or it may be warmed if required." Medley cited the latest recommendation of the Barrack Commission in England concerning required rate of air change: 20 cubic feet per man per minute. For a whole Company Barrack housing 100 men, 2,000 cubic feet per minute would thus be required. Apparently a single 6 foot thermantidote making 60 revolutions per minute could do the job. This had already been demonstrated successfully at the Agra Jail and, back in England, in Sir Charles Barry’s Reform Club where a similar apparatus driven by a 5-horse power steam engine supplied 1,000 cubic feet per minute.

Medley’s footnotes excitedly offered further details of recent innovations in mechanical climate control. British coal mines had apparently been employing an alternative to thermantidotes in the form of a piston and cylinder type mechanism to ventilate the pits; and furnaces were blown similarly. Back in India, Medley speculated, a small steam engine of 3 to 5 horse power ought to be able to pump air and pull the old "punkahs" as well. Even if bullock power were harnessed to such a task, he figured it would surely be more efficient than the conventional

168 Medley obviously borrowed some of his ideas on air-handling from another article in the same issue of the Professional Papers... by Major F. De Bude, R.E., concerning technical aspects of climate control in large buildings in India. The Builder 2, 7 (May, 1865). De Bude discussed in considerable detail the latest rage of ventilation by "thermantidote". These devices had already been well proven in the temperate climate conditions of Europe, by the 1860’s, but De Bude was doubtful of their utility as such in the hot climate of India where the air exhaled by human beings inside a room was still comparatively cool relative to exterior temperatures. One had to find a way of circulating cool air up and out of buildings, for which the thermantidote used as a pusher of air was evidently no good. As an alternative, he proposed the idea of sucking the used air out either with a thermantidote (powered by bullocks) or, ideally where fuel was sufficiently available, by a furnace of all things that would generate an artificial chimney effect. Such, he suggested, could certainly do double duty as a cook stove as well. Medley, however, exercised his own editorial prerogative to note that he would not encourage the furnace method, especially since the system depended on the closure of all windows and doors in a building.
peon and toe technique.

Medley had novel ideas about the spatial planning of this new barrack prototype as well. It would have a centralized plan with dormitories radiating from a "general living apartment" serving as dining room, reading room and all-purpose common room. This would be crowned by a high lantern-like cupola for a light source and ventilation exhaust. In the long 'sleeping wards' he would have 8 foot high wood and canvas partitions erected, "giving each man a small room he could feel was his own." With respect to this detail, Medley made a special note to colleagues of the old (pre-Mutiny) Indian Engineers Corps, who would remember their own partitioned dormitory at Addiscombe, affectionately known to initiates as the "kennels". These would be suitably light and temporary in construction such that they could be removed if necessary in the heat of the summer.

Medley's terminology, and several obvious aspects of the planning and detailing of his novel barrack design, belied the influence of progressive contemporary hospital and penitentiary planning back in Europe. But he was certainly not behind the times, particularly in his notably humane consideration for the personal privacy of the soldiers he designed for. Such considerations were still evidently regarded as novel back Home, as we may deduce from the ideas and arguments posited in a most interesting paper entitled "On the Construction of Barracks in reference to the Physical and Moral Improvement of the Soldier", \(^{169}\) which was presented to the Social Sciences Association of England five years later.

According to the speaker, Dr. Stallard, (no doubt with some rhetorical consideration for his listeners' point of view) sanitation was not the primary issue in the continuing saga of barrack reform. It was, rather, the manner in which architectural planning could influence the behaviour of the inmates. Stallard argued that the moral standard of the ordinary soldier was prone to descend to that of the most depraved of his colleagues when holed up together in the typical barn-like barrack rooms of twenty or more beds to which they were accustomed. While commanding

\(^{169}\) As reported in "Barrack Arrangements", \textit{THE BUILDER}, 28, 1408 (Jan. 29, 1870): 90-91.
officers were thought to prefer this scale of co-habitation, the speaker was confident that a good soldier—of the somewhat more elevated stature and moral calibre that the British Army ought to be actively recruiting—would prefer more privacy in his off-duty hours. Stallard suggested that the most desirable design reform in this regard would be to provide not merely smaller communal rooms, but individual "cells" for each man, in the manner of certain of the most modern prisons.

The editor of the Builder, in which Stallard’s paper was reviewed, could not resist remarking on the irony of his proposal, in that "...the treatment of our soldiers, like that of our poor, would be more humane and proper if it were brought up to the standard of our treatment of scoundrel convicts." 170

But Stallard wisely backed up his proposal with a predictable utilitarian line of reasoning, arguing that such a transformation in the typology of barracks would also bring a major savings in construction costs. Existing large barracks buildings (in England) had been costing approximately 60 pounds per man accommodated, while prisons constructed in the same period on the cell and corridor plan had cost only 18 pounds per man. Even further savings could possibly be realized, Stallard reasoned, as a cellular approach to the accommodation of soldiers, rather than convicts, did not necessarily require fully isolated rooms for each man. Echoing Major Medley's recycling of the precedent of the Addiscombe "kennels", Stallard proposed a head-height partition system for future barracks for the metropolitan troops, as "had been introduced with good effect in the sleeping apartments of public schools".

At home and abroad, the engineers of the Victorian military establishment had much to learn from contemporary developments in modern civil architecture and engineering. In England, the work of the two arms of the profession could at least be compared and contrasted, and useful lessons learned. In India, however, where all military and almost all civil architecture were the product of one and the same agency, the exchange of such knowledge was not so obviously compelled, but rather pursued voluntarily as an essentially dialogical learning process within the Public Works Department itself. In a working context dominated

170 ibid.
conceptually by the military tradition and long-evolved methodological conventions, Major Medley and like-minded enthusiasts of modern technique within the Department were interlocutors in a dialogue between innovation and convention; alternately, in one and the same "mind", rationalists from the point of view of theoretical science and realists from the point of view of practice. Such military men were far more critically wary of the excesses of by-the-book rationality than their civilian counterparts gave them credit for. In some respects the heuristic synthesis of innovation and convention they achieved in their designs was even felicitous; whereas the orthodoxies of pure theory and pure practice, which were juxtaposed polemically in the acrimonious professional debates of the day between military and civil professionals could both be productive of unreasonable absurdities—as ossified modes of reasoning supporting merely rote professional production.

To close the present discussion of the conceptual paradigm and attendant processes of rationalization in post-Mutiny India, I wish now to consider more directly, if only selectively, the civil architectural output of the PWD in that period. I will first touch briefly on the diffusion of military hospital and barrack design conventions to the design of civil hospitals. I will then discuss the conceptual and architectural rationalization of civil jail planning in the 1860's, to which the colonial administration applied its intellectual, technical and financial resources with a conviction almost equal to its parallel efforts on behalf of the health and welfare of the Army.

5. CONVENTION AND INNOVATION IN CIVIL ARCHITECTURE

The will to rationalize and subordinate development to the needs of the colonial technocracy was most keenly (and naturally) expressed in the buildings and works produced by the Public Works Department for the Indian Army. Military life was regulated down to the most mundane details, and the physical environment that supported it was similarly prescribed to the nth degree of specificity.

The exceptional thought and energy the PWD was compelled to devote
to the rationalization, renovation and expansion of that military built environment in the period following the Mutiny, perhaps inevitably had wider consequences for the Department's parallel building efforts in the civilian sector. This was carried over implicitly through the experience ingrained tendency of the departmental engineers to interpret (and generate) design programmes in terms of hierarchies and categories of space and users, and their related predilection for a standardized, bureaucratically regulated design methodology. More specifically, design knowledge developed through efforts to rationalize optimal solutions for the accommodation needs of the Army, quite naturally percolated through to solutions furnished for similar civil buildings.

Civilian Hospitals:

Standard designs for civil hospitals by the PWD were among the most obvious instances of the direct diffusion of military design norms to the civilian sector. In the typical case of civil stations up-country in the moffusil, a simple single-storey barrack building, indistinguishable from any other such military building, would generally suffice for the care of the European sick. (see: fig. 8.6, station hospital at Satara)

Native hospitals, if any, tended to be privately endowed and operated by the specific communities concerned. In later years various European and American missionary societies were permitted to resume religious and social work among the indigenous population, building modest schools and clinics in villages as well as some of the most prestigious colleges and hospitals in larger towns and cities. Despite their independent agency, however, these mission buildings also tended to be modeled closely on the utilitarian prototypes the PWD had developed for the military.

These utilitarian strictures on the design of civil architecture were only rarely broken before the end of the century; and usually only in the most cosmopolitan urban contexts. It was only in such cities that there were sufficient concentrations of European civilians to merit the construction of large, sophisticated public buildings such as hospitals, on their behalf, for which "Architectural" issues, in addition to the technical aspects of building construction, could be accorded some valid
consideration. In the 1860's, major commissions of this sort began to attract the professional services of prominent metropolitan architects of the day, whose designs directly implanted in the burgeoning Indian metropolises the most up to date European planning ideas and technical considerations with respect to large buildings; and of course "style". Even in that metropolitan context, however, architects had stiff competition from the entrenched engineering fraternity of colonial India. Indeed, a select handful of FWD engineers proved themselves to be able architects, when given license to design not only on a grand scale but in a grand manner, in civil commissions of this sort. All the same, they could not completely transcend the cognitive constraints imposed by their departmental design knowledge and experience.

The most interesting of such "high" designs by these engineer-architects can be seen as palimpsests of canonical Anglo-Indian building types. A case in point was the monumental design for a European General Hospital for Bombay produced in 1863 by Captain St. Clair Wilkins (fig. 7.8); a basic barracks block overlaid with the splendid raiments of contemporary architectural fashion. In essential respects the design anticipated Col. Crommelin’s multi-storey barracks prototype (see above, fig. 7.3), which was first drawn up at roughly the same time but only approved finally and circulated generally in the later 1860's. The fact that the two men arrived at such essentially similar solutions, without any obvious opportunity to have shared their design ideas directly is, I believe, an interesting though not especially surprising indication of the high degree of consensus that evidently existed among FWD engineers with respect to the formulation of design problems and their relative respect for precedent design solutions.

The most obvious parallels between Wilkin’s design and virtually all military barracks and hospital plans adopted in the 1860's were the configuration and specific dimensioning of dormitory wards, straddled by deep verandah corridors on both elevations. More particularly, Wilkin’s integration of vertical circulation and private quarters for resident hospital staff in a transept-like cross-block was essentially similar to Crommelin’s solution for sergeants’ quarters in barracks. The problem of locating latrines and bathing facilities was also resolved similarly by the two independent designers. Both placed such
"necessaries" at the extreme ends of their buildings. However, as Wilkin's building was a hospital rather than a barrack for healthy men, he had to provide more ample facilities than the mere "night privies" of Crommelin's designs. These he clustered in semi-autonomous blocks separated nominally from the main building by secondary stairwells. These were to be incorporated seamlessly into the over-all architectural composition, according to Wilkins design, by full height screens of tracery spanning the gaps.

Notably, Captain Wilkin's unbuilt scheme was the product of an architectural design competition; one of seven premiated designs from a field of 17 submitted by architects and engineers both in India and in England. The commission was finally awarded to an English architect, T. Roger Smith, who went out in 1864 to supervise the construction of his design. As one of the very few professionally accredited architects to have practiced in India in that period—even so briefly—Smith was for many years to be regarded as the reigning expert on "modern" Indian architecture in professional circles back Home. 171

Wilkins was a Royal Engineer serving with the Bombay PWD and the architect of several other major public buildings built by the Bombay administration in subsequent years. 172 The building had been designed with a discerning fashion consciousness, in the Gothic style which was then overtaking classicism as the preferred architectural style in Bombay particularly. Wilkins had specifically adopted the Gothic architecture of Southern Europe as his model, convinced that this was "...the style of all others best suited to the requirements of a tropical country...the architectural requirements of India being more nearly allied to those of


172 Among the recent secondary literature concerning British colonial architecture in India, Philip Davies provides the most complete account of the architectural work of Wilkins and his colleague, Captain J.A. Fuller—a similarly accomplished engineer-architect attached to the Bombay PWD, whom we will encounter presently. See P. Davies, Splendours of The Rais: British Architecture in India, 1660 to 1947. (London: John Murray, 1985). Davies provides brief but useful biographical sketches of these and other architecturally notable figures of the British Indian scene, in an appendix.
Fig. 7.8. Competition scheme for Bombay General Hospital, by Captain St. Clair Wilkins, R.E., 1861. Source: Professional Papers in Indian Engineering, Vol. II/5 (Nov. 1864).
Fig. 7.9. Cowasjee Jehanghier's Eye Hospital, Bombay. Design by Capt. J.A. Fuller, R.E. of the Bombay PWD. 1863. Source: BA-map No. 3275.
Italy than of England..." However, as the scheme was described in the Professional Papers on Indian Engineering, he was not averse to "...various modifications of this style now universally adopted to meet modern necessities." This entailed some "judicious eclecticism" which Wilkins was commended for being bold enough to admit.

These modifications included practical concessions to the climatic demands of coastal Bombay, such as the specification of a steep roof pitch to shed off heavy Monsoon rains in lieu of the shallow roofs of authentic Italian Gothic buildings, and formally motivated inventions such as a huge gothic lantern over the central stairwell. This chimney-like shaft had superficial affinities with metropolitan precedent solutions for the ventilation of large symmetrical building compositions—which Major Medley later emulated in his ideal barrack prototype, with its central exhaust tower. However, Wilkin's tower could hardly have performed such a function effectively with the porous, compartmentalized plan he proposed. In his own explanations for the design, he downplayed technical considerations, justifying this grandiose feature as a necessary vertical counterbalance to the excessive horizontal expanse of what he conceded would otherwise have been a rather monotonous architectural composition.

Possibly the most significant carry-over from Wilkins' departmental planning mentality apparent in this effort of his as a civil architect, was his predilection for a strict classification and segregation of architectural space according to defined sub-groups of users. Col. Crommelin, as we will recall, was to insist on separate buildings for each regiment or detachment of such at a given station, in his guidelines for the planning of military hospitals. For his part, Wilkins translated the programme for this "general" hospital into an assemblage of distinct compartments. Each ward was designated exclusively for patients belonging to a specific class or occupational group of the European community of Bombay—who apparently could not be expected to share in their respective miseries together. Ward assignments discriminated clearly between naval

173 "European General Hospital, Bombay", Professional Papers on Indian Engineering 1, 5 (Nov. 1864).
174 ibid.
seamen and merchant seamen; basic soldiers and warrant officers (as a "general" hospital, both military and civilian patients were to be admitted); different operational categories of low-ranking civil servants such as "clerks of public office" versus clerks of the Telegraph and Mint Departments; and "females" versus "women of doubtful character". This latter ward was located conspicuously on the ground storey immediately adjacent to the quarters of the "Matron", well out of reach of all other wards, particularly those of the soldier's and sailor's, on the upper storeys. Finally, "paupers" were also provided with a discrete ward of their own.

By thus explicitly representing the complex social hierarchy of the European colonial community in large port cities such as Bombay, important public facilities such as this "general" hospital evidently served to reinforce that structure and its inherent power relations. It was clearly supposed that higher status civilians and army officers would receive medical care elsewhere.

In the rather special case of Bombay—where the local economy experienced an exceptional boom in the 1860s and 1870s primarily as a result of fortuitous external factors in the balance of foreign trade—rich native patrons hastened to respond to the need of the local Indian community for modern hospitals, among other public facilities, even in advance of the European administration's efforts on behalf of its own. One instance was the project to build a native eye hospital initiated with a pledge of funds by Cowasjee Jehanghier, a doyen of the Parsee community of Bombay, in the same year (1863) the Government staged the competition for the European general hospital. Beyond traditional communal paternalism, a clear motive of such philanthropists was the desire to earn the respect and confidence of the European community as "progressive" partners in the civic and commercial development of Bombay. Jehanghier evidently sought to build his hospital on the most modern and fashionable lines, and entrusted the commission accordingly to Captain J.A. Fuller, a close colleague of Captain St. Clair Wilkins in the Bombay PWD.175

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175 For an overview of Fuller's architectural accomplishments, see Davies, Splendours of the Raj.
Fuller's design (fig. 7.9)—which was duly constructed and stands today within the extensive complex of later buildings comprising the Sir J.J. General Hospital—is noteworthy as a further illustration of the carry-over to such one-off instances of civil architecture, of formal and conceptual presuppositions concerning design, which the Public Works Department had by then begun to institutionalize explicitly in its new design standards. Again, albeit on a much more modest scale than Wilkins' hospital design, we have the essential spatial schema of a familiar barrack prototype, represented with a panoply of stylish Gothic garb. This parallel will be apparent if the reader refers, for example, to the single storey half-company barrack plan illustrated earlier (Fig. 7.5). The essential "frame" or schema consists of an echelon of principal spaces (dormitory wards in these instances) straddled and accessed laterally by verandahs and bounded at each end by smaller rooms and service spaces reinforcing the corners of the plan. In Fuller's design, this schema is distorted moderately within the limits proscribed by its implicit classical taxis, by enlarging and thus projecting the corner spaces beyond the confines of the rectangular base plan. In the conventional barrack instantiation of this sub-type, all would be contained tidily under a simple hip-roof. However, Fuller reinterpreted his oversized projections as full-fledged cross-blocks; an occasion to elaborate the roofscape considerably, for both architectural and functional ends. The several lofty gable ends created by this complex conjunction of roofs were perforated, evidently to assist in evacuating "vitiating" air from the spaces below. Fuller further exploited his Gothic garniture to create small dormer vents in the principal roof, and a lattice-like frieze below the eves, through which the larger central wards of the building were additionally ventilated. In these respects the building evidently met the technical specifications recommended by contemporary sanitarians. However form, operation and performance were not particularly well married on other counts.

An excellent watercolour rendering of the front elevation of the hospital, which has been preserved in the Maharashtra State Archives, indicates considerable architectural competence, on Fuller's part—as a draftsman at least, if not in originality. Striking, in fact, is the overriding formalism of his design, for an engineer supposedly concerned
first and foremost with the technical rationality and utility of the building. If we look again at the plan, the impact of the architectural elaboration of the scheme—as a bi-axially symmetrical composition of intersecting gables—is readily apparent in what seems an excessively stiff, tartan-like grid. Closer inspection of the functions assigned by the designer to the various spaces thus configured reveals some curious mismatches. Patient wards are assigned seemingly arbitrarily to half of the eight largest contained spaces, while one of the two loftiest and formally significant spaces in the building is subdivided by a feeble partition into two minor service rooms: a dispensary and a storeroom. Equally incongruous and wasteful of architectural effect is the designation of the chapel-like rear extensions of the two cross-blocks as latrines. For sanitary reasons, these too are partitioned off awkwardly from the rest of the building.

Fuller was evidently too enamoured of his formally rationalized transformation of the common barrack to break symmetry or modulate the proportions of the spaces prescribed, to fulfill the programmatic requirements of the hospital he was designing in a substantively rational manner. This observation underscores the point I would like to draw out of the preceding two examples of civil hospital design. For the Public Works engineers, precedent design knowledge was an obvious and seemingly workable point of departure for any new design. But, already in these early examples of a broader application of that principle, we see that this ("case-based") mode of reasoning could become a relatively autonomous basis for design decision making, productive of—at best—sub-optimal designs from the point of view of "problem-solving". Efficiency in the process of design decision making, which this mode of reasoning enabled, assumed an equal and possibly even greater significance for the PWD engineers than the substantive efficiency and rationality of the buildings they designed. But either way, efficiency was not the only criterion. As such designs were constructed, the colonial built environment came gradually to embody and reinforce the authority of precedent as such.

As we move on finally to examine the colonial authorities' efforts to rationalize the design of Indian prisons with respect to the norms of the contemporary penal and sanitary reform movements in England, it will
be observed that design conventions evolved in the context of colonial India came in time to be perceived as uniquely rational with respect to that context and hence superior, in the end, to any scientific rationalization from first principles which distant metropolitan experts sought to impose.

Classification, Containment and Control: The rationalization of design standards for Indian jails

Along with the sharp increase in the number of British soldiers stationed in India, a direct product of the Mutiny was the throng of mutineers, rebels and other criminals who had to face justice before the Indian courts. The ensuing crisis in prison accommodation presented yet another challenge for the colonial administration; to both increase the capacity of its jail system and upgrade it to the norms of modern penal practice established by metropolitan reformers in the first half of the 19th century.

Here again, the first step of the exercise was to set up a committee of experts to report on the state of penal facilities in the country, and recommend appropriate measures for meeting and overcoming this crisis. The "Indian Jail Committee" was appointed accordingly in 1864, under the orders of the Viceroy.

The work of this committee was much accelerated by comparison to the contemporary sanitary inquiries of the Army, as a programme for the rationalization of the Indian penal system had already been worked out substantially, well before the shocks and changes of the 1850's had given the issue a new urgency sufficient to instigate action. Plans for the reformation of Indian Jails dated back in fact to the far more optimistic campaign of social development and reform on which the colonial administration had embarked briefly in the 1830's, under the aegis of the East India Company. In 1838 an earlier Jail Committee had tabled a substantial report with recommendations for improvements to existing facilities and design guidelines for the new facilities which even then it was thought necessary to build. However, progress in that regard had suffered with other reform efforts of the Company regime during its final two decades of rule.
With few changes or additions, the original recommendations of 1838 were revived by the committee of 1864 and circulated for the guidance of all local governments and administrations. This time there was an expressed promise on the part of the Supreme Government to back up the information with funds to carry out carefully matured proposals for increasing jail accommodations, according to those guidelines, wherever such was manifestly insufficient. In practice, however, there was little determination to stick to the letter of the meticulously rationalized prescriptions for jail planning that the successive committees had laid down. When it came to the crunch—as we have already observed with the barrack and hospital improvement campaign of the Army—the heuristics of fiscal parsimony were always liable to take the upper hand in design and implementation. This served to discourage the official adoption of standard plans for civil jails, which would have made the recommendations of the Committee more concrete and binding. 176

Penal Reform in India during the Company era, 1838-1864:

Jail reform had been an obvious plank in the campaign of the Liberal reformers who descended upon India in the 1830's, with their Benthamite zeal for institutional rationalization as a tool for the improvement and optimization of social welfare. Shortly after his arrival in Calcutta in 1835, as a member of the Indian Law Commission, Thomas Macaulay addressed the matter with a minute on the state of jails (dated 14th Dec., 1835), in which he laid out an agenda for change. 177

The principal deficiency of the existing system of imprisonment, in Macaulay's view, was its failure to be a coercive instrument of discipline and reform. Standards were so variable and flexible—and susceptible to corruption and manipulation—that jails were perceived to be breeding grounds for the further degradation of all those who entered.

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177 A.P. Howell, Note on Jails and Jail Discipline in India. The present historical account of jail reform in India relies on Howell's contemporary report, unless otherwise indicated.
This included those who supervised the prisoners, who could exercise very little effective discipline over their interns with facilities and practices as they were. It was therefore "of the greatest importance...", Macaulay advised, "to establish such regulations as shall make imprisonment a terror to wrong-doers, and shall at the same time prevent it from being attended to any circumstances shocking to humanity. Unless this be done, the Code,\textsuperscript{178} whatever credit it may do its authors in the opinion of European jurists, will be utterly useless to the people for whose benefit it is intended."\textsuperscript{179}

Macaulay's perception of the problem was founded in part on his own direct observation of the prison at Alloppore, in suburban Calcutta. His minute concluded with a call for the appointment of a committee of inquiry that might report in detail on the state of that and other notorious prisons, and suggest reforms by which the Alloppore prison in particular could be transformed into a model institution which might be emulated throughout India. Such a committee was appointed subsequently, Macaulay himself presiding; and two years later, in early 1838, an exhaustive report was tabled. According to Howell's account of 1868, this was to be regarded in following decades as "...the standard authority whenever principles of prison management and prison discipline [were] in question."

Notably, the Report of the Jail Committee of 1838 was not so much concerned with the physical as with the disciplinary environment of Indian prisons. The report presented a balanced, factual description of the physical state of Indian jail accommodation in the 1830's which was not altogether deprecatory. A humane minimum standard of physical comfort, sanitation and decency—the "first stage of jail reform", which John Howard and, later, James Neil had campaigned for in England beginning in the 1780's—had generally been achieved in the jails of India by the 1830's. In the estimation of Macaulay and his fellow committee members, the Indian prison system was even reasonably advanced

\textsuperscript{178} That is, the new codified system of Law that Macaulay and his cohorts on the Law Commission had determined to devise for India, to replace its traditional justice system and all of its perceived irrationalities.

\textsuperscript{179} As quoted in Howell, \textit{Note on Jails...}, 1.
with respect to the classification and spatial segregation of the various
descriptions of prisoners:

The mixture of debtors with criminals which in some places
still exists in England and which appears universal, or nearly
universal in North America, is unknown in any jail in India.
The proportion of distinct civil jails to all other jails in
India is very honourable to the Government. The mixture of the
two sexes in Indian prisons unknown, and in general the
separation of tried and untried prisoners is at least as
complete in India as in other countries.

It was at the "second stage" of jail reform, according to Howard's
programme, that the jails of India were found most wanting by Macaulay's
committee:

The physical condition of the prisoner had been looked to but
nothing more, and the consequences here as in England have been
that a prison without being the less demoralizing is not a very
unpleasant place of residence. This is a state which as one of
transition may be borne for a while, but which would if it be
continued for three or four generations infallibly do great
injury to society. The political necessity for turning
attention to a moral reform in prison discipline is only made
the stronger by there being little necessity for much physical
reform.

The second stage efforts of metropolitan penal reformers in that era
to "fabricate virtue" through the device of the modern prison, was a
fascinating and significant episode in the social and architectural
history of the 19th century. Fortunately, it has been well studied such
that we may proceed without digressing, to consider the ramifications of
those metropolitan efforts in the particular case of penal reform in
India. In that colonial context the ideals of the reformers were received

180 Report of the Jail Committee (1838), para. 153. Quoted in Howell,
Note on Jails..., 3.
182 See for instance: Robin Evans, The Fabrication of Virtue: English
prison architecture, 1750-1840, (Cambridge: Cambridge University Press,
1982); M. Ignatieff, A Just Measure of Pain: The Penitentiary in the
Industrial Revolution, 1750-1850, (New York: Pantheon, 1978); Martin J.
Wiener, Reconstructing the Criminal: Culture, Law, and Policy in England,
1830-1914, (Cambridge: Cambridge University Press, 1990); T. Markus,
but imperfectly diffused. Much as Macaulay and colleagues envisaged the rationalization of Indian penal practices on the most progressive lines—the substitution, that is, of a calculated and elaborately regulated system of carceral discipline directed at the mind, in lieu of traditional modes of punishment directed at the body—183—their ambitions were to be largely curtailed.

Along with most other ambitions of the Liberal/Reform faction of the colonial administration, in the final years of the Company era, reaction to the projected financial and social costs of any substantial changes to prevailing norms was sufficient to deter reform. However, the case for deferring indefinitely from implementing the recommendations of Macaulay's Jail Committee was backed up additionally by the perceived inapplicability of much of the proposed reforming strategy, devised in the context of European and American penal practices, to the peculiar physical and cultural conditions to which the penal system of India had to be tailored. As one skeptic, Lord Aukland, remarked in his resolution upon the first Jail Committee's Report,184 in India,

...for food, for labour, and for consort, there are habits and an inveteracy of prejudice and of feeling bearing upon health, and almost upon life, opposing difficulties to the just management of prisons such as are not elsewhere to be encountered.

Even if there was a will, on the part of some colonial officials, to make imprisonment an "improving", transformative experience for the inmate, it was questionable whether a "just measure of pain" could be calculated and applied effectively, by the modern European methods prescribed, for such a culturally hence morally different group of criminals.

This culturally based argument against a radical modernization of penal practices in India served more basic economic interests as well. Such that it was, the ad hoc penal system the British had established in India was relatively cheap to maintain.

Under the traditional Indian system of Law there had been, in fact, no prison system per se. The authorities had exercised harsh summary

183 Ignatieff, A Just Measure of Pain, xiii.
184 Quoted in Howell, Note on Jails..., 3.
justice through corporal punishment, the severity of which was determined by the severity of the crime (and by the social station and/or ability of the accused to appease his judges with bribes). From a logistical standpoint (quite apart from the question of justice) this system had been decidedly efficient and, hence, of negligible expense to the state. Few felons were incarcerated for any extended length of time while the unfortunate exceptions to that rule, usually political prisoners, were generally kept in effective if sometimes pitiless make-shift prisons such as the bottoms of dry wells. 185

Although the British had substantially assimilated their colonial civil administration to the systems of law and government they acquired with the conquest of India, the bloody public form of justice meted out by their predecessors could not be condoned (past a point) within British notions of decency, and had been super ceded by a more passive, proscriptive system of punishment. The ubiquitous civil institution of the jail (or gaol) had thus been introduced to India during the Company era; with little reference, however, to metropolitan jail planning norms. As a necessary evil—as far as the penny-pinching Company administration was concerned—these early facilities were built on the sparsest of budgets. Usually these consisted of little other than secured compounds in which the prisoners constructed their own hutsments or the most minimal of barrack-like sheds, on much the same principle as the native soldiers of the Army. While the different classes and sexes of prisoners were duly segregated, as Macaulay observed, they otherwise slept, worked, cooked and ate collectively. This simple "common" system enabled further economies, with respect to the provisioning and management of the prisoners, and effectively avoided planning conflicts with the complicated cultural and religious issues attending the preparation and eating of food and maintenance of personal hygiene.

Such solid practical points in favour of the status quo posed a convincing resistance to the uncertain wisdom of the jail reformers; a conviction that actually increased with time, even as other factors gradually brought about important changes.

Once Macaulay had departed from the colonial scene, the Government

185 Howell, *Note on Jails...*, 5-6.
of India scrupulously evaded commitment to a general programme of action on the jail reform front. However a local government initiative in the North Western Province, by Macaulay’s reform-minded acolyte, Governor James Thomason, served at least to keep the ideal of penal reform alive. In 1844, Thomason appointed for the first time an "Inspector General of Jails" for that province, who was subsequently responsible for making the first effective reform efforts in India in the directions urged by the Jail Committee Report of 1838. The Government of India and the Court of Directors only grudgingly sanctioned this augmentation of the provincial bureaucracy, with the understanding that this new inspector was to effect an "...improvement in the health and discipline of the prisoners, a reduction in the periods of imprisonment, and at the same time a material diminution of expense." But once these essentially economic benefits of such intervention had been conclusively demonstrated in the N.W.P., the Court of Directors relaxed its skepticism. The Inspector-General of Jails was presently ratified as a permanent post of the N.W.P. administration, and similar posts were soon created in the governments of the three presidencies (Bombay, Bengal and Madras) and the Punjab.

By this time Lord Dalhousie had assumed the Governor-Generalship. Among the more important of his progressive assaults on the administrative apparatus he had been bequeathed—in his own estimation186—Dalhousie pushed on with the reforms in penal management initiated by the larger provinces. Through the course of the 1850’s and 1860’s, all of the lesser local administrations (with the exception of Coorg) were compelled to follow suit and create formal posts in their civil establishments for jail inspectors.

In the post-Mutiny era, the N.W.P. Government was again the instigator of an institutional change which would have long term consequences for jail planning. This was the decision to transfer formal responsibility for the management of district jails from district magistrates to the civil surgeons of each district. Unburdened as the former had been by other preoccupying revenue and judicial duties, civil surgeons noticeably ameliorated the discipline and economy of that province’s jails along with the health of the inmates, which they were

186 Governor-General’s minute cited in Howell, Note on Jails..., 4.
now in a better position to monitor and act upon responsibly. Sanctioned permanently in 1864, after two years of trial, this altered jurisdiction was thereafter adopted in Bengal, Bombay and Madras also.

Meanwhile, the new Jail Committee convened in that year had dusted off the more ambitious agenda for jail reform laid down by its predecessor, a quarter century before.

**Independent local reforms in the 1840's and 1850's:**

When the Government of India finally took up the task of jail reform and reconstruction with commitment, in the mid 1860's, it had not only the administrative apparatus and expert knowledge of the provincial jail inspectors to rely on, but a good number of progressive precedent design efforts by the local governments from which to proceed. Again, the North Western Province had been the crucible of the greatest independent progress in this regard.

The first substantive "experiment" anywhere in India to implement the space standards for central jails recommended in the Jail Committee Report of 1838, had been carried out in 1846 by the first Inspector General of Jails for the N.W. Province, Mr. Woodcock, at the Agra Central Jail. Following upon that success, the existing jail facilities at Bareilly and Allahabad were similarly converted in 1848. Through the 1850's that province pushed ahead with its own agenda for the up-grading of its jail facilities, and by 1861 was poised to complete its system of central jails on the revised design standards. 187

Meanwhile, the Punjab administration had embarked on the construction of its own system of modern district and central jails. When that territory was annexed by British India in 1849, it had virtually no penal facilities of any standard. The pacification campaign of accelerated technological development with which Col. Robert Napier and his prototypical works department assisted in consolidating British political control, had addressed this dearth of modern penal infrastructure with almost as much urgency, and innovation, as the

187 Howell, *Note on Jails...*, 6-7. In this section also my account is based on Howell's report, unless otherwise indicated.
strategic necessities of new roads and bridges. By 1952 several major prison buildings were already in course of construction when the Punjab administration tabled a comprehensive scheme, for budget approval by the Government of India and Court of Directors, for a complete network of jails for the territory to accommodate a total of 10,000 prisoners. While the Court of Directors balked at the great expense projected to carry out the whole scheme from scratch, Dalhousie was supportive and ultimately attained the necessary budget sanctions. As a Utilitarian, and avid enthusiast of the hard core artifice of technological progress, Dalhousie might well have entertained a special interest in this case, in the construction of the Punjab’s first central jail complex, at Lahore. This was then close to completion, pending additional funding requested in the over-all budget proposal for prison works of that year. A description of the new Lahore jail while still under construction, in an early Punjab Administration Report, 188 clearly depicts the Benthamite architecture of this new ideal type. It consisted of:

two circles...each surrounded by iron palisades, with compartments (also walled), radiating from the centre to the circumference...within these compartments are the wards both for male and female prisoners, workshops and solitary cells. At the centre a lofty watch tower rises so as to command a view of all compartments.

Three other Punjab jails—at Multan, Rawalpindi, and Ambala—were planned on similar panoptic principles though considerably smaller in scale. Bentham’s principle of control and positive coercion through centralized surveillance—for the first time explicitly instituted in Indian penal practice in these facilities—was applied not only in the architectural conception of the prison environment, but to the operational conception and regulation of the prison as a correctional institution, as well. Whereas Indian convicts had previously been exploited practically, as day-labourers on government works projects outside the confines of their jails, the regime in force in the new model jails of the Punjab expressly forbade such out-work, incorporating into the conventional scheme of the prison whole new ranges of internally

188 Quoted in E. Stokes, The English Utilitarians and India, 245-246.
supervised workshops to keep the inmates gainfully (and above all, painfully) employed under the unceasing gaze of the prison authorities. 189

Most of the other local governments and administrations were not prepared to take such a narrow view as the Punjab, on the "utility" of convict labour. To put convicted criminals to work on public roads and buildings was commonly perceived as a just and beneficent means of imposing penance on malefactors for their crimes against society. Such labour was also believed to be free. Both of these beliefs were shown to be quite naive, however, upon scrutiny of actual experience in the field.

PWD engineers, for one, were far from unanimous in their opinions on this practice. 190 However, from the morally disinterested departmental point of view the question was at least limited to its economic parameters. Cost comparisons between ordinary contracted labour and convict labour—with its necessary overheads for additional guards, provisions, and temporary shelter—could tip the balance in favour of either strategy depending on local variations in rates. 191 In their opinion no general support for, or indictment against, the use of convict labour on public works could therefore be justified on financial grounds.

Penal reformers believed otherwise. The radical idealists who attempted to modernize penal policy in India through the Jail Committees of 1838 and 1864, deprecated the principle of convict labour on the

189 Ibid. Writing long before Foucault and others were to make their bleak interpretations of Bentham's "panoptic" legacy to penal architecture, Stokes was provoked to comment on this rather ironic fashion in which Bentham's Utilitarian ideas for social advancement were to triumph most visibly in India, "...his ghost presiding as the tutelary deity of the Punjab prison system".

190 For a contemporary intra-departmental discussion on the issue, see: PWD Circular No.4 of 1868: PWD (Civil Works -- buildings) Fort William, Jan. 21, 1868, re. "Employment of Prison Labour in the Construction of Jails".

191 From the point of view of the PWD accounts branch, the convict labour factor caused havoc in efforts to make responsible, accurate budget estimates for works in which such was employed. As indicated in an "Abstract of total probable expenditure on jails sanctioned since 1864", the real cost of jail construction by that method was difficult to pin down. In the period between 1864 and 1868, for instance, the estimated costs of the various jails constructed in different parts of the country—with the calculated values of convict labour factored in—where applicable—ranged from 190 to 577 rupees per prisoner. Howell, Note on Jails..., 9.
grounds that such activity was inadequately disciplinary. They were shrewd, however, to frame their conviction in more material terms. In the Jail Committee Report of 1838 it was argued, for instance, that extramural labour of this kind entailed a dead loss on the State, because it doubled the cost of maintenance. It was in fact cheaper to feed, clothe, and lodge convicts in jails than to employ them on works outside: "We cannot therefore but rejoice that it is in the power of Government to do so great a moral good with direct pecuniary advantage..." (that is, by abolishing the practice). Under the superintendence of the government engineer, the reformers countered—rather than the stern, reform-minded jailer they idealized—there was clearly a conflict of interest: "Where the object is the completion of a building rather than the discipline of the convicts...", the latter were at risk to be pampered, to improve their productivity. Meanwhile, such labour was taken away from intramural jail industries, which were a significant and manageable source of government revenue. 192

General consolidation and improvement of jail design norms under the Raj:

Under the Company administration, the initiatives of the dynamic frontier administrations of the Punjab and N.W. Province in the vein of progressive jail construction, were not followed by the other provinces and presidencies of British India where (in most cases) existing penal infrastructure and long established norms for its management engendered inertia. However, the Mutiny proved to be sufficiently compromising—logistically and conceptually—to compel significant new progress in penal reform on the part of all the local governments. Those most directly affected by the fighting and ensuing concerns for law and order, such as Dule and the Central Provinces, were first to follow the lead of the N.W.P. and the Punjab. To accelerate the process, projects for new district and central jails were fast-tracked immediately into construction on the basis of designs borrowed from those other

192 Report of the Jail Committee (1838), as quoted in Howell, Note on Jails..., 9-10.
governments. 193 Meanwhile, efforts were underway in the Public Works Department to design less precedent-specific "model jail" plans applicable to the various regions of the subcontinent, and to consolidate and improve jail planning guidelines generally. 194 In Madras construction was commenced on two new central prisons in the Mutiny year, with plans for three more. But the other presidencies were more characteristically recalcitrant in their sluggishness to conform to the collective norm. Following the Mutiny, Bengal procrastinated, consuming the judicial portion of its works budget on short-term measures to build and maintain temporary jail facilities, pending adoption of the new jail design guidelines under preparation by the PWD. 195 For its part, Bombay had made only nominal efforts to improve on defects in its penal system which Macaulay's Jail Committee had identified in 1838, and no new jail construction of any significance by the time the second Jail Committee tabled its report in 1864. 196

The Public Works Department responded to this jail report precisely as it had prepared itself earlier to act on the recommendations of the Royal Commission of the Sanitary State of the Army. The first step was a call for returns from all local governments and administrations regarding the amount of existing jail accommodation and the number of prisoners of all classes for whom such needed to be furnished in each district. While

193 In 1859, for instance, copies of the standard plans for central prisons and district jails already in force in the Punjab, were forwarded to the Government of Oudh on the request of its Judicial Commissioner to assist "...in the preparation of drawings for such buildings." PWD (Judicial) Proceedings, Oct. 21, 1859, No.1. [NAI]. Noteworthy also, was the enthusiasm to get on the band-wagon of progressive penal reform of nominally independent native states such as Hyderabad, which had remained a staunch ally of the British regime during the Mutiny. Among other modern building types for institutional and administrative purposes, which that government was keen to build in conformity with the latest norms of British India, a project for a new central prison at Dharaseo was underway in 1858, modeled on the central jail at Rawal Pindie in the Punjab. PWD (Judicial) Proceedings, April 23, 1858, Nos. 182-183; PWD (Judicial) Proceedings, July 7, 1858, Nos. 171-172.

194 PWD (Judicial) Proceedings, Nov. 26, 1858, No. 14; PWD (Judicial) Proceedings, Jan. 8, 1858, Nos. 402-403.
195 PWD (Judicial) Proceedings, Jan. 8, 1858, Nos. 402-403.
196 Howell, Note on Jails..., 6-7.
the data received lacked any qualitative information as to the nature of those jail facilities already constructed, it was ascertained statistically that some 22,000 prisoners or roughly 28% of the 74,000 prisoners of all classes incarcerated on average in India in that year, were theoretically without the minimum of 648 cubic feet of habitable space per inmate called for by the Jail Committee (i.e.: 9' x 6' x 12'). In addition to the obvious "improvements" and/or reconstruction of the existing buildings that adherence to the new norms would necessitate, close to 1 1/2 million square feet of entirely new jail buildings were required to be built across India.

Formal response to this data—with its implication of yet another massive, centrally coordinated works initiative—was predictably evasive. While the Government of India was prepared "...to consider on its own merits any proposal for jails that might be submitted" 197, it stopped short of laying down any programme for action or special funding provisions for "exceptional works" such that it had for the new military building programme. There was to be no rigid, standardized design prescriptions for the various classes of jail. Rather, all proposals from January 1865 forward—and including certain previously sanctioned projects not yet significantly advanced in construction at that point to make design changes inexpedient—were to be subjected post hoc to editing and modifications by the respective sanctioning authorities, in accordance with the principles (rather than the letter) of the design guidelines the Jail Committee had proposed.

This "reasonable", pliant attitude to the implementation of these improved norms was clearly promoted if not instigated by the engineers of the Public Works Department who, as with the parallel rationalization of military architecture, were the ones who ultimately had to carry out the work within strict constraints on budgets, and to a lesser extent time and resources. When, for example, in 1866 the previously delinquent Government of Bombay finally resolved to expand and modernize its penal system, and submitted for sanction a meticulously correct plan for a new Central Jail for the Deccan according to the approved new norms, the PWD was the first to reject it. To meet all the requirements of the Sanitary

197 As quoted in Howell, Note on Jails..., 7.
Commission of Bombay the scheme was projected to cost close to 300% of what the Department felt was a reasonable ceiling for this category of public expenditure. The rejection of the proposal was subsequently backed up by the Secretary of State for India, to whom the matter had been forwarded for clarification of what policy the Government of India might adopt in this regard. In his return despatch it was advised that:

The recommendations of the Sanitary Commission are not to be interpreted as utterly excluding all questions of expense, and the maximum rate of Rs.400 per man, which you have prescribed, ought apparently to suffice for all essential purposes. 198

Here again it was evident that rationalization entailed something other than mere slavish conformity to the carefully rationalized design norms of the experts. In another exchange almost three years later, the PWD Secretary was still compelled to correct the misconception on the part of local governments, that a hard and fast standard design for jails had been decreed. As he explained, "...a plan for a District Jail was simply circulated for information in 1865, being one of the best that had at that time been received." But this had evidently been mistaken as a universal solution, inevitably with some unsatisfactory results. 199 A further practical consideration that made strict uniformity of design untenable was the major regional variation in climatic conditions and building resources from one part of the Indian subcontinent to the next. Jail buildings were still to be built in many cases by the convicts themselves, and thus necessarily simply, according to the familiar and most sensible local norms of construction.

Nevertheless, in many of the new jails built in India in the 1860's there was significant conformity to an essential schema, regardless of architectural details. The most complete and elaborate class of such were the central jails in which prisoners convicted for terms of two years or more were contained. The ostensive prototype for these was the central


Fig. 7.10. Standard plan for a Mamultdar’s Cutcherry, Bombay PWD (Judicial), 1874. Source: BA-map Nos.5379. Such “cutcheries” (offices) were the seat of colonial civil administration and justice at the local “district” level of government.
Fig. 7.11. Plan for a new central jail at Allahabad to contain 3,200 prisoners, 1861. Source: The Professional Papers in Indian Engineering, Vol. III/10, Feb. 1866. Similar facilities were constructed at other major stations, including Lahore and Benares (see figs. 4.3, 4.4), according to this standard panoptic plan.
jail at Lahore, which was described briefly above. Similar large facilities built subsequently in the North Western Province and Oude in the 1850's and early 1860's prior to adoption of the new norms recommended by the Jail Committee, were planned for as many as 3,200 prisoners each. (fig. 7.11). From 1864 onward, however, the recommendation--on sanitary and disciplinary grounds—that no such jail should be planned for more than 1,000 prisoners, was generally adhered to. This entailed only a simple reduction in scale and relative density, while the essential schema for such jail complexes prevailed. The smaller "district jails" which were built at most administrative stations of any size, were similarly reduced versions of the central jails; often simply truncated fragments of the standard base schema.

The Note on Jails and Jail Discipline in India for the years 1867–68 (to which we have been referring at length in this discussion), compiled by A.P. Howell, the Undersecretary to the Government of India in the Judicial Department at the time, provides a detailed contemporary description of the essential planning configurations and building types of which virtually all larger jail facilities constructed in India in that period were composed. 200 I will quote that passage in full, referring the reader to the above plan of the Allahabad Central Jail as an excellent exemplar of the "typical" jail complex described. 201

The barracks for male criminals, which form the principal part of each jail, generally radiate from one central watch-tower, which commands the whole of the jail enclosure, and are enclosed between an inner and outer wall or palisading in the form of a regular polygon, the number of sides of which corresponds to the number of barracks. The barracks are further divided one from another by walls connecting the angles of the inner and outer polygons, so that each is in a separate enclosure of its own, in which are placed a privy and cook-house. To this polygon there is only one approach from the outside, and the barracks can only be approached from the inner

200 Howell, Note on Jails..., 8.
201 This striking plan was published in the Professional Papers on Indian Engineering in 1866 (vol. 3, no. 10, February), although the original drawings from which the plate was struck were dated 1861. Unfortunately, no additional description or explanation was published with the plan, hence we must rely on incidental references to this project in the PWd records to piece together its probable history. See below for further discussion.
circle or polygon in which the watch-tower is situated. For the larger jails two sets of polygons arranged in this way and placed near one another are generally provided. In some parts of the country where it is considered necessary, with reference to the monsoons, far all buildings occupied by prisoners to face in one direction, the radiating system had been abandoned, but these places are few in number.

The Central Jail proposed for Allahabad was clearly among the class of large double-polygon complexes described by Howell. Others which were carried out on a similar scale and design included those at important neighbouring stations in the north such as Benares, Agra and Lucknow. City maps of the late 19th and early 20th centuries indicate a strikingly faithful replication of the double-polygon plan proposed for Allahabad at Benares (see fig. 4.3, map of Benares Cantonment and Civil Lines, c.1931). These elaborate complexes occupied large tracts of land and were therefore built, in the general case, just beyond the fringes of the civil station; far from the native quarter of the settlement but in reassuring proximity to the cantonment. While older existing jails were, in some cases, capable of expansion and upgrading to the new norms that came into force in the 1860's, the original Central Jail at Allahabad built two decades earlier under Governor Thomason's regime was already too confined by the new railway line and encroaching growth of the civil station, as laid out by Major Strachey. Consequently, it was redesignated a "district Jail" and the new Central Jail was built from scratch at a more distant and unencumbered site in the suburb of Arail. 202

While the smaller district jails, for shorter term sentences and

202 "Report on Jails of the N.W.P. for 1867". Cited in Howell, Note on Jails... Possibly as a consequence if this relocation to a new site, progress on the jail works at Allahabad was very slow in the estimation of the PWD Secretary, Col. Dickens. "Considering the length of time these jails (including that at Benares) have been in hand...", as Dickens remarked in his Public Works Budget Orders for the N.W. Provinces for 1866-69, "...the Governor General in council considers that active measures should be taken to hasten their completion, in which view the grants for next year should, if possible, be increased by transfer from other works." PWD Circular No. 24 of 1868.

In the Budget Orders of the previous year, the allotment for these jails had similarly been criticized as too meager, with the suggestion that seemingly excessive funding for as yet unspecified police buildings might better be transferred to the ongoing jail projects. PWD Circular No. 23 of 1867.
defendants under trial, had to be in some reasonable proximity and contact with the "outside", the large central prisons were conceived as self-contained worlds unto themselves wherein all essential activities, utilities and contingencies of the inmates, and their (on duty) supervisory staff, were accommodated. Howell's description of the standard jail schema continues with a breakdown of additional functional components, and the discrete classification of prisoner groups and their respective accommodations:

Solitary cells for a certain proportion of the prisoners are sometimes placed in the section of the polygons, whilst in other cases they are in distinct enclosures.

Work-shops for the male adult criminals are constructed either against the walls separating the barracks from each other, or in separate enclosures generally connected with the mens' polygon by means of a passage between walls or rows of palisading.

The male hospital consists of one or more buildings in a distinct enclosure in which are placed the native doctor's house, dead-house, and the necessary out-offices. A separate ward for contagious diseases is sometimes provided.

Female criminals are still as a rule lodged within the same general enclosure as male criminals, but the portion of this reserved for their use is divided off from the rest by a wall some 12 feet high, and within this are placed female work-shops, cook-houses, privies, etc., and sometimes a female hospital, so that they are completely shut off from the rest of the prison. A similar remark applies to juveniles. The latter are generally provided with separate cells, whilst the former are as a rule in wards containing a moderate number.

There are also generally in the large jails separate wards for

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In later versions of the scheme, separation of workshops and barracks was favoured on sanitary grounds. In departmental correspondence with the Madras Government in 1866, concerning its several advancing central jail projects, the presiding PWD Secretary to the G. of I., Col. Dickens described the latest wisdom on this matter: "The workshops are in the position in which, till lately it has been usual to locate them, viz., between the rows of barracks. This position for them has however, lately been objected to by the Inspector General of Prisons, North Western Provinces, and he has in his late plans placed them in separate enclosures outside of the polygons, but within the main outer wall. In this position, the men are quite away from the sleeping enclosure in the day, and the air in it had thus an opportunity of being purified." PWD (Civil Works -- Buildings) "A" Proceedings, Feb. 1866, No. 32.
European prisoners and for male and female debtors, and in the district jails others for prisoners under trial. These may be in divisions of the principal polygons, or in separate enclosures. The provision of quarantine wards has also been lately approved. The whole of these groups of buildings are enclosed within one outer wall, generally rectangular, provided with one entrance gateway, over which are the quarters of the jailer, and adjoining which are the guard-rooms and necessary store-rooms and offices.

An interesting proposal that initially failed to receive sufficient official approval to be implemented—but which appears to have been experimented with later, as for instance at the Benares Central Jail—was the concept of housing native jail servants and their families in "model villages" adjacent to the jails in which they worked. The merits of such jail "colonies" were stated in a PWD Circular on jail design practices of 1869: 204

1st, to prevent jail servants from residing in the city or bazaar in times of epidemic disease, and being the means of conveying the same to jail.

2nd, to serve as a model for imitation by natives of the District for improvement of their villages as regards ventilation, drainage, arrangement of streets and conservancy.

Lunatics had commonly been incarcerated in segregated compounds within general jail complexes, before the reforms tabled in 1864. Thereafter, autonomous asylums for native lunatics were to become another conspicuous institutional feature of the suburban fringes of larger civil and military stations. (See, for example, the institutional "space" separating civil lines and cantonment in the above, figs. 4.3 and 4.4, plans of Benares, and Lahore). Europeans suffering from mental illness were generally repatriated. In some cases such facilities were modeled closely on the panoptic layout of the neighbouring jails; but medical authorities tended to deprecate that oppressive approach encouraging, alternatively, the design of sheltering, therapeutic environments comprised of informally distributed cottage-like wards among gardens and

204 PWD Circular (Civil Works -- Buildings) Fort William, Jan. 14, 1869: re. "Jails In India".
trees.

The actual buildings that comprised the elaborate geometries of Indian jails were single storied structures, in the general case, with plinths two to three feet above grade. Both male and female prisoners were housed in conventional barrack structures, each block 18 to 20 feet wide and divided along its length into 2 or 3 common wards for 20 to 30 occupants each. The Jail Committee's original recommendation of 64 superficial feet of floor space (in barracks) per inmate was subsequently reduced in practice to just 40 ft.

Verandahs were evidently considered an inappropriate luxury in all but the most extreme climatic conditions, and were rarely provided on Indian jail buildings. In other respects these buildings were ordinary Anglo-Indian barracks, with doors surmounted by clerestory windows between each of the prisoner's beds, and ample ventilation furnished through vents in the ridge of the gable roof. As was the norm for military barracks, each ward generally had a contiguous "night privy", accessible from the outside by sweepers. The principal latrines were housed in separate out-buildings in the same compound. Nevertheless, there was no "wet" plumbing; excreta were collected by the dry-earth method and buried in the jail garden.

Jail hospitals were built to much the same specifications and dimensions as the regular prisoners' barracks, but with higher plinths and verandahs on all sides. These were planned to accommodate 10 to 12 per cent of the adult male inmates at any time. As was mentioned earlier, female hospitals, if provided at all, were generally contained within the same compound as their regular barracks.

Work-shops were the simplest of all structures; merely open sheds to

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205 See, for example, the proposal and commentary of the Bengal Sanitary Commission for a standard plan for lunatic asylums in India, PWD Circular No. 90 of 1866; G.of I. PWD (Civil Works -- Buildings) Simla, Oct. 17, 1866.

206 Officially the minimum was reduced even more, to a mere 36 square feet, but was generally rounded up to 40 wherever feasible. Although roofs were raised sufficiently high (i.e. on a wall plate of 16 feet) to ensure a theoretical minimum of 640 cubic feet of air per inmate, these allowances still amounted to less than half those prescribed for European soldiers in Indian barracks.

207 Howell, *Note on Jails...*, 8-9, 26-37.
keep the sun off, and the rain in season.

Finally, cells for the solitary confinement of adult male prisoners were provided for 15 to 17 per cent of the total number of inmates. In all instances, with the exception of the jails constructed by the Madras PWD, these cells conformed to the Jail Committee's recommendations for minimum space requirements, 8 100 ft.\(^2\) and 1500 ft.\(^3\), respectively. Each cell was provided with a small airing yard of its own, and were often ventilated mechanically as well, by means of centrally located therma antidotes.\(^{208}\)

The Cellular Jail controversy:

Notably, the enthusiasm of metropolitan penal reformers for cellular jails—which had increased greatly in England in the years between the reports of the first and second Indian Jail Committees—had obviously not made a comparable impact on jail design practice in India. Metropolitan ideals of social reform through the moral improvement of the criminal underclasses—which the introspection-inspiring device of the individual jail cell was presumed to promote—may have been an engine for penal reform in colonial India; the circumstantial strain on the existing penal system following the Mutiny, a catalyst. But, the ultimate rationale of the renovated and expanded prison system that emerged in the 1860's could not really be equated with that of its English counterpart. The colonial Indian prison functioned in consort with other colonial institutions to control and maintain the status quo of traditional Indian society. Toward that end it served to classify, divide and contain those individuals who failed to conform to an artificially fixed idealization of an acceptable traditional social order which was under increasing strain by the forces of change imposed on it, paradoxically, by the colonial system itself. From the evidence we may glean from the mundane records of those responsible for the actual building of these facilities, they at least do

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\(^{208}\) Ibid., 9. In the design for the Allahabad Central Jail, it can be seen that the solitary cells at the foot of the plan were to be evacuated by therma antidotes situated at the hub of each semi-circular range. These were evidently to be linked by some unspecified system of ducts to make the device effective.
not appear to have had any great illusions as to what rational purpose their designs were to serve.

Unlike the issue of barrack design reform, which officials addressed more-or-less simultaneously in India and England, the jail reform movement had been in vigorous motion in England for at least two generations by the time reformers first attempted to transfer their principles and enthusiasms to India; and a further generation had transpired before a consolidated policy of changes and improvements to the penal system was finally pursued. As such, there was scope to judge somewhat more objectively the success in practice of the metropolitan reformer’s theories. For one, they themselves never really arrived at a clear consensus on the ideal principles of prison design. There was indeed a strong belief in the “improving” principle of solitary confinement, on the part of many reformers, but important disagreements as to how rigorously and extensively the principle was to be applied in the organization and specific design of prisons. The construction of model prisons reflecting these different conceptions of the “cellular” principle, in Europe and America in the 1840’s and 1850’s, meanwhile failed to demonstrate conclusively the superiority of any particular strategy, even on purely technical grounds such as health and sanitation (leaving aside the more doubtful matter of moral improvement); while all were invariably costly.

When the application of the cellular concept to India was considered in the original Jail Committee Report of 1838, skeptics had dismissed it intuitively as incompatible with the climatic extremes and endemic health hazards of the subcontinent. The closing up of convicts in confined spaces seemed a perfect invitation for malaria (as it was then believed to be caused).209 However, when jail reform came round again for consideration in the 1860’s, colonial technocrats had (as we have seen) attained a more sophisticated (though not necessarily more accurate) notion of sanitary science and the theory of disease. Advocacy both for and against the still much vaunted cellular principle for jail design was therefore much better articulated than it had been previously.

209 As Lord Auckland observed in his Resolution on the Jail Committee’s Report (1838). Cited in Howell, Note on Jails..., 3.
As we did earlier with the design argumentation of Col. Crommelin and Major Medley concerning the rationalization of barrack design norms for India, I would like to round out this overview of parallel efforts to rationalize jail design, with a further brief consideration of the conceptual systems that evidently informed and directed thinking in that vein by PWD engineers and other colonial technocrats. The debate over the desirability of cellular jail planning for India caused advocates and detractors of that strategy to articulate explicitly their decision-making structures and broader beliefs concerning science and progress in the colonial context, as they argued for the rational choices to be made in this particular matter of design.

There were four distinct systems of imprisonment generally recognized by metropolitan penal experts of the mid 19th century:

1. complete isolation of the prisoner in a separate cell day and night
2. isolation by day and night in a separate cell, but with individual labour and regular inspection
3. isolation in a separate cell by night with collective labour by day
4. association in labour and daily functions with other prisoners by day and night

The first and most radical of these had been tried in "modern" American prisons, but had long since been abandoned as in-humane. The second was the latest ideal of penal reformers in the 1860's, and was strongly advocated in the English Prison Act of 1865; although Howell had not yet received any conclusive evidence of the success of that system in practice to relate in his report of 1868. The third, so-called "separate" system, had been advocated for some time by certain of the local governments and administrations of India as the approach most suited to conditions and requirements in India. The fourth, or "common imprisonment" system, was—as we have seen—the approach that prevailed in the great majority of Indian jails. Whereas such had also been the norm in European prisons before penal reformers had convinced the authorities of its backwardness, the Indian system was regarded as somewhat more enlightened with its significant degree of classification.

210 Howell, Note on Jails..., 14.
and separation of convict groups.

In India, reformers argued for the "separate" versus the "common" system, as full-fledged solitary confinement on either of the first two models could not be morally or legally justified for the great majority of Indian penal cases. The enthusiasm (in principle) of some local governments for the separate system was, in most cases, a reflection of the personal advocacy and scientific arguments of their respective Inspectors-General of Jails. "On account of the expense", however, few were willing in practice to sanction the construction of cellular jail buildings. By the late 1860's the Government of the North Western Provinces had virtually achieved its jail construction mandate and was thus among the least enthusiastic for any further revolutions in prison design. Experience with the "common" system, and the various refinements and standard specifications with regard to the maintenance of the salubriousness and basic conservancy of common barracks which had been devised through repeated trials, had convinced that government of the sufficiency of facilities as they were.  

211 On the other hand, planning authorities in the Punjab were of quite the opposite mind to the N.W. Provinces on the question of cellular jails and "...strongly (urged) the immediate introduction of the separate system"--although presumably they too had a considerable vested interest in the status quo, as the harbingers of the most progressive jail design standards in India of the generation before.

The most outspoken zealot of the cause was the Inspector-General of Jails for Bengal, Dr. Mouat, who strenuously voiced the case for building modern cellular jails in India, in his reports and official correspondence. As the sanitary and penal expert at the most immediate disposal of the public works and judicial department authorities in Calcutta, Mouat might well have swayed the Government of India to his position. However, the latter ultimately resolved to stick to its well-tried methods and design conventions, no matter how out of step such

211 For example, jail barracks under its jurisdiction were furnished with fixed masonry berths; solid platforms supported two feet above the floor on shallow brick arches that could permit the free flow of air under and around the sleeping surface, while ensuring the minimum separation of sleeping persons in an enclosed space that contemporary sanitarians had prescribed. Ibid., 26-37.
a policy could be interpreted back home. This carefully reasoned position was expounded on behalf of the Government by Undersecretary Howell, who devoted a substantial portion of his Note on Jails to an exhaustive rebuttal of Mouat's arguments.

This debate, which was ostensibly about the correct approach to the accommodation of prisoners in India, could be characterized conceptually as a confrontation between different belief-systems. The Government's position was not simply conservative, but premised on the fundamental belief that planning in the colonial context of British India was truly a special case. On the other hand, Dr. Mouat backed his argument bull-headedly with what he believed to be the universally applicable truths of science.

Mouat's tactic was polemical; to draw a relationship between imperial politics and Science by which to bully the Indian Government authorities into acknowledging what he regarded as their pig-headed backwardness by comparison to the scientific jailing practices of the "advanced states of Europe and America". This line of argument had evidently been stimulated by a trip "home" to England and Europe in the mid 1860's on which he had employed much of his time visiting prisons and re-studying the expert literature on the subject of jail design (which, however, Howell was to pillory as woefully out of date). America and France in particular, were the "advanced" states to which Mouat looked for the most progressive application of science to public policy and social institutions. According to his investigations they had decisively embraced the cellular jail principle.

In his retort, Howell concurred disarmingly in the opinion that, indeed, "...French experience should be accepted without any hesitation. There is no country..." he agreed, "...that pays greater respect to results scientifically demonstrated..." However, he added, "...at the

212 Ibid., 15.
213 The home furloughs of professional consultants in the Indian Civil Service—such as Dr. Mouat and the architect John Begg, whom we will encounter in Chapter 9—were often catalysts for renewed innovation and reforming vigour in their respective fields upon their return to India. All the same, what they could glean from progress on the metropolitan front in just a few short months of starry-eyed observation was prone to be shallow and very partial, and hence naive.
same time the French are not inclined to waste their money on mere hobbies or sentimental delusions." 214

In a skillful exploitation of the substantive content of his opponent's own argument, Howell indicated that Mouat's "extremely positive" assertions were in fact scientifically unfounded. "With considerable diffidence", he wished his readers to know, he felt bound to elicit the sloppiness of Mouat's assessment of the state of knowledge on the issue. Howell's own evidently more rigorous survey of the literature had revealed that the most recent expert opinion published in France on the question of cellular jails had come out strongly against the principle; the experiments of the 1840's and 1850's having proved to be decided failures. In 1841 France had responded to all the best advice of the day and adopted the cellular principle for the design of all jails to be built thereafter. But, within little over a decade it had renounced that strategy in favour of "separation par quartier"—that is, precisely the principle that the Indian penal system had evolved of its own accord. Neither the disciplinary nor the sanitary revolutions that a strict regime of solitary confinement had been calculated theoretically to achieve, had been realized in practice to any scientifically demonstrable degree of satisfaction. The French had therefore made the rational choice to abandon the cellular jail principle on the financial grounds that huge investment in such an ineffectual and (after all) possibly even morally detrimental architecture, was pure foolishness.

Howell closed his argument on a conciliatory note by conceding that he too had presented a tacitly partial analysis of the issue—another body of information and opinion which he felt Dr. Mouat had quite ingenuously failed to report. The fact was, the most respected authorities in France and England were divided on the matter. No rash generalizations or headlong reforms in the vein of cellular jail planning, or any other penal architecture, could therefore be justified at that time. As such, the colonial administration could be excused for muddling along as usual with its reasonably effective local conventions; bolstered conceptually by consideration for the "peculiarities of Indian

214 Ibid., 17.
engineering", among other special conditions with which colonial technocrats had to contend, which discouraged uncritical recourse to the ostensibly "universal" technologies of the most advanced countries.

The dialogue between the universal and the particular in the development and application of design and planning expertise in colonial India was here, as in other areas of design policy and practice, articulated with some consciousness as those charged with the actual job of building were caused to rationalize their design choices and actions. Once such distinctions had been elicited in this way, however, the descriptions themselves were increasingly to be invoked as normative constraints on colonial planning practice. In the Indian Public Works Department, the "peculiarities of Indian engineering" were to be

215 The phrase belongs to Maj. J.G. Medley who offered an apologia for these "peculiarities" in one of his early editorials for the Professional Papers on Indian Engineering, 1, 5 (Nov. 1864).

216 Although the question of cellular jails was evidently put aside at this crucial juncture in the development of penal policy in India, there were to be at least some prisons of this type constructed in subsequent years. Mention should be made of a notorious exemplar which was built at Port Blair—a settlement on the remote Andaman Islands in the Bay of Bengal which was transformed into a penal colony in 1858 to receive those of the mutineers and rebels of 1857 sentenced to "transportation". Ibid., 62; UNR (Judicial) Proceedings, July 2, 1858, NOS. 80-81.

The Port Blair cellular jail was composed of massive three-storey masonry structures, heavily arched in the manner of contemporary multi-storey military barracks. In this variation on that theme wards were subdivided by stout brick walls into individual cells which opened out onto barred, semi-exposed individual exercise courts occupying the conventional space of the verandah. The cell blocks radiated in a spoke-like fashion from a central surveillance point.

The prison evidently gained notoriety as the maximum security facility at which the most threatening Indian malefactors—criminal and political—were incarcerated by the British regime. In this century it was home to many political detainees associated with the Indian independence struggle. When captured by the Japanese in World War II, the Andamans became the first symbolic stepping stone toward the re-conquest of British India by the disaffected Indian P.O.W.'s and prison inmates whom the militant freedom-fighter, Subhas Chandra Bose, had organized with Japanese support into the Indian National Army. A famous photograph of Bose in his INA uniform visiting the "liberated" cellular jail at Port Blair in 1943 was a symbolically significant piece of propaganda for his ultimately ill-fated campaign. (The photograph and relevant documentation are retained in the collection of the National Archives of India. My comments are based on a temporary exhibit of these and other holdings concerning the Indian independence struggle, mounted in the NAI Library in November 1992.)
institutionalized in prescribed design methods and increasing bureaucratic protocol. This phenomenon of standardization that ensued in the wake of the definitive rationalizations of official building and planning practices, carried out in the 1860's by the reconstituted colonial regime of the post-Mutiny era, forms the topic of the next chapter.

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Summary: In this chapter we have examined the cognitive implications of the crisis of 1857 with regard to colonial settlement planning and architectural design in British India, in the period of administrative consolidation and vigorously renewed technical development that followed that calamitous event. We began by considering the call to order which the Mutiny had provoked among the colonial community generally, and the consequent anxiety of the British to consolidate their knowledge base concerning all aspects of India's physical and cultural geography. We then considered how such knowledge and prejudices were applied in the rationalization of colonial settlement planning. The case of the post-Mutiny redevelopment of Allahabad provided insights on the strategic, economic, and ethno-medical norms that predominated the reasoning of colonial settlement planners in that period. We then proceeded to discuss the increasing preoccupation of the authorities with the issue of a healthy built environment, once military security had been restored. The application of contemporary ethno-medical in the development of new design standards for buildings deemed suitable for the accommodation of Europeans in tropical India was then examined in an interpretation of departmental design discourse concerning the rationalization and standardization of designs for all the "typical" military buildings of colonial India. The chapter concluded with a complementary analysis of design discourse concerning civilian hospitals and the rationalization of model designs for British Indian prisons. Here we observed further implications of contemporary scientific and strategic criteria in the design reasoning of the PWD engineers, as they applied themselves to the design of "civil" buildings. We also noted the heuristic efficiency of a mode of case-based design reasoning that increasingly relied, for its rationale, on predominantly military conventions of planning, organization, and decision making, with little recourse to first principles.

In the next chapter we shift our focus from the problem-solving intentionality of design reasoning in the immediate aftermath of the Revolt of 1857-58—and the explicitly articulated conceptual frameworks of the PWD engineers that we have been able to infer in part from the design discourse of that seminal period of questioning and change—to these increasingly institutionalized modes of reasoning, or "normative frameworks", that came to constrain their designs in the later decades of the 19th century.
STANDARDIZATION
DEPARTMENTALISM AND DESIGN

Executive Engineers may be reminded that no variation in a Standard Plan ought, on any account, to be carried out without previous departmental permission. No deviation from a Standard Plan is permissible without the sanction of the Chief Engineer, (*P.W. Code XIX, iv. 17) and under para. 10, i, IV of the Code, Executive Engineers are held responsible that no breach of this rule takes place.

---P.W.D. Proceedings, 1864

Introduction: In this chapter our historical inquiry moves beyond the dramatic events and developments of the middle decades of the 19th century, to consider the longer term patterns of intention which had become apparent in the routine working practices and design production of the Public Works Department of British India by the 1870's. Having focused attention on certain of the more pressing design problems to which PWD engineers addressed themselves and their expert knowledge in the decade of exceptionally dynamic technical development following the Mutiny of 1857-58, we will now consider how the design solutions devised and "rationalized"—with regard to the general scientific and economic criteria of the day, and the various "special" considerations of the colonial Indian context—were progressively institutionalized in subsequent years; explicitly in the official design standards, methods and regulations of the Public Works bureaucracy; implicitly in the evolving professional conceptual system of the engineers themselves. I will thus attempt to describe and analyze—in greater detail than has been attempted so far—the nuts and bolts of actual design practice in the Public Works Department; the explicit rules and apparent heuristics of the Department's bureaucratic procedures, and the implicit conceptual frameworks that constrained that design reasoning engendering the increasingly standardized architectural output of the department in the later years of the 19th century.

Some preliminary hypotheses:

Almost immediately after its establishment, the PWD had set about consolidating its norms of practice and the expert knowledge on which this relied, and by 1858 had already framed these in a departmental Code of Regulations. This compulsion to consolidate practice made further significant strides in the 1860's—as we began to analyze in the previous

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1 PWD (General) "A" Proceedings, January 1864, No. 27.
chapter—with concerted efforts, in the military branch of the department in particular, to standardize plans and specifications for all manner of buildings and other works which the PWD was regularly called upon to design and build. Meanwhile departmental bureaucrats proceeded further still, to rationalize and standardize accounting procedures, protocol for the preparation and submission of projects for budget sanctions, and all other aspects of departmental office routine.

Among the more obvious factors that might explain, in part, this bureaucratic "departmentalism" were the basic military notions of order and protocol which the Department had inherited from the Military Boards previously charged with responsibility for public works—along with the cadre of military engineers that comprised the great majority of its original executive establishment. The mentality of the parsimonious book-keeper, which the ordinary PWD engineer was given little choice but to inculcate, was another obvious inheritance from the Company administration—a stigma he shared with functionaries in most other departments of the mature colonial bureaucracy.

Another very different factor to be considered with regard to the standardization of the Department's design output was the relative value placed on the appearance of uniformity, in itself. The aesthetics of order were of essence for a colonial culture that was to be increasingly concerned with maintaining the impression of its strength and its permanence, as the imperial ethos reached its zenith in the late nineteenth century but began even then to sense its inevitable demouvement.

This aesthetic criterion was not merely a formal concern, but a matter of method as well. The keeping up of appearances by the chauvinistic colonial culture of Europeans in India was a collective compulsion which evidently obliged civilians as much as military personnel to cultivate self-restraint and a one-ness of purpose—what Francis Hutchins has described as the "cult of conduct" of the Victorian servants of empire.² It seems a plausible conjecture that the conformity of PWD engineers to the decidedly chaste and unostentatious standards for

architectural propriety maintained by the Department was to some extent a willing embrace of the principles, in themselves, of Discipline and Abstinence—norms highly valued in the general belief system of the Victorians with which the colonial community framed its faith in the morality of its imperial project. To corroborate this conjecture, however, will require considerable careful exposition in this and the final chapter in which I will compare and contrast these Victorian norms and their apparent cognitive bases with the marked shift in the architectural design policy of the PWD toward a more ostentatious but, at the same time, more culturally ambiguous manner of building, at the turn of the 20th century.

Records of the day to day business in the Public Works Department indicate that the ostensive motive for the standardization of design and departmental procedures was the often explicitly stated concern of the PWD functionaries to plan with accuracy the projected costs of the Department’s undertakings. To oblige conformity to familiar methods and known quantities, and above all to present information in prescribed formats amenable to efficient analysis and comparisons, were evidently perceived as obvious strategies for achieving economy in this regard. This is hardly surprising. More intriguing, perhaps, was the considerable dissent from this view which not only engineers in the field but even certain of the key framers of the departmental standards, were provoked to admit when it came to assessing the actual efficacy of such measures, and their own willingness to conform to them.

The consolidation and standardization of procedures, as a seemingly logical follow-up to the Department’s definitive efforts to devise rational solutions to its most frequently encountered design problems, caused engineers of the PWD to begin to recognize the professional dilemma in which they were placed in their parallel roles as corporate managers in a bureaucratic organization. This was a dilemma which most members of the European colonial community in India after 1857 were to share in some way. But the case of the engineers in India was an especially representative instance of this clash of the libertarian value system of contemporary British society with the antithetical centralized technocracy in which colonial service compelled them to work.

In Chapter 6, I posited the argument that the incorporation of
engineering professionals (civil engineers in particular) into the colonial bureaucratic system entailed a concomitant sublimation of their normal professional autonomy. The proliferation of departmental regulations and the standardization of procedures for the design, execution and accounting of departmental works, progressively reduced the potential for individual PWD officers to make their personal mark in the Department—as engineers, that is, according to the ideal type of free practitioner that the civil arm of the profession had fought hard to place securely in the ranks of Victorian social respectability. On the other hand the corporate hierarchy of the department afforded alternative professional opportunities. The institutionalization of the routine aspects of Indian engineering and architectural design, in the form of standard designs and procedures, enabled less qualified departmental subordinates to apply such knowledge effectively, with consistency and system. Meanwhile the engineer officers of the PWD could monopolize cognitive competence in technical matters on a comparatively grand scale, as the technocratic mandarins of colonial public works.

The task of this chapter is to test these various hypotheses and premises concerning the intentions that underscored the PWD's standardization drive, through a close comparative examination of declared policy in this regard, and actual implementation and observance of such regulations and standards in practice. As with the examination of policy and practice regarding rationalization, in the preceding chapter, I will attempt to discern a pattern of intention through a broad sampling and analysis of argumentation regarding standards and methods—as such may be gleaned from the PWD Proceedings and related documentation—which might account for the general uniformity of method in the PWD, as well as the quiddity of the individuals who subscribed (sometimes grudgingly) to such strictures.

I will begin with a systematic, chronological survey of the departmental records to chart the actual development of design standardization practices in the PWD and its predecessors, over the course of the 19th century.
1. Design Standardization in the PWD: The Evidence of the Record

Let us proceed directly to our principal concern: the standardization of the design output of the PWD. How concerted was this, in fact, and to what extent did this reflect explicit policy?

The practice of building according to standard plans was indeed common in the PWD, though by no means to the exclusion of one-off designs. Military buildings were subject to the most forthright and thorough standardization efforts, but at one time or another the department also appears to have proposed standard plans for most of the civil building types it was frequently required to construct. A methodical survey of the departmental records indicates periods when the adoption and implementation of standard plans was significantly more intensive than others; notably, in the immediate aftermath of the Mutiny, and again through the later years of the 1860's. But it appears that such were circumstantial surges for the most part, occasioned by more general building initiatives. They do not correlate decisively with specifically relevant policy changes. Such that official policy with regard to design standardization was stated at all, it remained ambiguous, if not contradictory with respect to the willfully regimented design practice the PWD engineers appear to have developed of their own accord.

Precedents for design regulation, in the Company period:

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3 The chronological survey of design standardization in the PWD described in the following sub-section reflects a systematic sampling of relevant government records, from the early 1850's to the 1920's. The annual volumes of the Abstracted Index to the Proceedings in the Department of Public Works, Government of India, preserved in the National Archives of India [NAI] in New Delhi, were the primary source in this regard. The reflection of the directives of the central government, regarding design standardization, in Public Works policy and practice at the local government level was examined through a distributed sampling of similar indexes to the proceedings in the Public Works Department of the Government of Fort Saint George (Madras), over the same seven decade period. These latter records were accessed in the Tamil Nadu State Archives [TNSA] in Madras. Other sources as indicated.
In the Company era, under the authority of the Military Boards, the replication of prototypical building designs had evidently been a tacit rather than an explicitly regulated norm of engineering practice. However, there were some efforts in that period to fix explicit standards. In 1834, for example, the Governor-General, William Bentinck (the aptly named "clipping Dutchman" whose Utilitarian zeal for institutional reform we touched on briefly in Chapters 3 and 4), had taken the first serious steps to normalize an acceptable standard design for military barracks in India. With a degree of direct, personal interest in the issue which was rarely thereafter to be seen from the upper echelons of the colonial administration, Bentinck had evidently circumvented the laborious sanctioning protocol of the Military Boards to consult directly with experienced officers of the Bengal and Madras Armies on a suitable standard plan for European regimental barracks in India. In a Minute of December 29, 1834,\(^4\) Bentinck proposed that an amended version of that plan ". . . be sent to each presidency, with a direction that, in the construction of new barracks, no departure from it may take place without the previous sanction of the Governor-General of India in Council."

This edict of Bentinck's on a policy of design standardization was possibly the first explicit statement of the sort on the part of the Government of India. But it appears that the British military establishment in India had already been compelled to conform, to some degree, to narrowly regulated design norms for barracks, and their management and maintenance, which were laid down in the standing orders of the King's Army. In periodic Warrants for the Regulation of Barracks issued by the home military authorities,\(^5\) exacting "schedules of accommodation" were decreed (among other regulations) which itemized the prescribed quantities of space and articles to be allotted to each

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officer and soldier of every rank in barracks. Such Warrants were sufficiently detailed in their specifications to insure substantial consistency in essential aspects of barrack planning, in all corners of the British Empire. However, it is significant that these regulations did not provide actual plans. The pertinent passage of the Warrant made it clear that they were intended as normative guidelines rather than inflexible design prescriptions:

As local circumstances, with regard to the Barracks in Our Colonies and Garrisons abroad, arising out of their distance from this country, the nature of the climate, or other matters peculiar to their situation, or government, which cannot now be contemplated, may render it necessary to deviate in some degree from these Our Orders and Regulations, you are hereby authorized to make such deviations, as far as may be necessary, to meet the circumstances of the case, keeping in view the general spirit of Our Regulations.

A similar "normative" attitude to design appears to have applied to works and buildings carried out by the Indian Engineers corps for the civil sector, during the Company period. As we have seen in earlier chapters, the unsophisticated buildings of the districts erected under the aegis of the Military Boards for the Revenue and Judicial Departments, had attained a generic order of considerable uniformity by the middle of the nineteenth century. Within a range of acceptable variations germane to this simple canon, unstated norms had evolved for each of the common building types such as dak bungalows, courthouses and cutcherries of various grades, which all evidence suggests were readily conformed to. Few minor buildings of that era actually stand today to substantiate this point, but contemporary drawings, incidental descriptions, and other depictions of such, indicate considerable continuity in these building practices from the late eighteenth through to the middle of the nineteenth century.

With the exception of jail planning—which, as we have seen, was subjected early on to the scientific rationalizations of metropolitan reformers in advance even of military buildings in India—there does not

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6 Regulation No. 16, Ibid., 20-21.
7 See the discussion of the rationalization of prison designs in Chapter 7, above.
appear to have been a formal policy or design method by which the manifest uniformity of Anglo-Indian civil architecture was obliged. By contrast to later years, official records pertaining to the planning and construction of civil works and buildings in the period pre-dating the formal establishment of the Department of Public Works in the Government of India, make no mention of "standard plans", nor any equivalent terms. It is interesting that the only expressed concern for conformity to prescribed design guidelines by the sanctioning authorities in that period, that I have noted, involved the design of churches—that is, the building type of the most ostensible "architectural" nature among the roster of structures regularly built by the engineers corps. The Home Secretary was insistent in the case in question—the construction of a cantonment church at Belgaum—that the design conform to principles prescribed two years earlier in a Dispatch from the Court of Directors. For this manner of civil building—at least where it was to be constructed in the military domain—there was thus, by the middle of the century, some endeavour to "schedule accommodation" and constrain any potential architectural excess, on the lines of the longer standing military design norms.

The first standardization campaign, 1858-1859:

There was to be no appreciable change in design policy in this regard, in the brief period between the reorganization of public works under one autonomous civil department of the Government of India, in early 1855, and the resumption of peace-time works and building three years later in the aftermath of the Mutiny. But things changed significantly at that point. For the years 1858 and 1859 we find that the Proceedings of the PWD are suddenly positively crowded with decrees and instructions

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8 according to my survey of a manuscript Index to public works proceedings in relevant civil departments (e.g. Judicial, Financial, Foreign) of the various local governments for the period 1850-1854.

9 Home Proceedings, Nos.20-21, Sept. 29, 1854.

10 Court of Directors Dispatch No. 3 of 1852, April 28, 1852.
pertaining to standard plans, for all descriptions of military buildings and utilities.

One of the first items of departmental business in 1858 was to forward for future adoption copies of standard block plans of Barracks for a Regiment of European Infantry, intended for stations in the Plains.\textsuperscript{11} These were to accompany a set of seven standard plans for Barracks and Hospitals for European Infantry then in preparation. There was evidently some haste to get these into circulation and two weeks later a bill was presented to the Department for the cost of engaging extra draftsmen to draw up in short order, 300 copies of each of those plans.\textsuperscript{12} These were subsequently forwarded to all the superintending and executive engineers' offices of the departmental system under the local governments and administrations.\textsuperscript{13}

By all indications, this new push to standardize was to be quite thorough indeed. Within the subsequent few months, the Department was to deliberate on standard plans for a wide variety of other buildings, including an early prototype for a standard double-storey barrack, as well as guard rooms, cook rooms and other minor military buildings. Also considered were design standards for details as surprisingly particular and seemingly unimportant as "cupboards" for European soldiers in Barracks.\textsuperscript{14} Moreover, there were now to be standard plans as well for at least some of the common administrative buildings required by the civil administration. In May of 1858, for example, orders were given to lithograph 300 copies of a standard plan for a Deputy Commissioner's Cutcherry.\textsuperscript{15} Standard plans for other classes of cutcherry,\textsuperscript{16} and related judicial buildings, were also disseminated in this period--the

\textsuperscript{11} PWD Proceedings, Jan. 8, 1858, No. 380. [NAI]
\textsuperscript{12} PWD Proceedings, Jan. 22, 1858, Nos. 165-166. [NAI]
\textsuperscript{13} Within three months they had been received by the PWD in Madras, in the southern most part of India. Proceedings of the Government of Fort St. George in the Public Works Department, March 12, 1859, Nos. 20-21; -----, April 13, 1858, Nos. 29-30. [TNSA]
\textsuperscript{14} PWD Proceedings, April 4, 1858, Nos. 151-152; -----, May 7, 1858, No. 145; -----, May 16, 1858, Nos. 108-110. [NAI]
\textsuperscript{15} PWD Proceedings, May 28, 1858, No. 60. [NAI]
\textsuperscript{16} For a somewhat later design standard for this fundamental building type of the district administrative system, see fig. 7.10, above.
latter due in part to the longer standing design improvement and standardization efforts of the provincial Inspectors-General of Prisons. Standard plans for a broad range of other civil buildings were also anticipated. But progress in that vein was somewhat uncommitted, it appears; the notion of standard plans for civil buildings had caught on more rapidly than they were actually being produced. As early as January of 1856, for instance, the Chief Engineer at Mysore had requested the PWD secretariat to furnish him with standard plans for a "district treasury" and for a "native educational building". However, he was informed that no such plans were available.

Military buildings were clearly a priority in this first significant spate of standardization. But, surprisingly—as explained in a retrospective defense of progress in barrack reform that appeared in the proceedings of the Military Department in 1859—it was largely by chance that this overlapped with the reorganization and rationalization of the Indian Army and the advent of the new Raj, in that same period. Since the late 1840's an improved de facto standard design for barracks had been developed—as with progressive prison design—by the Punjab PWD, at the various important military stations under its jurisdiction including Umballa (Amballa), Mean Meer, Rawalpindi and Peshawar. This progressive barrack design was a comparatively modest 3/4 scale prototype for the double-storey barrack Lieut.-Col. Crommelen was to institutionalize in the 1860's in his definitive canon of standard designs for Indian military buildings. It had meanwhile been copied with success at Agra and Cawnpore in the North Western Provinces, and in 1857 (quite by coincidence it appears) the Government of India and Court of Directors had decided to institutionalize that progressive trend, and extend it to the whole of India. Evidently, once the medium of standard plans had been determined upon, it seemed sensible to prepare such not only for barracks but for all other types of military building as well, using the Punjab

17 PWD Proceedings (Madras), July 2, 1858, Nos. 115-116. [TNSA]
18 PWD Proceedings, Jan. 8, 1856, Nos. 137-139. [NAI]
scale of accommodation as a basis.  

The subsequent crisis of 1857-1858 had disrupted this process only marginally, as it appears that the proposed standard plans had already been forwarded to the Court of Directors in London for approval, by the time the fighting had broken out. With the priority of military affairs at that moment, the sanction of the home authorities had evidently been accorded with little of the delay that might normally have been expected. By the time the first contingents of additional British troops had arrived in India to quell the Mutiny, the plans had completed their round-trip Home, and were already being implemented in the still tranquil southern presidencies of Madras and Bombay.

Not surprisingly, the new design standards—conceived as they had been to suit the generic climatic conditions and building resources of the northern plains—did not necessarily prove compatible with specific conditions in the different regions of India in which they were meant to be applied. A case in point—related in the proceedings of the "local" Madras Public Works Department21—was a scheme for "married men's quarters" which was in the course of construction in the early months of 1858 at the British cantonment at Bangalore. These had been sanctioned to be built in compliance with the applicable "...standard plan lately sent out by the Honourable Court." But the engineer in charge had authorized some deviations from the prescribed specifications, possibly to recoup certain advantages of the earlier "one-off" design for those buildings submitted to the Government of India for sanctioning a year earlier—which had evidently been superseded by the new standard plan.

This unilateral decision to flaunt the imposed standards was criticized by the local departmental authorities at Madras; rather meekly however, as a clear and binding protocol on the implementation of

20 Ibid. In my survey, I have not managed to find any explicitly stated rationale for this sudden resort to standard plans. But it may reasonably be surmised that the contemporary inquiries of the War Office Barracks Commission back in England were a contributing factor, along with the general hue and cry over the barrack reform issue, in the British professional and popular press. See the previous discussion of this episode, in Chapter 6-11.

21 Proceedings of the Government of Fort St. George in the Public Works Department, 19th Jan., 1858, 5,6; and 20th April, 1858, 118,119. [TNSA]
standard plans had apparently not yet been established. This particular matter was subsequently referred up the system to the PWD Secretariat in Calcutta with a request for some firm guidelines in this regard. But such were not immediately forthcoming. When the question of deviating from the new standard plans was raised again later that year—in this case by the Government of Bombay—the response from Calcutta was acquiescent and essentially non-committal: the various standard plans that had been circulated were intended (so far) to be used "for information only."

This was the moment, the reader will recall, when the logistical expediency of accommodating the suddenly greatly augmented force of British troops in India had compelled the PWD to resort to innovative temporary solutions to their needs in lieu of expensive, long to construct, permanent facilities. For the time being, at least, it was evident that the new standards could not reasonably be enforced. As a spokesman for the Military Department was later to remark in this regard, the expense of building simultaneously a great number of cantonments on the scale of Mean Meer... would have been enormous even if time had been of little moment. Indeed, the difficulty found in carrying out rapidly even the more moderate scale of building adopted shows that the achievement would have been impossible.

However, it appears that this provisional policy was not clearly stated at the time, such that questions and attendant conflicts continued to arise concerning the uncertain new departmental protocol for standardization.

In this regard it is worth noting a further incident of deviation from the new design standards, of which we have a record in the proceedings of the Madras PWD for this same period. Beyond mere

22 Ibid.
23 PWD Proceedings, July 9, 1958, Nos. 4-6. [NAI]
circumstantial criteria, refusal to conform to the new design standards was prompted in some cases, such as this incident at Hyderabad, by what appears to have been a more fundamental resistance "in principle" to any rigorous standardization of building practice. While the military engineers of India had submitted to their own bureaucratic regulations for design over the years, some evidently resented the prescription of such by the centralized civilian authority of the new Public Works Department (a reaction that was perhaps particularly marked in Madras where the Department had only just been reconstituted on the standard system of the other presidencies and provinces).

Through the course of 1858 a heated antagonism had developed between the PWD Chief Engineer at Hyderabad and a senior officer at the important neighbouring cantonment of Secunderabad over the latter's refusal to cooperate with the new departmental regime. Major-General Coffin was evidently an old soldier with his own head-strong ideas of design and appropriate martial ostentation. He also believed in his own experience-hardened methods for getting a job done. Repeatedly in the preceding months, he had ignored the authority of the PWD in order to carry out a series of military building projects under his own independent agency. Coffin had even constructed certain of these according to his own plans, with no acknowledgement of the new standards the Department had issued. In subsequent correspondence with the PWD Secretariat in Calcutta, the Department head at Madras was compelled to request the "...early and authoritative interference..." of the Government of India, to rectify the matter. This he hoped would salvage "...the efficiency of the public service [which was] seriously compromised by the total want of a good understanding between those officers."26

In 1859, the standardization drive initiated in the previous year was carried forward on most fronts. Many of the principal military building types had already been dealt with, hence, the majority of departmental business in this vein concerned standard designs for the various secondary buildings, utilities and accoutrements that supported the daily life and work of European military personnel and their

26 Ibid.
families, in the typical cantonment environment. These included essential facilities such as wash-houses, privies and urinals, as well as regimental bakeries, and hospital and school buildings for the women and children of the soldiers. Standard designs for all the basic furniture used in barracks and schools were also introduced in this year.27

In the civilian domain, the PWD busied itself with the standardization and general dissemination of the prison design norms developed previously by its members in the Punjab administration, and with other judicial building types such as police thannas, required by the revamped colonial regime with its much heightened concern for Law and Order.28 Buildings associated with the burgeoning network of transport and communications were a further object of design standardization in this period, including dak bungalows, toll houses and toll gates.29

However, for all this intensive effort to lay down well delineated design standards, it is unclear to what extent they were actually carried through into construction. As suddenly as they had been introduced in the late 1850's, the departmental records fall conspicuously silent again with regard to "standard plans", throughout the first half of the 1860's. This may have been, in part, a function of changes in the departmental methods of record keeping (as we will discuss a little later in this chapter). But it also reflected the resolve of the Government to delay budget approvals for many of the new buildings which the Indian Army in particular was poised to construct, pending the new design guidelines anticipated from the deliberations of the Royal Commission on the Sanitary State of the Army in India and the various ensuing commissions of inquiry in the local governments of India. As we saw in the previous chapter, that process was ultimately so prolonged and thorough that the original corpus of standard plans issued in 1858-59 (at least those for military buildings) appears to have remained largely unimplemented, as

27 PWD (Military) Proceedings, Nov. 25, 1859, Nos. 23-25; ----, Dec. 2, 1859, Nos. 7-9; ----, Nov. 11, 1859, Nos. 5-7; ----, Oct. 28, 1859, No. 21; ----, Jan. 26, 1859, Nos. 45-46.

28 See for example: PWD (Judicial) Proceedings, Oct. 21, 1859, No. 1; and, ----, Dec. 22, 1859, 1-4.

29 For example: PWD (Communications) Proceedings, Feb. 25, 1859, No. 4; ----, Aug. 26, 1859, No.1; ----, Mar. 11, 1859, No. 4; ----, May 13, 1859, Nos. 11-12.
such. However, many of those designs were substantially recycled in the
definitive new "specimen" plans for military buildings devised by Col.
Crommelin, beginning in 1863.

**Standardization in the later 1860's**

By 1865 the bulk of Crommelin's proposals had completed the peripatetic
process of review, revision and sanctioning, by each of the consulting
commissions and governmental authorities in India and England. As these
were subsequently put massively into practice, the department was again
besotted for a time with the issues and pragmatic of design
standardization.

The range of building types subjected to such regulation was
extended still further than that of the first spate of standardization.
In addition to the essential buildings for the accommodation and
logistical support of the British troops, such as barracks, hospitals,
bakeries, cook-houses and privies, standard plans were devised as well
for the quarters of their superior officers, including staff sergeants,
warrant and non-commissioned officers, and even commanding officers.  
(see figs. 8.3, and 8.4, below.) With the important exception of the
Indian troops, who were to continue in normal circumstances to build
their own hutments, virtually every class and grade of personnel in the
military hierarchy—including even the native staff of native regimental
hospitals—was to be accommodated in future in quarters specified
exclusively for them.  

The decision to include officers accommodation under this
standardization regime was an indication of the significant changes in
attitudes and in economics in this period, which directly underscored the
move toward standardization. Officers of the Indian Army had
traditionally enjoyed some freedom from military regimen when it came to

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30 For example: PWD (Mly. Wks.) Proceedings, Dec. 1867, Nos. 22-23,
B; ----, Oct. 1866, Nos. 102-103, B; ----, Nov. 1866, Nos. 52-53.

31 PWD (Mly. Wks.) Proceedings, May 1866, Nos. 100-103, p.460.

32 The Proceedings indicate there was a proposal at one point to
prepare standard plans for "lines of Native troops", but nothing seems to
have come of this. PWD (Mly. Wks.) Proceedings, July 1866, Nos. 42-43, B.
their choice of private residence. In post-Mutiny India, however, such independence—and more particularly the presumptuous architectural ostentation that the military traditions of the Company era had encouraged in this regard—had become too costly for the average officer to afford.

The Commander-in-Chief of the Indian Army had addressed himself personally to this unsustainable state of affairs. His revealing arguments on the matter were put across in a memorandum of 1865, on the basis of which Col. Crommelin was instructed to draw up his definitive plans for officer's quarters. According to the Commander-in-Chief, there had been earlier attempts to accommodate military officers at Government expense, but these had generally failed to be sustainable because of "...the larger accommodations assumed to be necessary in Government designs than is practically found to be so in the case of Officers lodging themselves." While he was convinced it was the Government's prerogative to provide quarters for its officers, this would only be economically feasible, or indeed desirable from a viewpoint of fraternal morale, if this practice of representing rank through the idle and wasteful consumption (or rather, disuse) of architectural space were abandoned. A more sensible principle for the planning of officers quarters, as he saw it, might be, "...rather, that which obtains in a Club, for, with the exception of the married men, no Regimental Officer, whatever his rank, requires more than two fair rooms." With this notion of essential accommodation as a minimum standard, the C-in-C proposed how the particular requirements of the different ranks and classes of officers could be worked out:

Let the unit be the Subaltern's quarter, consisting of one large airy room, with bathroom and verandahs, one being partially enclosed. A Captain might have two such rooms, with the option of restricting himself to one if he liked. A married Lieutenant might also have a double quarter, on the understanding that he paid rent for the same. The enclosed verandah would give him separate accommodation required by the circumstances of a married man of not very large means.

In like manner, the Field Officer might have a single, or double, or a treble quarter according to his wants, the

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33 PWD Circular No. 41 of 1866; PWD (Mly. Wks.) Simla, May 14, 1866, re: "Provision of Quarters for Officers by the State".
principle being that whatever an Officer's rank, he should only pay for what he took up, that is to say, for the unit quarter, if that sufficed for him, or for the double or treble quarter, as the case might be.

By the adoption of such a principle, every Officer would be lodged wholesomely and properly, and in the most economical manner, as it would be found that the single men would all like the same rent as they do now, the vacant rooms being thus left available for the married men. The unit quarters with doors of inter-communication should be built in groups, so as to hold either 2 Field Officers, 3 or 4 Captains, or 6 or 8 Subalterns, or to be adapted according to the wants of married or single men as has been sketched. There is no occasion to draw any distinction between Commanding or other Field Officers. The old rule of choice of quarters according to seniority, does all that is required in that respect, but I would lay down that no Officer should have more than a treble quarter, whatever his rank.  

Frugal as this strategy was proposed to be, it was nevertheless assumed that each such Officer's quarter would require additional accommodation in the form of adjacent out-buildings for at least five Indian servants, and stabling for one or more horses.

In the series of specimen plans for Officers quarters that Col. Crommelin subsequently devised, the Commander-in-Chief's specifications were faithfully adhered to. While Commanding officers were still to enjoy a detached dwelling of their own, according to this scheme, quarters for all lower ranking officers were to be clustered in ranges of from two to eight units in line. In this respect, these new design standards did tend to level considerably the hierarchical distinctions between officers and enlisted men, on the one hand, and between the officers themselves on the other. But there was still an explicit, if comparatively subtle spatial hierarchy to these plans; a meticulously graded scale of standard types, which further extended the fast proliferating corpus of standard plans. Moreover, the already large number of different basic plan types that had to be drawn up to match even the simplest correlation of rank with floor area — according to what was later to be referred to in departmental jargon as the "schedule of accommodation" — was compounded considerably by a further discrimination between the various arms of the Military establishment. Thus, for each generic category of military personnel,

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34 Ibid.
such as staff sergeants for example, separate standard plans were duly drawn up for each type of regiment—Artillery, Infantry, Cavalry—for which such quarters were required, regardless of how nominal the differences between their respective spatial and functional requirements often were. (See fig. B.3: Staff Sergeant’s Quarters for a Regiment of British Infantry.)

Beyond these various accommodation "types", so to speak, the standardization effort of the Military Branch of the Department was extended further still to the broad range of auxiliary buildings and structures that supported the day to day functioning of the Indian Army. These norms were specified more simply, however, on the basis of the generic functions the buildings were to perform and, hence, were usually deemed applicable as such to any branch of Army operations. There was, for example, a standard plan for "stables" which was presumably to be employed by Artillery regiments as by the Cavalry, whereas a separate standard plan had obviously to be devised for elephant stables. A further functionally differentiated sub-type in this particular category, for which a separate standard plan was developed, were so-called "hospital stables". For a regime dependent on communications and the rapid mobility of its officers and cavalry, the regulation of a decent minimum standard for the design of health-care facilities for its horses was of considerable importance.

35 PWD (Mly. Wks.) Proceedings, May 1865, Nos. 77-78, p.490; ----, July 1865, Nos. 0-10, B; ----, August 1865, No. 53, p.761.
37 PWD (Mly. Wks.) Proceedings, Aug. 1867, Nos. 12-13, B.
38 See for example: PWD (Mly. Wks.) Proceedings, Nov. 1866, Nos. 70-73, p. 952; ----, June 1867, Nos. 11-13, p. 489.
39 The development of design guidelines for military stables was a serious undertaking for the British. Back in England, in 1863, the War Office had convened a special sub-committee of the standing Army Sanitary Commission to inquire into the principles of modern stable design. That investigation was eventually reported in a parallel and similar fashion to the findings of the various sanitary commissions on the state of the Army with respect to the preferred principles of barrack design. See: Report of the Hospital Improvement Committee on Ventilation of Cavalry Stables (reported 31st Oct. 1863), an extract of which is reprinted in E. Ingress Bell, "The Modern Barrack: Its plan and construction." TRIBA (1880-1881): 15-40.
Other utilitarian military building types for which standard plans were established in this period, included gun sheds (fig. 8.1), armourer's shops, and saddle and store-rooms gymnasia, quarter-guards and prisons, canteens for British troops, cook-houses, plunge-baths, and guard rooms and dead-houses for regimental hospitals.  

Ongoing in the Civil Works Branch of the PWD in the later 1860's, was the major parallel campaign to improve and expand the penal facilities of British India in accordance with the norms resolved upon by the Jail Committee of 1864. Although there had been no immediate move to devise explicit standard plans on the basis of those norms, we know that multiple copies of the plans for the various classes of jails constructed in the Punjab between the 1840's and 1860's were widely circulated for information within the Department in the mid 1860's. By the end of the decade these de facto standards had evidently been adopted officially, and a formal set of standard plans had finally been issued—though almost immediately subjected to alterations. In 1869 the Government of India circulated a series of edicts in this regard, to the various departments of Public Works in the local governments. These directed, for example, that the standard plan of the larger central and district jails should be altered to separate life-sentenced convicts from short-term prisoners; to provide "night-latrines" for the prisoners' barracks; and to provide quarantine accommodation within the jail compound. Planning issues and details such as these had been in discussion for considerably longer, but it appears that the belated determination to lay down the assumed design norms in explicit standard representations had ultimately forced such questions to be resolved.

A related case was the distribution in that same year (1869) of new


42 PWD Proceedings of the Government of Fort St. George, Feb. 9, 1865, Nos. 244-245, p.606; ----, Sept. 10, 1869, Nos. 266-267, p.4230; ----, Sept. 11, 1869, Nos. 313-314, p.4260. [TNSA]
standard plans for sub-jails and talook cutcherries. Here again, the "hard" representation of a familiar architectural design problem in the form of prescriptive standard plans compelled a critical recognition of the more "fuzzy" tacit design norms for such buildings that had prevailed previously, and further rationalization of the proposed designs. In this instance the standardization initiative had actually been at the local government level, which had in turn provoked the Government of India to establish more explicit universal design guidelines of its own for these ubiquitous building types of the district administrative infrastructure (particularly in South India).

In 1869, standard plans for three different variations of Talook Cutcherry were lithographed and circulated by the Madras PWD. However, these plans—which, significantly, had been designed by the resident civil architect at the presidency—had not met with immediate success. When an exemplar of one of the designs was erected at the town of Pollachy in Coimbatore District, the building drew criticism from several quarters. The Collector of Coimbatore had questioned the security of the "treasury" component of the building, while the Inspector-General of Police had complained of inadequate light and ventilation. The PWD Secretary for Madras had confidently defended the plans against these


44 It will be recalled from our overview of the organizational structure of the Public Works Department in Chapter 4, that the affairs of the Civil Works Branch (alternately referred to as the "Buildings and Roads" Branch at certain periods in the Department’s history) were only nominally centralized in the PWD Secretariat of the Supreme Government. The bulk of the projects that fell under this broad category were regarded as "local works", subject to the directives and budget sanctions of the respective local governments and administrations. As such, these could be undertaken with substantial autonomy from the greater PWD system.

45 R.F. Chisholm was one of the mere handful of architectural consultants in the employ of the colonial administration, in that period. See Metcalf, An Imperial Vision, for the most comprehensive account to date of this significant figure in the diffusion and development of "high" Victorian architecture, in British India.

technical criticisms, but was apparently less persuasive in justifying
the excessive expense of executing this architect-designed scheme.
Supplementary funds had been requested from the Government of India to
cover the cost of completing several such buildings in course, which had
over-run their original budgets. But the PWD authorities in Simla were
unbending as usual, when it came to fiscal responsibility. A committee
convened by the Supreme Government to review the case evidently accepted
the premise of the Madras PWD that these common building types should
thereafter be standardized. However, this only emphasized the necessity
of reducing the eccentricities and attendant costs of the prototypical
designs which that local authority had approved; and various design
revisions were imposed accordingly in the resolutions of the committee.47
A consequence of these economies was a watering down of the individual
architectural distinction of the Madras Government’s original plans,
rendering them more generally applicable. But, there was no ostensive
intention to homogenize design standards India-wide indicated in the
record of this particular intervention by the Supreme Government.

Apart from jails, there were actually very few civil building types
for which the Government of India attempted to impose universal design
standards, in this period. Those civil buildings for which the PWD did
issue standard plans applicable to the whole of India included lunatic
asylums and, appropriately, "inspection bungalows" in which the
circulating officials of the colonial administration might expect to gain
some degree of repose in dependably familiar lodgings, during
"night-halts" on their tours through the districts.48

Retrenchment and further rationalization of Public Works programmes in
the 1870’s:

The accelerated works program of the post-Mutiny decade had largely been
accomplished by the beginning of the 1870’s. In the following period the

47 PWD Proceedings of the Government of Fort St. George, Sept. 15,
1869, Nos. 369-370, p.4287.

48 See for example: PWD (Civil Wks.--Buildings) Proceedings, Oct.
1866, No. 22, p. 343; PWD (Civil Wks.--Communications) Proceedings, Sept.
1866, Nos. 1-2, B.
volume of new works, requiring the development and sanctioning of new designs, was to fall off considerably.

Expenditure on public works had reached a peak by the 1869-70 fiscal year. The total grant for all classes of works and establishment charges in that year was 8,104,850 pounds; approximately 8.5% greater than the year preceding.⁴⁹ Within another couple of years, however, the trend had reversed dramatically. The annual grant for 1872-73, for instance, had fallen back to just two million pounds; less than a quarter of the grant three years earlier. This reflected an overall retrenchment in Public Works spending of 16% over the preceding year, and over 20% with respect to the portion of that budget earmarked for buildings and related works per se—as differentiated from irrigation works which, beginning in that year, were relegated to a virtually autonomous sub-department, taking with them one third of the budget.⁵⁰

The major budget supplements that had been sanctioned in the preceding period for so-called "extraordinary works" were also to be curtailed, gradually, in the 1870's. The effect was felt immediately, however, in the most conventional branches of the Department's activities. An additional 1,000,000 pounds was made available in 1872-73 for extraordinary works in the irrigation branch, and for the major new initiative in the railway branch which had commenced construction of the first government funded "State Railways", in the previous year. But ordinary military and civil works under the Buildings and Roads branch were cut back significantly. In the Budget orders for 1872-73 it was even decreed that military buildings in the process of construction were to be left unfinished wherever such were not immediately required according to the latest distribution of troops in the subcontinent. Even then, Military works still accounted for 60% of the overall budget. The grant for works in the civil sector—in which postal and telegraph works and buildings commanded the most significant individual allotments, in this period—had been diminished so much that it was exceeded in that year by

⁴⁹ PWD (Accounts) Letter No. 129, Simla, Sept.18, 1869, G 1 to SS. Enclosure to PWD Circular No.92 of 1869.
⁵⁰ PWD Circular No. 62 of 1861: PWD (Account--General), Simla, Oct.28, 1871. re: "Grant for Public Works for 1872-73".
the grant for the maintenance of the departmental personnel. 51

These important shifts in focus and clarification of priorities in
the activities of the Public Works Department do not appear to have had a
direct bearing on the design standardization policies of the Department.
But the general retrenchment of works in the civil sector had the effect
of confining the matter of "standard plans" all the more conspicuously to
military works and buildings, from then on.

Consolidation and categorization of design standardization data:

We can very briefly survey the record of departmental practice in this
regard, during the later decades of the 19th century. With few
exceptions, all new military buildings in India were being constructed
according to standard plans, by the mid 1870's. 52 The general decline in
the rate of new construction, and the fact that virtually all
architectural standards had more or less been fixed, resulted in an
alternative emphasis in the PWD on the design standardization of the less
substantial but equally ubiquitous elements of the military environment
in India; the basic furniture and appliances with which the soldiers' 
barracks and officers' quarters were made habitable.

Meanwhile, deficiencies in the supply and distribution of up to date
sets of standard plans, in the Department, had been a problem resulting
in unnecessary, time-consuming inquiries as to the existence of specific
standards and the production of unwarranted new designs for building
types already standardized. 53 One way the Department tried to manage this
problem was to compile an index of all the standard plans it had
developed over the years, including the legacy of standards (official as
well as those simply adopted by tradition) which had been retained on
file from the era of the Military Boards. 54

51 Ibid.

52 A rare example of a relatively common military building type that
had not yet been subjected to an official standard plan by this time, was
"family barracks for hill stations". PWD (Mly. Wks.) Proceedings, Oct.
1874, Nos. 217-218, Part B. [NAI]

53 PWD (B&R--Civil Misc.) Proceedings, Nov. 1872, Nos. 14-18, Part B.

54 PWD (Estab. -- Gen.) Proceedings, Dec. 1875, Nos. 5-6, Part B; PWD
Such efforts to index these designs necessitated a further form of standardization, in this case of the nomenclature which was adopted to label and categorize these plans systematically. One consequence of this was the effective exclusion of all but designs for military buildings, appliances, and furnishings from possible membership in the category of standard plans. Thus, while the term "standard plan" was effectively confirmed by this exercise as the exclusive preserve of the Military Works Branch of the Department, in the taxonomy of the PWD Proceedings, the term "type design" began to be used in an analogous fashion in the Railway Branch. "Types" in this sense were primarily standard details of railway engineering; standard sections for roadbeds or culvert designs, for instance. But, just as the range of standard plans of the Military Works Branch encompassed all manner of artifacts, such as barrack furniture or even "boilers for browning arms" 55, in addition to the barracks themselves, the type designs of the Railway Branch referred to buildings as well as to the more proper railway works per se.

The relative arbitrariness of these categories and descriptions by which the Department attempted to account for its accrued design knowledge, was evident. With increasing familiarity with the catalogue of prescribed design solutions for specific design programmes, it was often apparent that new design programmes could very well be answered adequately merely by redesignating an existing standard plan conceived for some other typical building, sometimes with no substantive design changes at all. 56

**Design standardization in the consolidation of the State Railways:**

From a cursory reading of the PWD Proceedings, one might deduce that concern for design standardization had lapsed by the 1880's. This, however, was only apparently so. For its part the commitment of the Indian military to its design standards was, if anything, more staunch than ever. But the records of the PWD fall silent in that regard as, from

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55 PWD (Mly. Wks.) Proceedings, Feb. 1874, No.105, Part B.
56 For example: PWD (Mly. Wks.) Proceedings, July 1877, No.147, B.
1882 onward, the Military Works Branch was finally accorded full autonomy from the PWD as an independent department of the Indian Government. Along with all business concerning military buildings, the term, "standard plans", which had been so closely tied to military works, disappears thereafter from the PWD records. However, turning to the alternative terms which the departmental record keepers employed to label the design standards developed in the other branches of Public Works, it is apparent that the replication of common building types—in particular, dwelling quarters for the ever growing numbers of employees of the colonial administration and its various technical departments and services—had certainly not diminished in this the heyday of European imperial expansion.

Over the course of the last three decades of the century British control of the Indian subcontinent was further consolidated, most dramatically in the realms of transportation and communications. The direct undertaking of railway works by the PWD, since the commencement of the State Railway construction programme in the early 1870's, had served to focus the design standardization efforts of the Department again on architectural matters, among others; and it was in this period that a panoply of (for the most part) mundane and repetitive new building types was thrown across the whole of the Indian cultural landscape, to house the operations, and the operators, of the ramifying railway network. By the early 1890's this design and construction effort had been substantially accomplished and, as with the earlier building drives of the PWD for the military and judicial departments, the concern was now to compile and consolidate that design knowledge. In 1890 a call was circulated throughout the Department for drawings showing the most appropriate types of station buildings, staff quarters and other basic accommodations as erected on the various lines of the system of Indian railways. The response to this call was relatively speedy and thorough, by comparison to similar design data collection efforts by the Department in earlier years, and by the end of the following year this collected

57 PWD (Rly. Const.) Proceedings, Jan. 1890, Nos. 337-357.
data had been thoroughly analyzed and compared. The process was taken a major step further at that point with a directive that all existing "type designs" in use by the various state railways were to be canceled. Engineers were instructed that they would thereafter be required to apply to the Director General of Railways for approved (new) drawings and any other particulars in connection with the construction of railways in India.

Despite their government financing the state railways had still been conceived and laid out on a largely autonomous basis by their own consulting engineers. In this regard the approach differed little from that of the guaranteed railway companies of the first phase of Indian railway development. Retroactively, however, the government appears to have been determined to draw together this variegated array of local lines, into a consolidated network, through the imposition of universal design standards. This ostensive predilection for a more orderly, standardized aesthetic on the level of architecture was underscored by the genuine practical necessity of standardizing type designs for the "harder" technical details of railway construction and operation such as standard dimensions for rail gauges, clearances, set-backs etc., with which the PWD Railway Branch was largely preoccupied in this period.

**Stasis: Standing Orders regarding standard plans for military buildings, in the early 20th century**

In the final years of the Victorian age, and early decades of the 20th century the methods and built product of the PWD were to come under a mounting onslaught of criticism, for reasons we will examine in the final chapter. The standard plans of the Department were to bear the brunt of these aesthetically oriented attacks, as they were perceived—quite correctly—to be both the most representative and pervasive product of the Department's allegedly bankrupt design imagination, and the essential kernel of its banalizing method of architectural production.

Although the omniscience and rigidity of design standardization in

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the policy of the Department was hardly as consistent or extreme as these anti-PWD polemicists were to argue—as the preceding survey has indicated—standard plans had indeed become an institution of departmental design practice; as a bureaucratic instrument for organizing and physically managing and disseminating design information, and as a conceptual institution—a form of "default reasoning"—through which the intellectual labour of design production could be made more efficient and even creative.

The military engineers had always been the most ardent exponents of design standardization in the PWD and while it remained within the Department, the Military Works Branch had, as we have seen, developed the most rigorous and thorough "system" of standard plans. A glance, finally, at the Code of Regulations for the Military Engineering Service—the autonomous agency that had splintered off from the PWD in 1882—published in 192960 will give us a good indication of the degree to which the principle of standard plans had evidently been institutionalized on a lasting basis in the design reasoning and, in an integral and interdependent manner, in the explicit procedural conventions of this and other governmental works agencies. Noteworthy is the limited flexibility implicit in these regulations whereby time consuming routine decision making could be safely entrusted to low ranking local authorities, the higher standing design norms for which senior authorities remained responsible being embedded in the inviolable general principles of a given standard plan.

I will quote the relevant articles concerning "standard plans" in full:

a) The scales of accommodation and the general designs of quarters and certain other buildings, have been approved by the Govt. of India, eg, the dimensions of rooms and verandahs and the general nature of the floors, walls and roofs. In other cases the general design and specification are to be furnished with the plinth area estimate and will be approved by the authority competent to accord administrative approval to the work.

60 Regulations for the Military Engineering Services, (Calcutta: Government of India Central Publications Branch, 1929): Section V (Buildings and Roads), para. 61 (Scales and Designs of Buildings), 82.
b) The scales of accommodation and general designs and specifications as approved by the Govt. of India are contained in the Barrack Synopsis (India). Any deviation from the approved scales requires the approval of the Govt. of India in the case of new buildings, and of the administrative authority competent to approve the estimate in the case of the adaptation of existing buildings for purposes which can be authorized without approval of the Govt. of India.

c) Standard plans of buildings embodying the approved scale, general design, and specification, will be issued by the Engineer-in-Chief and copies are to be maintained in the offices of C.E.s., C.R.E.s., and G.E.s. Copies will also be furnished to local administrations for use by the PWD in areas where they execute military works.

d) Standard plans are to be regarded as a guide and, provided that no deviation is made from the approved scale, general design and specification, the standard plan is to be adapted, when framing the detailed estimate, to suit local conditions, having due regard to economy and structural efficiency. Important deviations are to be referred to the engineer authority who sanctioned the estimate (see M.E.S. accounts code).

e) It is not obligatory to apply changes in scales of accommodation or general designs in the case of works to which administrative approval has been accorded before the introduction of the changes. Each such case will be considered on its own merits.

In the first section of this chapter we have gathered some idea of the historical pattern of development and general scope of design standardization in the Indian PWD in the second half of the 19th century, through a systematic sampling of the relevant departmental records. A significant evolution has been observed over the course of the century, with respect to the objectives and degree of rigidity of such standardization practices. The cadences identified in this particular aspect of departmental operations indicate that the PWD resorted most

61 The Barrack Synopsis was a manual of regulations and specifications pertaining to all routine aspects of the soldiers' life in barracks and the maintenance of that environment. This was updated and re-published periodically. See for example: India, Army Regulations. Barrack Synopsis (India). Calcutta: Government of India Central Publication Branch, 1930.
conspicuously to standardize its design output in periods when the Department was mandated to build especially large numbers of new works and buildings in relatively limited time frames. There was, however, no predominant technical rationale for the development of, and adherence to strict design standards in that endeavour. Whereas the mass-production of standardized building components, and indeed entirely pre-fabricated modular building systems, had made a major impact on the Victorian building industry, not only in Britain but even more conspicuously on foreign shores where both the commercial power and military might of the expanding British Empire were making their mark, the application of industrialized building technologies in Victorian India was, as we have seen, surprisingly nominal.\textsuperscript{62} The incentives to design standardization were evidently more internal to the operations of the PWD itself. As our sifting of the records has intimated, the utility of such might be explained in terms not only of the material, but of the political and cognitive economies operating within that bureaucratic organization as well. We now need to see what sense we can make of those hunches.

The issue might be more specifically framed, to begin with, by considering the problematic duality inherent in the linking of the antithetical processes of "designing" and "standardizing".

A design process strictly constrained by standard plans more or less entails an effective abstention from innovation, if not the obsolescence of the design act per se.\textsuperscript{63} In the routine building efforts of the British

\textsuperscript{62} Factories for manufacturing hollow concrete blocks, and patented reinforced concrete beams, had begun to operate in India by the early years of this century. See, for example, the description of the Indian Siegward Beam Co., Ltd., established in Madras in 1910, in Southern India: Its History, People, Commerce, and Industrial Resources, ed. Sommerset Playne, F.R.G.S. (London: The Foreign and Colonial Compiling and Publishing Co., 1914-1915.) By that time the Indian-owned Tata Steel Works had also begun to make an impact. Rolled iron and steel beams, had begun to be considered as standard building components, by the end of the 19th century, in both trussed and vaulted roof construction. Ubiquitous in short span structures built by the PWD—in the railway Branch in particular—beginning around the turn of the century, was the so-called "jack-arch" comprised of brick vaults supported on simple iron rails. See fig. 4.9, "Proposed Assistant Engineer's Bungalow at Rutlam."

\textsuperscript{63} Design theorists conventionally distinguish two broad types of design: "routine" and "non-routine". Sriram distinguishes three further sub-classes of non-routine design: "redesign", "innovative design" and
Indian administration, in the last three decades of the 19th century, there was certainly little evidence to the contrary. But, was this dearth of further innovation an objective of design standardization in the PWD, or merely a by-product? We need to explain whether there was, in fact, any formal intention to economize on design effort or, alternatively, whether there was any conspicuous value placed on uniformity of method; and, did either intention/effect conspicuously determine the other, or was there a "multi-functional" relationship between them?

A further obvious question arises, with respect to the actual product of the Public Works Department's standardized design production: was there any conspicuous value placed on the uniformity of appearances or, conversely, was design novelty actively discouraged?

These questions are addressed (not necessarily in this order) in the final three sections of this chapter. I proceed, first, to examine the larger economy of information that operated within the PWD, of which the production and exchange of design information was one significant component. I then consider the corporate conceptual system that had come to be embodied institutionally in the normative frameworks of the Public Works Department and the larger bureaucracy of which it was itself a component, to try to explain the seemingly inverted design priorities maintained by British engineers in colonial India by comparison to their metropolitan colleagues. Finally, I will describe and analyze the actual methodology by which architectural designs were evidently developed by the departmental engineers. I consider the apparent utility of standard "creative design", respectively. The design practices of the PWD inclined increasingly toward mere routine, the simplest type—a process based on the assumption that both the knowledge of design and problem solving techniques are known in advance. Routine design consists essentially in refining an a priori plan of the design or prototype to the particular requirements of each new instance. "Redesign" proceeds similarly within a well-defined state-space of potential designs: the creation of new artifacts by modification of existing ones, so that it fulfills new functional demands. See: S. Sriram, Knowledge Based Approaches for Structural Design, (Southampton U.K.: Computational Mechanics Publishers, 1987), in A. Zandi-Nia, Zandi-nia, A. Topgene: an artificial intelligence approach to a design process. (Delft: TUDelft, 1992), 2-5/2-7. Once the fundamental climatological and construction issues had been satisfactorily resolved by "innovation", the departmental system made do with these prototypical solutions by simply re-instantiating them or, at most, "redesigning" them as such.
plans, techniques, and design data in that process, as a case-based system for design production.

2. STANDARDIZATION AND THE ECONOMY OF INFORMATION IN THE PWD

In the present section I take a further look at the organization of the PWD bureaucracy and the standardized procedures it developed for all aspects of its day to day operations. I consider the information economy that organization supported, and the possible effects that it had in shaping design protocol.

Let us begin with that protocol, and consider what the departmental officials actually declared to be their rationale for formalizing design standards.

The official rationale for design standardization:

A relatively straightforward explanation of the intended use of standard plans in ordinary departmental practice was offered by Lt.Col. C.H. Dickens, Richard Strachey's successor as PWD Secretary, who served in that post through the particularly intensive period of PWD building activity in the second half of the 1860's:

...Standard Plans are only intended to show the general arrangement and extent of accommodation to be provided, and should not be considered in the light of "working drawings" as showing structural details which should be invariably followed. Such details should be left to be worked out by the officers of the Department under the orders of their local governments. 64

The Inspector-General for Military Works, Col. Crommelin, concurred in this flexible notion of how design standards were to be used. In his exhaustive exchange with the Government of India, the India Office, and the various sanitary commissions, over the design standards he had proposed for the Military Works branch, it had been concluded that the best plan was "...to lay down the general principles to be followed in barrack construction, and to leave the designs to be prepared by the

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64 PWD Circular No. 76 of 1865: (Mly. Wks.) Simla, May 15, 1865.
Local Officers, subject to review by superior authority. All the same, the authorities were not unreservedly confident in the skills of those local officers. In a departmental memorandum of 1864, the view was expressed that "[t]here are comparatively few officers who can furnish good designs... (Therefore,) the safest way to ensure uniformity on important points is to provide standard plans...and standard block plans showing the only approved modes of distributing these buildings in all possible cases."

For their part, the incumbent Viceroy in that period, Sir John Lawrence, and the Secretary of State for India, Sir Charles Wood, were in agreement over the value and basic purpose of a policy of design standardization. According to Wood, "...the style, magnitude, and number of the various classes of (military) buildings should,...throughout India be regulated as nearly as possible on the same principles." "[T]he utility of a system of standard plans..." as he saw it, was "...in checking the indulgence of individual caprice and fancy..." Individuality in such architectural matters was evidently equated not only with unnecessary cost, but with counterproductive distraction from the larger, united objective of the colonial administration: to uphold the authority and system of British dominion in India, with as little ambiguity as possible.

These various viewpoints found their way into the more formal (though less than definitive) directives pertaining to standard plans that were included in the second edition of the PWD Code of Regulations published in 1868:

All military buildings must be constructed according to the standard designs fixed by the Government of India, when such have been published; and the sanction of that Government should

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65 PWD (Mly. Wks.) Proceedings, Feb. 1866, No.5.
66 PWD Memorandum, May 23, 1864, re: "Barrack accommodation for unmarried Europeans". Quoted in A.D. King, The Bungalow.
67 PWD Despatch from the Secretary of State No. 27 of 1864, June 16, 1864.
be obtained when any deviation from the standard is considered desirable.

Evidently, buildings conforming to standard designs did not generally require the sanction of higher government authority so long as the budget for the project fell within the already allotted annual grant for public works expenditures, under the appropriate category. Only where no standard existed was a design for a military building required to go through the full sanctioning routine with the Government of India. For military works, at least, the virtue of standard plans was therefore the fact that they could considerably accelerate the process of carrying through a building project, by streamlining the bureaucratic aspects of the undertaking.

The ambiguity of the Code with regard to the standardization of designs for civil buildings corroborates our observations from the departmental records. Works and buildings in that category were not normally the concern of the supreme government authorities according to the partial devolution of authority in the PWD, and apparently subject to less rigorous and thorough standardization measures as a result:

Standard plans of the principal Civil Buildings in common use should be prepared under the orders of the Local Government or Administration; and where such standard plans exist, they should be followed as far as practicable in the preparation of designs, with respect to the authorized accommodations and arrangements approved by superior authorities.

The elliptical references to standard plans in the PWD Code give us no conclusive indication of what the Departmental policy with respect to design standardization was really based on. But my survey of the departmental records has furnished no statements more specific than these, from which we might deduce that an official policy in this regard had ever been clearly laid down. The evidence suggests, in fact, that there may well not have been any such original initiative. Rather, a predilection of the departmental engineers to seek satisfactory if not

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69 CHAP.IX, Sec.4: Military Buildings, No.4. Ibid.
70 CHAP.IX, Sec.1: Civil Buildings, No.4. Ibid.
optimal solutions to a given problem, capable of replication, seems simply to have been reinforced at different times in the Department's history when a greater degree of control was deemed necessary.

A case in point was the introduction of the system of "type designs" in the PWD Railway Branch, at the outset of the State Railways construction boom of the 1870's. Guilford Molesworth, the civilian railway engineer engaged by the Government of India to manage that major undertaking, was the PWD official personally responsible for instituting those standardization measures. In an early report on the progress of the various state railway projects, Molesworth observed that misguided notions of time-saving had encouraged a too hasty submission of projects to his office. In their incomplete state, such rushed submissions had actually resulted frequently in time losses due to the need to clarify unspecified details. Conversely, he had also observed that poor judgment of the relative significance of matters submitted to superiors for decisions was similarly bogging down the system. The capacity of Molesworth and his staff in the PWD secretariat to cope with matters of key importance was constantly being compromised by comparatively trivial questions concerning minute and mundane details.

Molesworth's answer to these impediments was to issue lithographed type drawings for all the common design details engineers could expect to encounter in typical railway construction in India; drawings he took upon himself to prepare. The purpose was to economize as efficiently as possible on the consumption of professional cognitive resources within the departmental establishment, as much as such measures addressed the obvious technical necessity of standardizing design throughout the network of State Railways so to insure their operational compatibility as an integrated transportation system.

Consolidation of power through division of departmental labour:

Design standardization was a method by which the senior departmental

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authorities could divide and delegate labour while consolidating their power to control the work of the Department. Through standard designs, as the case of the State Railways Branch suggests, they retained a firm grip on the more consequential matters of project management, including cost and scale of accommodation, while delegating routine, time-consuming decision making at the level of construction details, and minor local exigencies, to the distributed subordinate levels of the departmental hierarchy. The limited flexibility accorded to the executive engineers in their adaptation of the official design standards to local conditions, actually enhanced the effective control that the central Government could exercise over the building operations of the PWD as a whole. The clerical and cognitive economies realized through the considerably reduced demand for assessment and approval of new designs and design changes, freed the Superintending and Chief Engineers of the Department to exercise more acute vigilance and decisiveness on the design issues and specific design problems on which they were obliged to take direct action.  

72 The conventional professional organization of knowledge tends to minimize the conceptual distance between actual cases and professional reflection at the level of principles, as Hillier and Hanson argue in The Social Logic of Space (Cambridge: Cambridge University Press, 1984), 189-190. Such a structure is most successfully sustained and legitimized where the technicalities of cases are sufficiently complex or indeterminate, or where their implications are potentially significant as for instance in even the most banal of legal cases, such that professional judgment must be applied directly and personally to best control risk. The professional organization of knowledge ideally does not allow for intermediaries "...between those who hold the knowledge--that is, those who have knowledge of principles to be applied--and those who deal with cases...If organizations are structured so as to best control risk, then a professional organization [of knowledge] must be structured so as to maintain this direct interface between principles and cases as far as feasible." (ibid., 189)

The bureaucratic organization of knowledge, as we have begun to observe, exhibits an opposing tendency by placing faith in a central discipline of "procedures" to control risk, rather than the personal intercession of professional judgment. But, referring again to Hillier and Hanson, "...if procedures are to control risk then they must both be set out and seem to be followed. The mode is essentially hierarchical. Those at the top of the organization concern themselves with principles...while those at the very bottom deal with cases." In the hierarchy there is usually also a series of layers in which each layer inherits principles from above and transmits them below as procedures. The internal logic of such a procedure-based organization tends continuously to increase the conceptual distance between those who deal
By contrast to the "Whiggish" division of powers that had characterized the "regulation" system of administration developed under the East India Company—epitomized by the notorious "red-tapism" of the former Military Boards—the move toward design standardization in the Public Works Department of the post-Mutiny era was among the more convincing indications of the crucial value change in the conceptual system of the colonial administrators that Stokes has described; from the polarized idealism of the radical reformers and Tory paternalists of the old Company regime, to the brazen Utilitarianism of the new Raj. 73

Standard plans themselves were (at least) intended to be optimal solutions for the particular design problems they addressed, balancing maximum satisfaction of basic spatial and service requirements against the criteria of maximum adaptability to multiple contexts and users, and (of course) minimum potential cost. As a medium for efficiently accessing and applying the expert precedent knowledge accrued over the years by the departmental engineers, to very specific design problems, such plans and the regulated procedures through which they were to be applied served to bolster the cognitive authority of the individual PWD engineers. This enabled them to exercise a relative omnipotence and autonomy in their actions as executives of the greater departmental works program. Within the explicit constraints that such an ordering and regulating framework of design standards imposed, the engineers of the PWD were therefore empowered—each at their own level of the departmental hierarchy—to act as the responsibly despotic technocrats that the Utilitarians had idealized.

The significance of this value change, and the consequent changes in the internal economy of information and productivity of the PWD, may be gauged from an amusing anecdote attributed to the celebrated Madras irrigation engineer, Sir Arthur Cotton. "The Great Putty Case" (as he satirically labelled this true-life saga culled from the records of the

in principles and those who deal in cases "...since the elimination of indeterminacy at the point of contact with cases must depend on procedures that can deal with every conceivable type of case, and this must in turn lead to an even more complex hierarchy of control." (ibid., 190)

73 See Chapter 4.
Rationalization, Standardization, and Control in Design

Madras PWD was a typical example of the red-tape methods and the divided powers of decision making that had so encumbered the machinery of the old works administration under the Military Boards. (The anecdote is of sufficient interest to quote in full):

"The Great Putty Case":

A range of barracks is built by an Engineer at a cost of 30,000 or 40,000 pounds; there is a large saving on the estimate sanctioned, for which he receives the thanks of the Court of Directors. Some time afterwards, a storm occurs which breaks a few panes of glass valued at 7 pounds. The heads of that division of the Army are directed to assemble a committee of officers to investigate the matter. Their report is referred to the Military Board, who forward all the documentation to the Governor-in-Council with a deliberate and elaborate report. They conclude that the cause of the windows being broken is the quality of the putty used, and that therefore, the Engineer ought to pay for them.

All the papers connected with this intricate and vital matter are now examined by the Secretary to Government, who sends them in circulation to the Governor and three Members of Council; and the important day at length arrives when the whole is to be reviewed and discussed in Council. The Government Secretaries are summoned, and a solemn investigation is proceeded with upon which the fate of 7 pounds depends. After much discussion it is decided that the Secretary shall draw up a report embodying the opinions of the Council, to be submitted, with all the important documents connected therewith, to the Honourable Court of Directors and the Board of Control. After many months, during which the papers have been the frequent subject of communication and discussion among the secretaries, directors, etc., etc., in London, a steamer proceeds to India with the freight of these papers, greatly increased in bulk. They reach Madras; the Council is again assembled; the despatch is considered; a copy, with resolutions, etc., is sent to the Military Board; and after having been circulated, considered and discussed by them, instructions are issued announcing that the Honourable Court, of course with the concurrence of the Board of Control, have decided, for reasons duly stated, that the windows shall be mended at the expense of the Engineer.

In the meantime, as the officer is not in India, that matter lies over for a year or two. On his return, being surprised at the receipt of these orders, he addresses the Chief Engineer, giving him, in a few words, reasons why he ought not to be held responsible for the loss of the 7 pounds. The Chief Engineer, draws up a minute on the subject, which is

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laid before the Military Board, who again consider the question and once more report to Government. The Governor records a minute, the Second Member of Council minutes, the Third Member minutes, the Governor winds up by a fourth minute. Again the Council assemble, consider, decide, and issue instructions to the Military Board, and finally the officer is told that he may keep his 7 pounds. And so ends the affair till the report of the Governor-in-Council reaches the Court, when they will possibly order the matter to be taken up de novo and thoroughly investigated. It should be mentioned that it was found at last that some brads had been omitted in fixing the glass, which was not likely to be discovered either by the President of the Board of Control, the 24 Directors and their Secretary, the Governor and Council of Madras and their Secretaries, the Military Board, the Chief Engineer, the General of the Division, the Committee of officers, or the Engineer himself, as none of them had ever served an apprenticeship to a glazier. This is the literal history of an Indian question that has recently been agitated.

The absurd degree to which decision making had been distributed and counter-balanced in the "patch-work" system of works administration that prevailed in local governments such as Madras up to the very end of the Company era, had not merely provoked derision, but had seriously hobbled productivity. Dalhousie's reforms of the early 1850's had set about rectifying this impediment by consolidating the powers of the new Public Works Department. But that process was pushed considerably further with the advent of Crown Rule in the subsequent decade, when the reform of the colonial polity as a whole resulted in a marked centralization of administrative structure and practice, in all departments of government. Referring back to our discussion of that process in Chapter 5, it will be recalled that the essential traits of the new PWD technocracy were the unity of authority it vested in professional expertise, on the one hand, and the uniformity of information and decision management procedures it maintained, on the other, through which such expertise could be most effectively coordinated and applied. The concentration of limited decision making powers in the hands of responsible, professionally qualified officers, at each of the executive levels of the departmental hierarchy was made practical and productive, in principle, by a system of standardized procedures through which the decisions and actions of those officers were made fully accountable.

Standard plans were just one facet of that system of uniform
information management. The energetic drive to standardize the design output of the PWD in the years following the Mutiny was a parallel of a more general consolidation drive in that period which aimed to define and rigorously standardize the procedures by which the Department executed its business. Clearly conducive to the use of standard plans, these measures appear to have contributed to the standardization of design methods as well.

The standardization and control of bureaucratic procedures:

The official view of the virtues of a strict and thorough approach to the processing of departmental business was defined by Richard Strachey in a PWD circular of 1862, in which precise procedures were laid down for the proper submission of projects to the Government of India for sanctioning purposes:

The Government of India desires that it may be understood that in addressing these instructions to Local Governments and Administrations, it has no wish to interfere in any way with a complete legitimate freedom of action on the part of the local Officers, whether Engineers or others. On the contrary its intention is to lead to the reduction, as far as possible, of all ground for interference, and there is no more certain way of accomplishing this end, in respect to the matter in hand, than to see that all projects are submitted in a form that shall at once show beyond question that they have been thoroughly considered by the projectors, and that shall at once enable the Government of India to appreciate and weigh the whole of the grounds on which they have been put forward by the local authorities. The number of projects that call for sanction from the Government of India is now so small, and their importance on the other hand is so great, that any additional elaboration required to ensure complete attention to the points that have been adverted to in this Circular, will, it is believed, not be practically onerous; while it most assuredly will lead to great improvement in the projects themselves, as well as to the cessation of much criticism, which at present is quite unavoidable on the part of the Government of India, and very distasteful to the local authorities.

75 PWD Circular No.123 of 1862; PWD (General), Fort William, Nov. 29, 1862. All references to Strachey in the following discussion pertain to this document.
The key points of Strachey's instructions were that project submissions should be as complete and detailed as possible, both in substance and exposition and, further, that such should only be forwarded to the supreme Government accompanied by a distinct record of the opinion of the chief professional officer of the Public Works Department in the local government concerned.

In preparing a design submission, the engineer responsible was to provide complete plans, specifications and estimates for the scheme, and an equally "...complete account of the basis on which every part of his project has been framed in respect to the various considerations that have guided him in questions of engineering details, of economy of construction, or of utility or practical working of the project when carried out..." He was also obliged to consider the methods and estimate the time frame in which the project would be possible to execute.

The necessity for explicit evidence of the prior review and approval of the project by the local head of the PWD, was equally obvious in Strachey's view. Despite all efforts at thoroughness, a project submission could not be expected to be absolutely explicit. There would always be many points, of local or technical detail, which would necessarily be left to the judgment of the engineers on the spot. The duty of the professional heads of the Department was to assure the Local and Supreme Governments that such matters were properly planned and accounted for.

The crux of these directives was, as Strachey emphasized, "...that nothing should be left to be taken for granted..." when any matter was referred to a distant authority. The Government of India was duty bound to assess a project on its own evident merits; not merely on faith in those who had forwarded it. He was apparently determined to allay any misconception that the sanctioning protocol of the Department was just a rubber-stamping exercise.

The proportion of public works projects, "of such magnitude as to call for [their] submission to the Government of India", had diminished considerably since the days of the Military Boards, as Strachey indicated, as a result of the consolidation and clarification of the departmental hierarchy whereby a practical distinction had been drawn between "Local", predominantly civil works manageable directly with the
portion of the departmental budget allocated to each local Government for such purposes, and "Imperial" works including all military buildings, which the Supreme Government was obliged to sanction. Nevertheless, with the deluge of works that the Department was saddled with generally by the mid 1860's, the still excessive demand on the PWD secretariat in the Government of India to review new projects for sanction soon brought the impossibly cumbersome practice of exhaustive submissions into question.

Shortly after succeeding Strachey as PWD Secretary in 1865, Lt.Col. C.H. Dickens issued a new departmental circular on the topic of project submissions. Experience had demonstrated that virtually all projects for large military buildings (the most common class of "imperial" works in this period), no matter how well worked out, were almost always subject to some degree of revision before they could be accorded the sanction of the Government. This inevitably entailed the production of new drawings and estimates. To avoid wasting time and effort, therefore, it was now considered advisable to reverse the standing orders in this regard. Engineers were instructed to eschew detail in any preliminary project submission; plans, specifications and estimates were, as efficiently as possible, to present only the most essential information concerning the projected building.

This ostensive reversal of policy can be seen as an evolutionary rather than a contradictory measure in the Department’s progressive effort to achieve a more effective economy in the processing of information. It had become apparent that, past a certain point, a plethora of mere information was encumbering if not counter-productive to design decision making. What the sanctioning authorities required to know were the projected cost and the fundamental schema of a design, on which all other details would depend. The basic responsibility of the engineer proposing a project was to exercise judgment, as a professional expert, to discern that most essential knowledge of a particular project, and communicate it with optimal economy.

Departmental regulations for office routine:

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76 PWD Circular No. 102 of 1865: PWD (Mly. Wks.), Simla, Oct. 18, 1865.
The three-way relationship that the departmental officers endeavoured to optimize, between sufficiency, efficiency, and accountability in the exchange of information in the PWD, is further illustrated in the protocol of procedures the Department evolved to process its day to day business.

A standardized office routine, applicable to each of the technical and administrative branches of the Department, was meticulously prescribed in the PWD Code of Regulations. This routine was an elaborate ritual consisting of registering, relaying, receiving, and interpreting incoming letters; collecting and compiling additional documents, maps and plans from the departmental records to prepare a given case for consideration; submission of prepared cases to departmental heads for orders; re-registration and distribution of considered cases for further or final preparation; re-submission of cases to Department heads for final orders; drafting of letters for issue and further approval of same; fair-copying or printing of approved drafts; and, finally, the "disposal" of cases including the signing, dating, registering, and collating of final letters and their enclosures prior to despatch. At every stage of this routine the flow of information was carefully accounted for. Every in-coming and out-going case was methodically registered and every additional document such generated or to which such referred was duly listed. Furthermore, every case passed repeatedly through the Registry to record its current status and the re-distribution of the various documents of which it was comprised.

At the end of this process disposed of cases were committed to the departmental Records Branch, for which a further meticulous routine was prescribed. It was this Branch that was responsible for maintaining and managing all the past records of the Department, and for compiling and indexing the monthly Proceedings of its current business. Once definite orders had been passed on a given case, all of the previously unrecorded papers received or newly generated in connection with that case were at once prepared for record or filed. Other papers drawn from the

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77 PWD Code of Regulations, Chapter VI: "Office Routine", "Recording". As reprinted as an enclosure to PWD Circular No.69 of 1968.
departmental records were returned to their original files at this point, but countermarked with the newly recorded papers.

The sheer mass of documents to be reproduced, catalogued and filed in this manner would have been overwhelming were it not for a crucial process of classification by which incoming material was sifted, and the majority relegated to temporary files subject to destruction after a limited period. There were three such classes of records: In "Part A" were placed papers of first importance; in "Part B", papers of minor importance still considered worthy of being preserved; the remainder simply filed for destruction after a statute of two years. The monthly Proceedings of the PWD were essentially the compiled and numbered record in full of "Part A" cases. These were printed at length and bound together with a Table of Contents, an abstract of Part B cases, and an Index, to form the monthly volumes.

Despite this sifting procedure, the Department was still prone to propagate the mass of documentation on record. At least six additional copies of every collection of papers published for the monthly proceedings were struck off at the printers for filing in the departmental Record Room. And papers of exceptional importance, likely to be much referred to, were printed and duly filed in even greater number. Only after five years were the records keepers permitted by the regulations to weed out these extra copies, if any remained. (As each of the provincial works departments maintained their own records, and published their own monthly proceedings, this proliferation of records by the Department as whole was indeed considerable.)

The great bulk of these labours were carried out by the clerical staff of the Department, their collective duty consisting in preparing each case in full for the orders or approval of the Department head, and for disposing of such according to the latter's instructions. Clearly, the whole operation depended greatly on this subordinate cadre. However, the regulations explicitly distinguished the procedural nature of those labours from the professional judgement that the engineer officers were called upon to exercise in their capacities as the executives of this bureaucracy. In the crucial matter of classifying the departmental records, for instance, the Code obliged the Officer in Charge of the Records Branch to exercise a careful check over that process;
particularly to guard against important cases being recorded in Part B, merely because the letters were short. 78

Like a well oiled machine, the procedural apparatus of the PWD could process and dispose of departmental business almost automatically. It could also be regulated to be more or less parsimonious in its consumption and reproduction of information. Left to its own devices, however, this predominantly "native" staffed bureaucracy was not trusted to be sufficiently discriminating in dealing with matters that strayed at all from routine. Power and responsibility were still firmly vested, in theory, in the engineer officers in charge. Constantly, officers were called upon to exercise their professional judgement to process the still very substantial portion of the departmental business under their particular authority that actually passed across their own desks.

One is astounded at the quantity of correspondence the average Victorian bureaucrat was capable of processing. However, the pyramidal hierarchy of departmental authority functioned inevitably to deluge each successive desk higher up the ladder of seniority with ever greater quantities of paper. All the while, therefore, senior staff were obliged to remain vigilant and prepared to intercede at the more routine level of decision-making, where doubtful or ambiguous cases made it necessary, to insure the supply of a sufficiently substantive rather than overwhelming flow of information from below. But there was evidently little scope in practice for such constant vigilance.

The standardization of departmental forms and documents:

The more the executive cadre of the Department could depend unquestioningly on the performance of the subordinate staff, the more manageable and efficient their own tasks became. The standardization of office procedures offered one significant means of control, in this respect. Another was the standardization of the form and content of the typical documents the departmental staff used to communicate basic data, orders, designs, etc., such that information was relayed with maximum directness and a minimum of ambiguity arising from unnecessary

78 Ibid.
interpretation. Specific standard forms were devised accordingly for every manner of document and data regularly circulated within the Department in its day to day affairs. These included standard forms for different types of official letters; tabular statements for all manner of prescribed data, such as schedules of accommodation, materials specifications, standard dimensions for public buildings; bills of quantities, and forms for the preparation of budget estimates. The combined bulk of these standard forms was such that they comprised a full supplementary volume to the PWD Code.

Among the more avid promoters of such procedural and documentary modes of standardization within the PWD was Col. George Chesney—that singularly willful institution builder and critic responsible for establishing the Cooper's Hill engineering college and for instigating India-wide administrative reforms in the 1870's through his influential critique, Indian Polity. (see Chapter 5). Chesney first gained the attention of the India Office with the rigorous procedural reforms he brought to bear on the PWD in the early 1860's, in his capacity as Accountant General of that department, through which considerable economies had been achieved. Among various measures he introduced to rationalize and consolidate accounting practices in the Department, Chesney had zealously promoted the use of standardized tables for the compilation and presentation of financial data. These had greatly improved knowledge of the actual performance of the Department, in particular through comparative enumeration of basic data such as budget estimates vs. actual costs, and annual works grants vs. net expenditures and the particular breakdown of such between the different local governments and administrations under the various categories of works. In such tables, the allocation of funds was not only accounted for by category, but Chesney also introduced the principle of classification as to the relative priority of projects—a criterion which considerably

79 On at least two different occasions Chesney earned the personal accolades of the Secretary of State for India, for the smooth working of his revised system of accounts, and the generally healthy state of arrears and fiscal control the Department enjoyed during his tenure as head of the Accounts Branch. See: PWD Circular No.27 of 1863: SS to G. of I., Letter No. 16, April 24, 1863; and, ---- No.21 of 1867: (Accounts) Fort William, March 5, 1867. (NAI)
altered the works granting policy of government, enabling the focused acceleration of efforts on "extraordinary" military and judicial works, in the later 1860's. 80

Chesney's tabular accounts drew attention to further revealing comparisons such as the net cost of works vs. the corresponding costs of maintaining the departmental Establishment; and the trade-offs between revenues from the so-called "productive works" such as railways and irrigation canals and outlays on construction and maintenance. Of greatest utility were, possibly, the exhaustive historical tables of such data, comparatively charting their fluctuations from year to year, that Chesney's neatly organized data base enabled him to compile in his later reports on the annual Public Works Budget Estimates. 81

The tabular statements produced by the Accounts Branch had depended, in turn, on strict guidelines for the submission of budget estimates, and all other manner of accounts and finance related correspondence, that it imposed on the rest of the Department. The more integral to the accounting system that thorough, accurate, yet economical reporting of financial data became, the more the procedures and formats for such reporting were rigorously standardized. By the mid 1870's, Chesney's successors had developed an exacting methodology; budget estimates could only be received on the specially printed "pattern forms" that were tailored from a standard template to the specific criteria of each branch and category of works therein. 82 On this standardized basis for effectively distributing and sharing the perennial labour of compiling the Annual Budget Estimate for the Department, the task for the Department head had been streamlined down to little more than checking and approving the received statements, and sending them off for binding.

80 Ibid.
82 The specificity of these pattern forms had certain incidental drawbacks from a point of view of efficiency, however, when it came to reflecting any changes. Obsolete forms had to be discarded and new ones printed and distributed; an added administrative headache that could easily lead to its own inconsistencies. See for instance: FWD Circular No.91 of 1876: FWD (Acct.--General), Fort William, Dec. 30, 1876.
Responsibility over routine in the duties of the executive engineers:

The standardization of bureaucratic procedures such as office routine in the PWD, applied principally to the business of the departmental secretariat in the Government of India, in Calcutta and Simla, and to its sub-departmental equivalents in the various Local Governments. A virtue of standardization at that level of operations was, as we have seen, its effect in reducing the cognitive exertion of the engineer officers in charge, in particular. Where so much of the departmental business was indeed a virtual repetition of routine decisions and solutions, the strict standardization of the forms in which such was presented and the methods through which it was processed, made very clear the distinction between the reams of mundane information pre-supposed in a given case, and the comparatively small number of issues, details or anomalies to which the PWD Secretary and his deputies in the various departmental branches were obliged to turn their professional attention. The procedural standards of the Department, along with its design standards, can be said to have been, in this sense, the institutionalized "default reasoning" of the departmental decision-making system.

The basic logistical requirement for such "time-saver" standards at the level of the departmental secretariat did not apply however--to the same degree at least--to the executive engineers in the districts. For those officers, departmental standards were a necessary common currency for communication in the departmental "economy" of information. Most obviously in the form of standard plans, they were also a very efficient means of diffusing the aggregated technical knowledge and managerial experience of the Department to its outlying representatives in the field in the most ready-at-hand manner, directly applicable as such. On the other hand, the temptation to the engineering field staff to regard the relative dependability of rote routine as an opportunity for relaxing vigilance and relying on subordinate staff to accomplish the work, was firmly admonished.

In financial matters especially, the Department was reluctant to relinquish any substantial responsibility to the clerks. For instance, standardized procedures and reference aids employed in estimating project budgets were evidently adopted by the Department to assist the
engineering staff in accomplishing the task themselves, as autonomously and hence (presumably) responsibly as possible. It was with that end in view that standardized "schedules of work", or rate scales, were introduced by Col. Chesney, early in his tenure as Accountant General. As his later efforts in engineering education would suggest, Chesney was concerned to bring practice in British India in line with the most advanced metropolitan norms— in this case, the system of costing standardized for government works projects back in England. In a circular of 1863, Chesney outlined the advantages anticipated from the adoption of such a system in the Indian PWD:

The time has not come for introducing completely the English system into India, involving, as it does the invariable adoption of contract work, but the Governor-General is of opinion that an approach towards it may be now made with extreme advantage by the adoption of a set of standard schedules, and that such a step will both tend to facilitate the extension of the contract system, and will greatly simplify the accounts and estimates of work not carried out by contract...

Enclosed with Chesney's circular were two full sets (amounting to no less than 400 pages!) of the current schedules of specifications and rates published for the War Department of England and Ireland. These he hoped could serve as a general model for the Indian PWD, though he considered them far too elaborate for the immediate requirements and relatively straight-forward nature of the usual works undertaken by the Department. He felt, however, that they would illustrate the principles and the advantages of efficiently managing and estimating the increasingly complicated works anticipated in the future. Chesney's immediate concern was to arrive at a consensus within the Department, in all of its branches and local sub-departments, on a standardized nomenclature, mode of specification, and method of calculating quantities for which India-wide standard schedules of works could be prepared.

In time, such schedules were indeed developed. Updated and reprinted

83 Governor General's Circular No.45 of 1863: PWD (General), Simla, Sept. 9, 1863: "Proposed Introduction of Schedules of Work for the PWD". [NAI]

84 Ibid.
at regular intervals, they became a key component in the bank of published standards and regulations on which the operations of the Indian Public Works Departments and related agencies have depended to this day. While standardizing the basis for costing, these did not, however, liberate the engineering staff from their personal executive responsibility for carrying out the tedious and time-consuming task of calculating the exhaustively itemized budget estimates that the departmental regulations required for every project submission.

An acrimonious exchange on this matter between the Government of India and a Superintending Engineer in the Government of the North Western Provinces—which the PWD chose to publish for general guidance on the issue, in a departmental circular of 1869—indicates the paramount importance the administration attached to financial matters. Most interesting from the point of view of this study, it also suggests an evident presumption that matters of such importance were necessarily subject to painstakingly conscientious intellectual labour on the part of engineer officers, which they were duty-bound to devote on account of both professional and class discriminations in the division of departmental labour.

The PWD Circular in question reproduced a memo from a senior provincial member of the Department in which that officer had protested against the inordinate time and energy that the standing orders of the PWD concerning the provision of estimates obliged the executive staff of the Department to squander, in his view. This practice was inconsistent, he argued, with professional practice in England, and taxed the skills and resources of the departmental engineers unnecessarily, when such tedious (and often ultimately redundant) labour could and should be carried out by "mere computers" of more lowly status in the departmental hierarchy.

In its response to this protest, the Department stood by its policy with a scarcely disguised rebuke for the questionable assertions of the superintending engineer in question. The retort emphasized the

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85 PWD Circular No.36 of 1869: "Preparation of Estimates", PWD (Civil Wks.--misc.) Simla, May 21, 1869.
86 Superintending Engineer, 2nd Circle, N.W.P. (No.4422, Sept 18, 1868).
obligations that distinguished professional officers and Gentlemen from mere "computers":

Where bills of quantities are required upon which tenders for works have to be based, it is of the utmost importance that gentlemen or officers, or other persons having defined social positions which would be forfeited by conviction in any under-hand dealing, should be alone employed upon estimates...

If "computers" are to be employed instead of those by whom estimating is now done in India, men only of good position and education should be allowed to be so employed.

The importance attached to the accuracy and efficiency of the methods by which the Department planned and managed its accounts was underscored by the Government's paramount concern for fiscal responsibility in the building of public works. This was indicated in no uncertain terms in a reply from the Governor General in Council to the Bombay PWD concerning a protest the latter had lodged with respect to the allegedly inadequate annual works grant for 1863-64:

The Government does not require to be reminded of the importance of public works to the country at large, and will continue to place at the disposal of the Public Works Department, as it has for many years past, all its available surplus funds. But it cannot forget that these objects, essential as they are to the prosperity and advancement of the community, can only be carried out within the limits of a thoroughly secure financial position, and that it is to this last that it must look as the true foundation for real progress.

3. DEPARTMENTALISM

In the previous section we examined the conventions and the actual regulations governing the routine procedures of the Public Works Department as a bureaucratic organization, and began to consider the utility in practice of design standards—as "information technology", as it were—in such an information economy.

87 Bombay Budget Orders, 1863-64. Enclosure to Governor-General’s Proceedings, Circular No.13 of 1863, PWD (Gen.-Accts.), Simla, May 9, 1863.
In the present section we will address that bureaucratic organization of knowledge as an institution within larger bureaucratic and social frameworks of knowledge, to which specific values were attributed. Specifically, we will consider the value conflict that service within that colonial institution presented for British engineers committed to the libertarian value-system upheld by their metropolitan professional bodies.

Corporate control vs. professional responsibility:

The bureaucracy of public works administration in India was denigrated by almost everyone who came in contact with it, not least those directly engaged in operating it. For William T. Thornton, Secretary for Public Works in the India Office in the early 1870's-the "Home" end of the system--the Department was "very far from perfect" in its bureaucratic constitution, and worsening steadily by virtue of its counterproductive tendency to multiply functions and increase complexity in every effort to improve operations. Thornton found himself attuned in his criticisms to the conceptual system of the civilian professionals who had, by this time, begun to dominate the middle management of the PWD--in numerical strength if not otherwise. In a rather surprising polemic that he published commercially while he was still holding his post at the India Office, he pin-pointed the fundamental problem with the Department in its inherent lack of trust in its own functionaries:

Governments in general, and the Indian Government in particular, behave as if they believed all their servants to be knaves, only to be kept from picking and stealing by being sharply and suspiciously watched. In constituting the Indian Public Works Department, the aim seems to have been less to stimulate than to control activity...

The departmental system operated according to an ulterior logic that had little to do with productivity, as far as Thornton could see. Efficiency and progress were checked at every level of the bureaucratic hierarchy; it seemed to have been imagined, he suggested, "..that the

forces of control would be augmented by being arrested at a series of barriers, and filtered through a series of sieves."  

As an evident sympathizer, in this view, with the Parliamentary lobby of the civil engineering profession of England, Thornton’s libertarian convictions in the utility of the responsibly autonomous professional were even more passionate, perhaps, than those of the British Indian engineers he presumed to speak for. The hierarchical checks and controls imposed in the new State Railways Branch of the Department—for which, paradoxically, the key proponent was one of the senior most civil engineers in the Department, Guilford Molesworth—were among the more absurd examples of this constricting departmentalism, in Thornton’s view, in which:

swathed round so tightly with coils of red tape, the veriest engineering Samson would become helpless. To what end have his services been engaged, if he is to be denied the free use of his faculties?—denied the confidence which, when worthily bestowed, tends above all things to elicit zeal and public spirit, and treated instead with a show of jealousy and suspicion than which nothing is so apt to engender precisely those frailties against which it is designed to guard?  

The critical juxtaposition of the courageous individual agent of imperial progress versus the obstructive machinations of the colonial bureaucracy was a common refrain of both critics and champions of Empire; recanted with increasing conviction in the final years of British Rule as the unwieldy administrative machine was perceived to be slowly but surely paralysing the capacity of the regime to respond decisively to the internal political and social challenges with which it was faced. For the imperial apologist, Maude Diver, the engineers were the “unsung” heroes of the British Indian Empire, particularly those who had bucked the system; but departmentalism had unfortunately stymied the potential of most. Personal at its best, she felt, Public Works, along with other departments of the colonial government, “...had too soon become an over-centralized bureaucracy with all the faults of that deplorable system—wittily defined by one of its victims as “Government by files and

89 Ibid., 169.
90 Ibid., 172.
despatch boxes, tempered by occasional loss of keys."

The mild amusement with which the fallibility of the departmental system was admonished was an indication of how most were, nevertheless, resigned to its necessity. Despite his criticisms of the internal structure and performance of the Indian PWD, even Secretary Thornton was able to concede that there was some common sense in the notion that "public" works should be the responsibility of a government agency. In India, at least, the special nature of the relationship between the British administration and the colonial Public made such a formal undertaking practically unavoidable. It was recognized, for one, that long term undertakings such as important building projects could rarely be entrusted to single individuals, with the itinerant nature of colonial service on the part of the majority of the European colonial community; the momentum of the machine-like bureaucracy was therefore crucial to the continuity of operations. This argument applied in general to the provision of services by the colonial administration, but in the particular case of the building efforts of the British in India it applied to the demand for services as well. The rationale for the overriding responsibility for works and buildings undertaken by Government was, in this respect, quite obvious to observers of the Indian scene such as the architect T. Roger Smith—a veteran of a short professional visit to Bombay in 1864:

No Englishman goes out to India to settle there as a colonist. He only goes there with the idea of making money in a short space of time, and coming back again. He cannot reside there long without injury to his health. He cannot marry and bring up a family there, because the children must be sent to England early in life. He is a bird of passage and an unsettled person, and consequently seldom attempts any building on his own account, and either for residence or business purposes occupies such premises as he can rent, and therefore the only buildings of importance met with are Government buildings...

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92 W.T. Thornton, Indian Public Works, 8-10.
The British architectural establishment had strong views on the matters of architectural style and taste and how these might be advanced in British India (which we will consider properly in the next chapter), but it was surprisingly acquiescent to the notion that the conditions for practice along with the mandate of the imperial builders in India were sufficiently different from those that prevailed in Britain to bring into question the applicability, for one, of the modern architectural profession in that country and, more fundamentally, of the individualist principles of Anglo-Saxon professionalism which architects subscribed to—along with the civil engineers whose stake in the Indian PWD was more immediately at issue. As another architect, Mr. T. Morris, interpreted the Indian scene, the rapid introduction of works of utility of all classes had shown the Government to be genuinely intent on progress. "As to the employment of officers of departments in architectural affairs," he suggested, "it seems to be done under more excusable circumstances than we are accustomed to witness at home, where it is far too commonly adopted without plea of necessity. In India things are different, and the Government has both to provide and apply the means of operation." 94

Of course, this omni-functional role that the Department played was not without its problems. The architectural profession offered some further insightful observations in this respect from its still quite peripheral point of view on the British Indian building scene of the early 1870's.

William H. White (another Fellow of the RIBA who had the uncommon benefit of some actual professional experience in India 95) agreed that "the peculiar circumstances of British rule" necessitated government by Departments. However, he also concurred in the popular view that a Department was "the paradise of mediocrity"; as he explained, "a member of one to succeed must sink his individuality in the general organization


95 White had served in the Bengal PWD for a brief period of 13 months, in the 1860's, during which he had responsibility for the design of the Small Causes Court, and Presidency College, both in Calcutta. He was later to become secretary of the RIBA, and an examiner in architectural matters for the Royal Indian Engineering College at Cooper's Hill. P. Davies, Splendours of the Raj, 257.
of the whole machine." 96 White presumed that the original object of this substitution of administrative for individual enterprise was "...to make more use of the military engineers than had hitherto been possible—the argument that they are under the thumb of authority while the professional man is a free agent being conclusive". (In India, he pointed out, "the civil engineer in the employment of the State is amenable to the same strict discipline."). But a serious impediment inherent in this hierarchical regime of bureaucratic discipline was, paradoxically, that it was effectively irresponsible. As White observed, "responsibility ... is divided amongst so many different officers and grades of officers as to be almost null." 97

The "general orders" are very precise about responsibility; and each engineer is understood to be responsible for his particular share of work; but it is difficult to define the limits of his share. The characteristic quality of all departments, regiments, and corporations generally, esprit-de-corps, renders it almost impossible; for where all are willing to take the general blame none are likely to suffer individually. 98

The hierarchical gradation of authority in the PWD was seen as neither a real division of power nor an effective division of labour. While, as we have seen, sanctioning authority rested only with the highest ranking officials, what would be expected to have been the most significant decision-making responsibility, the actual design of works projects, was delegated to the lowest level of the engineering cadre, the Assistant Engineers. Officially, the latter were only required to prepare drawings and make themselves generally useful, both in the office and on the works; but rarely did the senior officers make time to consider design matters themselves other than to reject unsatisfactory proposals. In between the (Assistant) designers and the Public client (that is, the Governor General in Council or its equivalents in the local governments) were those more senior officers; the Executive and Superintending Engineers, the respective counterparts in the departmental hierarchy to

97 Ibid., 152.
98 Ibid., 143.
the builder and the architect of the conventional building industry. These theoretical equivalencies were confounded in practice, however, by a blatant conflict of interest, (again) according to the conventional understanding of professional responsibility. As William White described this departmental inversion:

...the Assistant Engineer designs a building; the Executive Engineer builds it; thus the artistic portion of the work is made inferior to the mechanical part of it; the architect's functions are degraded below those of the builder—the latter being practically master of the position, since he is the official superior of the man who best understands the design. The Executive Engineer as master of the architect—his Assistant—controls, where as a builder he should be controlled; and often "measures up" the work he himself builds. If a mistake happens to be made, whereby a wall is put in the wrong place, or built too high, or too thick, he is rarely called upon to alter it, because all such alterations must be effected at the Government expense. An Executive Engineer holds in his hand, as it were, the five orders of architecture, the building materials, and the public cheque-book, together with almost despotic control over his Assistant Engineer, the foremen, and workmen. It is indirectly in his power to alter, condone error, and spend indiscriminately—he and his Assistant being the only people really conversant with the drawings of the building in course of erection...

Superintending Engineers were generally too immersed in other matters of departmental business to bring much practical benefit themselves to the works for which they were responsible. White's remarks on this point were conciliatory, laying emphasis upon the difficulty faced by these senior—most field staff of the PWD in maintaining a responsible and effective cognizance of the design efforts of the men under their control. "[I]t is easy" he granted "for men of the greatest experience to lose themselves in the confusion of walls and arches if they have not an intimate and personal knowledge of the plans, sections, and elevations of a large building." 100 Evidently it was also easy for those overstretched senior officers to appreciate the utility of design standardization, whereby the design output of the Assistant and Executive Engineers could be strictly constrained within well known parameters; a

99 Ibid., 143.
100 Ibid.
strategy for neutralizing an inherent problem in the departmental system without abandoning its corporate power structure.

Evolving attitudes toward the centralization of professional agency, in the 1870's; the English view of the French:

The conflict between the individualist notions of Anglo-Saxon professionalism on which the metropolitan institutes of civil engineers and architects defined their vocations, and the corporate nature of professional work in the Indian PWD had already peaked by the late 1860's. Although still keenly and critically articulated, the issue was debated in subsequent years, as examined above, with less rancour and contention. Back Home, the topical issue in professional circles in this period--of raising professional standards through technical education--was underscored, we will recall, by a more probing questioning of fundamental British premises concerning the role of Government in the material development of the nation. Recognition of the growing economic challenge of the continental European nations--with their more centralized, technocratic approaches to the mobilization of technological and professional resources--had brought the traditional laissez-faire approach to technical development in Britain under increasingly critical scrutiny.

Victorian engineers and architects were particularly inclined to define their libertarian mentality in binary opposition to that of the French; although most could not deny their considerable respect for the general social and technical development that their closest continental neighbour had accomplished with its conspicuously centralized technocracy, a wary admiration that extended to the colonial development efforts of the French as well. 101 For Lawrence Harvey, an English architect...

101 Even in the halcyon days of their imperial glory late in the 19th century, the British were anxious to maintain their presumed advantage over their rivals in the colonizing game. With the French especially, the PWD engineers were keen to compare notes. In 1893, for instance, the Government of India requisitioned the India Office to send out a set of type drawings of colonial buildings for government residences and other purposes, which had apparently been prepared and made available by the various French colonial administrations. PWD (Civ. Wks.-- Bldgs.) Sept. 1893, Nos. 4-7, Part B. In the final analysis, however, the British
who sought a sterner, more reasoned vision of architecture than that of Victorian eclecticism, "the French spirit of centralization" had a strong appeal. As he wrote in an article with the intriguing title "The French Mind":

Buildings are monuments of mind and architecture is the truest index of a nation's genius. If English art is free, but often queerly whimsical, it is because the English character loves liberty above all things, even at the expense of wisdom and beauty. If French art, in its timid sameness, has the oneness of massive creation, it is for a psychological reason...

The key characteristic of the French mind, in Harvey's view, was the collective will to "centralize", thereby submerging that other quintessentially English preoccupation (and counterpart to Liberty), individuality:

The history of France is the history of centralization...the history of leading ideas. Politics, literature, science and art have always in France revolved around centres. French military monarchies, the French Academy, and French schools of art, show how readily Frenchmen will sink their individualities in behalf of an idea.

Despite the implied contrast with English mentality, in important respects there was very little distance between this cultural-cum-psychological characterization of the French and the corporate conceptual system that the officers of the Indian F.W.D. were expected to uphold, along with the rest of the community of British colonial servants in India. From the outset of their Indian careers, through the select academies that supplied the various departments of the colonial administration, they were socialized as a group to selflessly promote the "leading idea" (and sustaining ideology) of the Imperial Raj; that the British had a social contract with India to instill the gospel of (English) law and order, and to enable and secure it through the strategic development of a modern technical and military infrastructure.

were dismissive of the colonial legacy of their rivals. See E.W.C. Sandes, The military Engineers of India.

102 Lawrence Harvey, "The French Mind", The Builder, 28, 1416 (April 9, 1870): 280.
Quite the contrary to the woolly ideal of individual liberty (toward which the British Parliament took a further major step with the Reform Bill of 1867\textsuperscript{103}), there was a firm belief shared by colonial administrators in that period that the centralized authority and rationalism of the British Indian polity was "...the best corrective in existence for the fundamental fallacies of Liberalism..."}\textsuperscript{104} For both rulers and the ruled, the discriminating hierarchy of power and the stern creed of law and order it upheld was regarded as "...a compulsory gospel which admits of no dissent and no disobedience."\textsuperscript{105}

An especially pertinent indication of the parallel I have drawn between this corporate mentality of the colonial British and the "French mind" (as represented by the British) was the generic similarities between the Indian FWD and the celebrated engineering arm of the French administrative system, the Corps des Ponts et Chausées. Formally instituted in 1716 following the death of Louis XIV, the antecedents of that civilian Corps of engineers had been organized by Colbert during the reign of the great monarch, to develop the vital network of transport and communications through which Paris controlled provincial France. In its very constitution, therefore, this founding body of the modern profession of civil engineers epitomized the French model of centrally organized power. Accordingly, it drew both admiration and disdain from across the Channel.\textsuperscript{106}

British engineers were leery of what they perceived as the excessive political and bureaucratic control under which their French colleagues operated in that para-military government agency. At the same time, however, they were greatly impressed by the manifest organizing faculties

\textsuperscript{103} The Reform Bill of 1867 sought to extend the right to vote to the British working classes for the first time.

\textsuperscript{104} Thomas Metcalf, \textit{An Imperial Vision}, 314-317. This belief was specifically articulated by J.F. Stephen who served as the Law member of Viceroy Mayo's council between 1869 and 1872.

\textsuperscript{105} Ibid., 319-320.

of the French; and also, surely, by the elevated esteem in which the profession was held in France, by both government and the public, as a result of the formal status and authority that the Corps secured for its officers.

As the prototypical model for government engineering departments, the Corps des Ponts et Chausées bore a predictable similarity to the Indian PWD with respect to general operations and responsibilities, as well as internal organization. With the exception of military works, which remained the exclusive concern of the distinctly separate corps of French military engineers, La Genie, the responsibilities of the French Corps were extensive. These included the inspection and control of every railway, canal and navigable river; every mill and manufacturing establishment; mines, collieries, quarries; steam engines, stationary and locomotive; all telegraph systems, water and sewage works; all harbours, channels, lighthouses, buoys etc. for marine navigation; roads and carriageways. The Corps was also responsible for establishing and regulating the guidelines for submission and sanctioning of projected works, and for the full supervision of every project subsequently executed. It therefore brought together under one agency responsibilities which, in the British system, were distributed among many separate authorities or overseen, as we have discussed, by cumbersome Parliamentary committees.

In obvious ways this was a much tidier and more potent organ for action than the British could boast, as far as the execution of Public Works was concerned. However, as the President of the British Institution of Civil Engineers criticized it in an address to his colleagues in 1870, this "enormous machine" was necessarily comprised of an inordinate number of employees subordinated within a complex hierarchy of discretely subdivided executive and technical labour. "In theory the system (was)

107 Ibid.
108 Ibid.
109 Ibid.
110 According to statistics available in 1870, in Paris alone the Corps maintained 32 bureaux, each with its own chief and deputy engineers, and staff of clerks, of which fully one half had their attention devoted exclusively to public works. Country-wide there was a
perfect" but in practice, he observed, it dragged along far too slowly by British standards of efficiency. Moreover—he added, resorting to a familiar refrain—however powerful it was to control, it was "ill adapted to originate". 111

The similarity in the criticism that the Corps des Ponts et Chausées and the Indian PWD attracted was corroborated by further aspects of organization and tradition that the two agencies had in common. As we have seen, the various Indian engineering colleges established to supply the PWD followed the example of the professional training academies of France and other continental countries. The Corps des Ponts et Chausées had its own professional school for the training of its engineer establishment, the Ecole des Ponts et Chausées. 112 Engineer candidates entered this school at about twenty-one and usually took between three to five years to qualify for and pass their professional examination. A typical engineer would take his first commission at about age twenty-five, upon leaving the Ecole, beginning with the rank of Engineer, 3rd class. His career would span from 35 to 40 years usually attaining the highest rank of Inspector-general, 1st class, after 36 years of service.

As also in the PWD, these executive officers of the corps relied greatly on a subordinate cadre. The "Conductors" of the Corps des Ponts et des Chausées were a lower class of officers—"the corporals, sergeants and sergeants-major of the Corps". These men were instrumental in the actual supervision and execution of works. Their careers in the Corps ran in parallel to the upper engineer establishment; entering service after apprenticeships to master workmen, in their mid twenties; reaching their highest possible rank, "sub-engineer", in their mid to late fifties.

111 Ibid.
112 In 1870 it had just fifty-five pupils though the large complement of faculty, including 15 professors, mostly from the Corps, 8 teachers and 30 other staff members of one designation or another was just about equal in size. Ibid.
From the doctrinaire point of view of the British Institution of Civil Engineers, the cardinal defect of the Corps des Ponts et Chausées was this debilitating division of professional labour. According to a favoured maxim of the day, it was "the combination of the workman and the man of sciences that forms the civil engineer."

The Corps was seen to be composed quite literally of these two types of men; the young "highly educated scientific gentlemen" of the upper establishment too dependent, at least in their youth, on the "practical men" of the Conductor class. The free-practitioner idealized by the British engineering profession was perceived, on the other hand, to be an individual incorporation of these two personae; autonomous from the inhibiting dependency inherent in a large bureaucracy such as the French Corps; theoretically empowered with an equivalent composite of knowledge to accomplish the same ends.

The French view of English engineering practice:

With all the critical attention paid to the Corps des Ponts et Chausées and related institutions by the British professions, it is no surprise that the reciprocal impressions of British practices and their underlying value-system which the French offered in return were received in England with considerable interest. As the British competed economically and politically in the fast expanding domains of technological development and colonial trade, the exchange of such representations conceivably contributed dialogically to the construction and critical adaptation of the conceptual system through which British professionals perceived and participated in that process.

An interesting case in point was the response of the professional readership represented by The Builder to an official report on public works policy and practice in England, which had been prepared for the French Ministere des Travaux Publics in 1874.

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113 attributed to Professor Hosking, who had taught the Architecture and Engineering course at King's College in the 1860's. Ibid.
114 Ibid.
115 Du Regime des Travaux Publics en Angleterre: Rapport adresse a H. Le Ministre des Travaux Publics. par Ch. de Franqueville, Maitre des Requetes au Conseil d'Etat, Secretaire de la Commission Centrale des
much intrigued by the French perception of the oddity of the English way of going about things, and by what was posited as the fundamental collective ethos on which such a seemingly chaotic but historically productive system was based. French engineers, like the British, perceived that their professional cultures differed most fundamentally in their respective attitudes toward centralization. The French rapporteur drew attention to the almost absurd irrationality of which his British counterparts were capable, in their ideological rejection of such. For want of a centrally regulated system of signaling standards for coastal navigation, for instance, sailing in and out of England's ports was a dangerously chaotic affair. The impossibility of coordinating this vital component of the nation's infrastructure stemmed in no small part from the essential impediment that there was no ministry or equivalent agency for Public Works in the Government of Great Britain, nor even any regular and separate budget earmarked for that purpose. Legislators were typically the last to move for any public expenditure in that vein. In France, by contrast, not only did the government have such a Ministry but it was the Legislature that generally took the initiative in identifying and mobilizing works for the public good. Project execution was generally entrusted to local authorities. In the English system, it was observed, it was Parliament that reserved exclusive authority for the sanctioning of public works; but, paradoxically, it had no mandate to plan such development strategically.

The Builder countered that the British could not therefore be considered as entirely decentralized in their approach. But from the unsympathetic point of view of the independent engineering and architectural professionals this dependence on the sanctions of an ill-informed and uncommitted Parliament amounted to an inverted and potentially even less efficient variant of centralization than that of

Chemins de fer. Paris: Hachette & Cie., 1874). This report was the subject of at least two major editorials in The Builder. The first dealt exclusively with the key issue of railway development, but the journal was provoked in the second instance to discuss an addendum to the French report which had specifically addressed the essential "Englishness" of the British approach to the building and administering of Public Works. See: "Foreign Criticism of our Public Works Administration", THE BUILDER, 33, 1677 (March 27, 1875): 269-270.
the French—a critique that the Builder had often tried to put to the attention of the politicians in the past.

The British journal was not about to deny, however, that there were fundamental differences in national ethos. Rather, it argued that the differing works regimes of France and England had evolved as optimal systems for their respective cultural predilections. The laissez-faire English system had—after all—produced the great railway network of Britain entirely through private enterprise. Government had merely "tolerated" the boom but had never directly "assisted" it. The reviewer was quite convinced the French would have failed to achieve the same had they tried to without the substantial involvement of the formal government sector, "...the English public having more enterprise and more capital than the French."

The Builder continued its defense of the status quo with a useful description, for our purposes, of the sanctioning procedures that were applied by the Home Government to buildings and works of public improvement, in this period. The preliminary proceedings to any large scheme of public works were, in fact, an admirably complete and balanced "public" exercise in Britain, where "...everyone whose interests are concerned is heard, and, what is better, is listened to." But, the resulting Parliamentary expenses for such a process were great as compared to the executive economy of the technocratic French system where the Government engineers tended to "...have it all their own way."

The tables were balanced, however, by the relative economy of the British system when it came to the inspection of works. In the French railway administration, for instance, there was a complex hierarchy of engineers and fonctionnaires for inspection and general superintendence comprising an establishment of over 600 government employees. For its part, the British Government employed just four official inspectors for this purpose. Obviously these four could only have had a nominal effect in keeping railway works "on track", as it were; but more were not required, The Builder reasoned, for in practice there were "millions" of inspectors "for the public themselves fulfill these functions." The demanding and critical attitude of the British public to the operation of its new railway system was its strongest compulsion to provide good service:
Let there be a delay or some small accident, and *The Times* resounds with complaints, and under the heading of 'Railway Unpunctuality' the victims continue, during a week or so, to make known urbi et orbi that they were delayed an hour beyond the proper time, or, that a booking-office had been opened too late, etc... This sensitiveness of the English public, and disposition to complain openly at the smallest thing in which it has been wronged, is no doubt a very important element in the way of keeping things going here; one which we may forget or underrate until thus reminded of it by the impression produced on a stranger. This difference in national character is, to the French Commissioner’s eye, curiously illustrated also in the freedom of our railway stations, as compared with the French system of shutting up the passengers like so many cattle behind barriers and in 'salles d'attente'. "You may shut up Jaques Bonhomme in this way," says the reporter, "but you will hardly get John Bull to submit to it."...But the fact is, it is John Bull’s great respect for constituted authority which renders it unnecessary to hedge him up in this way.

The contrast between public works policy and practice in Britain and that which the British pursued in colonial India couldn’t be better characterized than it was—quite inadvertently—in this comparison of French and English attitudes to railway planning and operations. The norms for the planning of Indian railway stations, for instance, were decidedly "French": separate class and gender specific waiting rooms, eating facilities, bathrooms and latrines were strictly prescribed for European passengers, while the throngs of third class native passengers were compelled to wait in a separate fenced-off portion of the platform, or under simple open sheds separated from the main building if they were lucky enough to be provided with any shelter at all.117 (figs. 6.2, 8.7)

Under the pitiless Indian sun John Bull was expected to keep up the side all the more, but he was given little chance to lapse. Authority was everywhere constituted explicitly; and without scruples.

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116 Ibid., 270.

117 For an example of class and race-conscious planning considerations in the early development of design norms for Indian railway stations, see: Despatch No. 3177 of 1862: Revenue Commissioner, Southern Division, to the Secretary to Government, Railway Department (Bombay), (signed) W. Hart, Camp Beejapoor, 29th December 1962. (IOLR: L/PWD/3/272)
Fig. 8.1. Standard Plan for a Shed for Light or Heavy Field Guns, PWD (military works), 1865.
Source: Enclosure to PWD Circular. No. 74 of 1865.
Fig. 8.2. 1st Class Choki for Road or Canal. Source: Construction of Buildings, (Part I.), 3rd edition, Roorkee: T.C.E.C. Press, 1863; Third Class Railway Station. Source: Papers Papered for the Use of the Thomason Civil Engineering College, Roorkee: No. XII, "Railways”, Roorkee: T.C.E.C. Press, 1864. These Generic plans and sections for ‘typical’ PWD-constructed buildings were used as ‘text-book cases’ for exercises in ‘designing’ and estimating, in the curriculum of the Thomason College.
4. DESIGN METHOD AND THE COGNITIVE UTILITY OF STANDARDIZED DESIGN PRACTICE IN THE PUBLIC WORKS DEPARTMENT

In the preceding three sections I first surveyed the evolution of design standardization in the PWD, and the correlation of that process with other pertinent developments in the operations of the Department through the course of the 19th century. I then considered standardization as a more general organizing process within the PWD. The apparent absence of a well-articulated rationale for design standardization, on the part of the departmental authorities, indicates a more structural explanation. I observed that the general consolidation and centralization of decision-making powers in the Department in the Crown era was attended by a corresponding division of labour in which standardized forms and procedures for conducting departmental business insured a sufficient and effective flow of information between the various technical branches, the local government works departments, and the network of divisional and sub-divisional engineers and their staff in the field. By the same token, I argued, these formally standardized bureaucratic procedures appear to have clarified the hierarchy of decision-making responsibility. That which was purely routine conformed to what I suggested was the default-reasoning encoded in the standard procedures of the Department, and could thus be confidently left largely to the subordinate staff to process. Where matters did not fall within routine—or where they were expressly excluded from rote standardization, as in the case of project estimation—the executive cadre of engineers were compelled to exercise their professional judgement and thereby confirm their responsibility for defining and upholding the principles on which departmental policy was based.

Having considered the cognitive utility, that is the reliability and risk minimizing potential of standardization in the departmental organization of authority and procedures of the PWD, we then considered how that widely criticized departmental system was actually condoned. The grudging submission of British engineers to the strictures of "departmentalism" appears to have depended, in the end, on the belief that colonial India was a sufficiently different context of practice from Britain that the conventional professional ideals of autonomy and
innovation did not necessarily apply. This devaluing of individuality and change had an evident bearing on Design, among other aspects of departmental activity.

In this final section of our inquiry into standardization we turn to the issue of design method to consider more specifically the cognitive utility of standard plans and the design procedures through which such were developed, in the operations of the PWD.

The design process:

It will be instructive, to begin with, to consider what was entailed, conceptually and practically, in the exercise of designing the common building types that the PWD was regularly required to construct.

"Design" evidently held no special status among the various tasks and responsibilities undertaken by the PWD engineers. This we may deduce from the hardly more than incidental treatment the topic was accorded in the curriculum of the engineering colleges that supplied the Department with its Establishment.

In the Roorkee Treatise for instance, the compendium of instructional manuals developed around the curriculum of the Thomason Civil Engineering College, the question of "designing" is only discussed directly in one brief chapter of one of the eleven manuals of that comprehensive series. It is no surprise, then, that innovation was perceived as the least of the designer's objectives. If one had to design a building, the point was to satisfy requirements as sensibly and

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118 Roorkee Treatise on Civil Engineering, sixth ed., Vol.I, Sec.I, Chapter XI: "Designing", (Roorkee: Thomason College Press, 1900), 107-113. The first edition of the Roorkee Treatise was put out by J.G. Medley in 1866, based on manuals that the faculty of the college had prepared in earlier years for their particular courses. Published and bound in a modular format of concise separate manuals for each of the technical sections such as Materials, Masonry, Bridges, and Irrigation Works that it covered, the Treatise became a standard reference aid for all engineers in Indian service, military and civil, and their subordinates. With this extensive demand, the limited print-run of 1500 copies of the first edition was quickly exhausted, necessitating the printing of several successive editions over the years, with updates and revisions. Ibid., Preface.

119 The text in question made it quite clear that all subordinate
practically as possible. The "useful man", the Treatise explained,

is not the would-be brilliant man, always upsetting recognised
methods to try new ones wholesale; all changes, that is, as
long as work is going on fairly, should be gradual and
tentative, and above all things a man's ...watchword should be
..."bandobast". There is no equivalent word in English, but the
man who looks ahead and makes "bandobast" is the successful one
in the end. 120

The proper approach to any new instance of building design in India,
the text implied, was to acknowledge the implicit norms and order of the
established way of building in that country and to first address the
knowledge of experience to the issues perceived. In normal circumstances
known solutions could be systematically and dependably modified to the
evident peculiarities of the circumstances at hand.

In the simple even patronizing language of the Roorkee
manuals—which had to suffice, in greater and lesser doses, as the
standard text for both the engineers' and overseers' courses of that
college—the "principles on which designing is done" were sketched out
through the example of a typical building project. In the case of a
house, as the manual proposed, the essential design problem consisted in
enumerating fully and clearly the requirements and then considering what
specifications would meet those wants:

Requirements.—Suppose a Resident Engineer's quarters, with a
view to sale as a small dwelling-house when done with. The
first consideration is the accommodation there must be. In this
case it would be say a drawing-room, dining-room, bed-room,
with two dressing-rooms and bath-rooms, and an office-room,
which will make a spare bed-room if required. Now think how
these should be arranged. In hot weather it is inconvenient to
have to enter directly into main rooms, and also to have to go
through one room to get to another, so a most desirable feature
in a house is an entrance hall or passage, from which access is
given to most of the rooms. The dining-room must always be
easily entered through a servant's room, or a passage near the

ranks of the departmental establishment were excluded, "as a rule," from
that obligation. Ibid., 107.

120 Ibid., 106. Bandobast (or bundobust) was a term of
Persian-Hindustani derivation meaning, literally, "tying and binding".
Figuratively, it implied disciplining any system or mode of regulation.
The most common application of the term in Indian administration was as
the term for a revenue settlement. Hobson-Jobson, s.v. "bundobust".
cook-house, and there should be store-rooms, &c.

The engineer-designer was instructed next to account for environmental parameters; forewarned, however, that optimization in this respect was not necessarily feasible:

Next the prevailing winds and direction of sun should be considered. Some people like a house pitched east and west, so that they may get the hot winds to work through, but this gives the room all the morning and all the afternoon sun straight into them; so that others think it is better to make the drawing-room at all events face chiefly north, so as to be shady, the dining-room also, while the bedroom had better face east and get only morning sun; we cannot have all the rooms facing the best way.

In attending to these genuine operational and performance criteria, designers were cautioned to be sufficiently critical of their own predilections, particularly any formal caprice, that might confuse their assessment of the true requirements to be resolved:

Many Indian houses have the rooms very inconveniently arranged, seemingly because the draftsman thinks it necessary all partition walls should be in straight lines right across the building, whereas with the usual roof, where there is no thrust on the walls, this is no way useful...[T]he only way to make the best possible design is to remember all the above points and many more, and draw the plan out roughly, then consider yourself living in the house, and see whether it would be convenient in all ways...

Although the actual users of the Roorkee Treatise were predominantly Indian and Anglo-Indian engineers and subordinates in training, by the time this particular edition of 1900 was printed, the social presumptions concerning the class and race of the departmental engineering establishment had been faithfully preserved from earlier editions:

[TT]hink of visitors coming up, of servants going to the bazaar, of hot winds and cold winds—and everything. Then work out what servants' houses are wanted and stables, and arrange them at convenient distances, not too close, as then the servants will not be allowed to make any noise and enjoy themselves. Then the well and the garden: have the flower garden, with room for games played by people likely to live in the house, in front, and the kitchen garden behind, and the well convenient for all.
The matter of architectural style was largely presupposed--much as the life-style of the British Indian community, its expectations and prejudices, were taken for granted. Accordingly, the young engineer was instructed to leap directly from his consideration of design requirements to the matter of specifications--what the manual described as "the actual builder's guide in construction". This came down, very simply, to the question of permanence:

The style of work in each case will partly depend on the material available, but as in general all kind of material that will be used in a house can be got, the decision will mostly depend on how good it is desired the house shall be, whether it is to last for ever or only for a limited time. Pucka masonry all through, with similar roofs, should be used for large public buildings, about which repairs are highly inconvenient,...but for an ordinary dwelling-house, like the one under consideration, less expensive material will suffice, and kucha masonry well protected from white ants and rain water is really as lasting as pucka...

It is interesting to note that the earliest instructional manual on "Construction of Buildings" prepared for the courses at Roorkee in the 1850's, had at least entertained the possibility of some architectural pretense in the design work of the Indian engineer. In the 1859 edition, for instance, the text made some effort to inspire an appreciation for the potential beauty inherent in a utility-conscious building design:

[T]he first thing to be thought of, and one which should not be lost sight of throughout, is the object or objects it is to serve and all the requisites of strength, convenience, beauty and economy for the attainment thereof. By beauty is not to be understood the mere presence of ornament. A building utterly devoid of ornament may possess great beauty architecturally, from the perfection of its proportions generally, the variety of outline resulting from the projection of some of its parts and the difference of relief, i.e. height, given to them, and its appearance of harmony with the use it is intended for; on the other hand, pretentious buildings, introducing columns, with elaborate entablatures, and a multiplicity of mouldings, each good in and by itself, may be utterly devoid of all architectural beauty.

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However, even such wise and distinctly sober encouragement to consider the aesthetic possibilities of design (a passage which was probably borrowed verbatim from one or another of the encyclopaedia or standard handbooks on the building arts of the day) was excluded from the substantially rewritten Roorkee Treatise, the first edition of which appeared seven years later at the height of the building boom and the parallel efforts of the FWD to standardize its designs and departmental methods.

The earlier instructional manual of 1859 provided an alternative example to explain the basic "principles on which designing is done", which gives us some idea of the presuppositions that applied to that other ubiquitous building type of British colonial India, the barrack:

In designing a barrack the number of occupants must be first known, then the space required for each in the apartment allotted for sleeping; in India, buildings have generally but one floor, and the middle rooms are made higher than the rest—these therefore are the main barrack-rooms, those in which the men sleep by night and sit by day, on each side of the main room are narrow side rooms, in one of which the men should take their meals, in the other accoutrements should be cleaned, and washing and dressing should take place. Outside of these again are low verandahs shading off the sun from the walls and the doors of the occupied apartments.

The next point to be attended to is ventilation, the air

122 The first generation of technical manuals published at the Thomason College Press for the use of its students were in great part a straight-forward compilation of selected material from the standard manuals and handbooks of Civil Engineering widely used in the mid 19th century in England and America. That theoretical material, data, tables, etc.—usually reprinted verbatim—was supplemented as much as possible with Indian material and examples drawn from sources such as the Calcutta Civil Engineering Journal, and various manuals such as the Madras Manual and the Barrack Master’s Assistant which had already been compiled for the use of the Public and Military Works establishments.

In the preface to the first edition of these Papers... on Building Construction (as reprinted in the 3rd edition) the editor, specifically lists the standard construction manuals by Mehan, Dobson, Millington, and Abbott, and the Encyclopaedia Britannica article on "Building", as his key sources. "No pretense to originality..." had been made, "...the extracts have been generally left in the words of their authors." In the main body of the text borrowings straight out of the recently published FWD Code of Regulations are also frequent and clearly referenced. Papers prepared for the use of the Thomason Civil Engineering College, Roorkee, No.VI, Part I: "Construction of Buildings", (3rd edition), Roorkee: T.C.E.C.Press, 1859.
entering by the doors should be able to escape by means of
apertures in the roof, so that the whole of the air within the
apartment may be frequently changed, and light should be
admitted from above.

Another point to be considered is the aspect of the
building with reference to prevailing winds, use of tatties,
topographical peculiarities of the neighbourhood, etc. In upper
India the long sides of barracks are generally made to face the
west and east, so that one of these may be exposed to the
westerly wind; as however a house whose long sides face the
north and south is most sheltered from the sun, it is best so
placed when westerly winds are not prevalent. This point
determined, the out-offices must be distributed conveniently,
yet as not to interfere with the object sought in the first
instance. 123

Structural considerations in the designing of such basic building
types were surprisingly casual for a curriculum directed at engineers:

It is only when extremely heavy vaults or very high towers have
to be built that the resistance to crushing need be considered
in the design of a building, but it must always be remembered
in such cases that allowances must be made for inexactness of
bearing surface, and inequality of texture, and that at least
eight times the bearing surface that would crush under the load
must be allowed. 124

The above passage offers some explanation for the characteristically
solid construction of typical British Indian buildings. An accompanying
figure that the manual provided to illustrate the principles of
proportional support and buttressing in masonry construction of that sort
was more specifically suggestive. The figure in question was a sectional
view of the Romanesque Church of Saint Paul's Outside the Walls in Rome;
another borrowing from secondary sources. The striking similarity between
that centuries old Italian chapel and the quintessential building section
of the modern barrack buildings of British India—so clearly evoked in
the above description of the basic design requirements for such a
building—suggests it could have served as an actual prototype for the
latter. However, the comparison appears to have been merely didactic. The
basic sectional and spatial configuration of the British Indian barrack

123 Ibid., 80-82.
124 Thomason College Manuals of Civil Engineering, Vol.II, No.6,
"Construction of Buildings" (Roorkee: Thomason College Press, 1864), 43.
had been arrived at empirically, like the bungalow, through a long process of assimilation and incremental modification of a generic indigenous prototype, according to the conceptual predisposition of the European military engineers, as building designers, for the familiar taxis and symmetries of the classical canon of European architecture. But the archaeologically fueled enthusiasm for the various historical and regional styles of building with which Victorian architects were preoccupied, had more recently brought the basic climatological and constructional rationale of historical Italian building technology to the attention of British Indian builders. 125 The rather curious reference to the higher-standing authority of historical European precedents—such as the Church of St. Paul outside the Walls—evidently bolstered their commitment to the conventional Anglo-Indian design solution they had

125 In the same year that the Thomason College Press published its instructional manual on construction, drawings and commentary by the architect, Walter Granville, were published at the same press, in the Professional Papers on Indian Engineering, concerning the later's competition winning design for the Mutiny Memorial Church at Cawnpore (fig. 8.14). As Granville had explained in his "descriptive remarks" to the design jury, the design had been carried out in accordance with the suggestion of the Government of the North Western Provinces of India, in the "round-arched Lombard and Romanesque styles". As such, it was is a studied fusion of elements which permeated Ecclesiastical Architecture in Italy during no less than five centuries, from the reign of Charlemagne, A.D. 768 to that of Rudolph of Hapsburg, A.D. 1273. The metropolitan architect attempted to educate his colonial jurors by explaining the historical pedigree for his design, making a very interesting miniature essay on the progression, reception and diffusion of architectural styles between Northern and Southern Europe in the early middle ages, and even throwing in a little "coda" of Orientalism with a remark about his one explicit stylistic gesture to the East:

...I have ...endeavoured to give at least an Oriental stamp, by the introduction of colored bands, which, so far as I remember, had their origin in the East amongst the Tartar tribes, and were introduced by them into every country they occupied.

In addition to his stylistic mastery, Granville offered a convincing technical rationale for his choice with his analysis of the climatic appropriateness of the Lombard Style adapted to his design. With the support of quotations from Fergusson's recently published Illustrated Handbook of Architecture, he argued that the Lombard style

...is peculiarly adapted to the above arrangements for admitting light and affording ventilation in the most efficacious and natural way that can be devised for a climate like India...

"Cawnpore Memorial Church", Professional Papers on Indian Engineering, 1, 4 (August 1864).
developed themselves. (fig. 8.2)

The cursory instructions of the Roorkee curriculum regarding design method ended with the simple but emphatic advice to insure that all requirements of a building project were thoroughly considered and the designed solution convenient in all ways, "while it is still on paper"; for, in spite of all its checks and balances, it was recognized that the departmental protocol for project sanctioning could not be relied on absolutely to discern and correct all design deficiencies. As the author of the 1900 edition recounted from personal experience:

I have known a case of design and estimate for a two-storied house being sent in without any staircase provided, and what is more, it was passed by the Superintending and Chief Engineer, and the omission not discovered till the construction begun—no one had lived in the house on paper.\footnote{126}

With these admitted short-comings of the departmental system, and the patently under-developed design skills of the civil engineers and subordinates specifically trained in the Indian colleges to staff it, untried new designs posed a considerable liability.\footnote{127} The tried and true norms of established practice were a surer basis for utility; standard plans were a sensible strategy for keeping in touch with those norms.

Design instruction in the Chatham course:

In their practical training at Chatham, military engineers were somewhat better introduced to the problems of design than were their civilian...


\footnote{127} Up to the end of the historical period encompassed by this study, these deficiencies persisted in the Roorkee curriculum. In his evidence to a committee convened in 1917 to recommend measures for the reorganization of the Public Works Department, the incumbent principal of the Thomason College, W.G. Wood (a civil engineer), reported that "Design" instruction was still insufficient, accorded a mere 4 lectures in the overall programme. Basic drawing skills were certainly not neglected, but he admitted regretfully that "...a number of men on leaving the college actually did not know designing." Report of the Public Works Department Reorganization Committee, Vol.3 (Calcutta: 1917), 186.
counterparts and subordinates, if only by the fact that they were required to carry out at least one complete hypothetical design exercise in the scope of the course. At the same time, however, the case-based method of both lectures and practical instruction at Chatham appears to have actually dissuaded rather than encouraged the military engineer to approach the design process from first principles.

In the six month component of the Chatham program of practical instruction which was devoted to military and civil building construction, the engineer-cadets had a series of lectures and exercises ostensibly concerned with the application of theory to practice in construction. Such "applications" consisted, in the first instance, in the lecture-illustration of 37 specific building examples for each of which every officer in training was required to make copious notes supported by mathematical calculations. These case studies were followed by two further series of lectures concerning building materials and the building trades, respectively. The practical modules of the course comprised exercises in quantity surveying, estimating and specification based on the analysis of scale models and drawings. These measuring exercises culminated in a full-fledged design exercise in which each officer was required to select a specific class of construction work, such as a bridge or a barrack, and produce a set of plans with report, specification, and estimate.\(^{128}\)

These lectures and exercises were backed up by a printed course manual (possibly the model for the Roorkee manuals) consisting of "notes and extracts" collected by the superintending instructor, "on the practice of building, and on military buildings of every class and description." Meanwhile, the particular case material of the lectures and estimating exercises appears to have been taken directly from a folio of 44 large copper-plate engravings, described as "costly and valuable", which the officer-trainees were obliged to purchase. These contained descriptions of the details of buildings, with numerous lithographs and printed tables, comprehending construction standards approved by the War

\(^{128}\) Francis Bond Head, The Royal Engineer, (London: John Murray, 1869), Part II: "School of Instruction", 197.
Office.  

Evaluation consisted in the examination of the copious notes the students were obliged to make on lectures and exercises. These were first reviewed by their instructors then written out again in a fair, "corrected" version for final examination. The duly accredited notes—further corrected and authenticated in red ink by the Director—were ultimately returned to the graduating engineers to be bound together with their notes for the other courses in the 20 month program of practical instruction at Chatham, as their own personal reference manual for future use in the field. It was not uncommon that these compiled "notes and examples" exceeded a thousand closely covered folio pages, in two or more volumes.

The penchant for recording and compiling reams of such informal reference data extended to the auxiliary series of evening lectures which the military engineer-cadets received at Chatham from invited representatives of the civil engineering profession and other "scientific men". Printed transcripts of these lectures were regularly prepared by enterprising sappers and non-commissioned officers of the Royal Engineer Printing School, on the basis of short-hand notes taken by a stenographer. These were then sold to their student-superiors at considerable cost.  

The use of design knowledge in practice:

If the newly commissioned engineer-officers had arrived in India with nothing but their wits, it is conceivable that a quite different, more innovative design tradition may have evolved in the Indian PWD. But saddled with ever increasing responsibility for executing works on time and in budget, from the outset of their Indian careers, the engineering field staff were given very little latitude for experimentation and error through which they might have made up their initial deficit of experience as self-reliant design problem-solvers. It will be recalled that the junior most members of the executive establishment, the Assistant

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129 Ibid., 198-199.
130 Ibid., 200-202.
Engineers, were the ones delegated, in practice, with the actual task of designing whatever project was at hand. Right off the boat, so to speak, they were virtually compelled to depend on whatever documented design knowledge they could scrounge up, not least the ready-at-hand stock of received information concerning design precedents and building technique preserved in their notes and drawings from their college courses.

The authority and presumed utility of the technical data and precedent knowledge contained in that documentation may well have been exaggerated in the minds of the military engineers in consequence of the major personal investment of time, energy and finances it represented. The fact that these officers were unlikely to have regular access to authoritative professional textbooks and reference works, or current professional journals (apart from the occasional extracts that were circulated in departmental correspondence) during their careers in colonial service, could well have amplified these sentiments further still.131

The built evidence suggests that this transferred knowledge was generally not applied directly, as such, to the building problems Chatham graduates encountered in India—selective and specific as it was to

131 The PWD Secretariat in Calcutta had quite a good reference library of its own, containing a wide range of both general and specific works on Architecture and Building Engineering. But obviously this was not easily accessible to the ordinary executive engineers out in the districts. According to a catalogue of the holdings in the PWD Library, published in 1886, the collection included classic architectural texts of the time such as Woolfe and Gandon’s Vitruvius Britannicus (1771), Gwilt’s Encyclopaedia of Architecture, Historical, Theoretical and Practical (1867), Pugin’s Gothic Architecture (1823), Owen Jones’ Grammar of Ornament (1871), and no less than five works by James Fergusson—his three major works on Indian architecture and archaeology, his History of Modern Architecture (1873), and his History of Architecture in All Countries, from Earliest Times to the Present Day (1874). More practical texts included two copies of a work on Mechanical Principles of Engineering and Architecture by Mosley (1855), The Cyclopedia of Useful Arts and Manufactures by Tomlinson (1872), various specifications manuals, price books and materials catalogues, and Notes on Building Construction, a course manual prepared for the syllabus of the Science and Art Department of the Committee of the Council on Education, South Kensington (1875–79). The Department also subscribed to a variety of professional and scientific journals including The Builder (commencing in 1869) and Scientific American (no dates given). Catalogue of Books in the Library of the Public Works Department Secretariat, (Calcutta: Superintendent of Government Printing, India, 1886).
English building norms. While they did not gain much prowess in architectural design in their training, it appears that they did at least learn to discern between principles and techniques in the construction of buildings such that they were capable to some degree of adapting that practical knowledge to local circumstances.

The more significant effect of the military engineers’ training on their subsequent design thinking was likely the way in which the case-based methodology of instruction engendered a particular appreciation of documented precedents as a basis for design. This tended toward a compulsive doctrine in practice—more conducive to standard plans than to intelligent design deliberation—as a consequence, I would suggest, of what was evidently little more than teaching by rote. With the inordinate emphasis the curriculum placed on the exacting transcription of the approved course content—which made such a fetish of the class notes and supporting documentation—the students appear to have come away from their training with a more lasting impression of that didactic methodology than of the knowledge it was intended to convey.

Few could afford to be as frank and critical in their perception of this problem than was Henry Yule who, as PWD Secretary, it will be recalled from our discussion of the professional training of British Indian Engineers in Chapter 5, remembered his instruction in architectural design and estimating at Chatham in the 1830’s as “a pure waste of time... It’s whole essence consisted in colouring certain engraved Plans, and in copying out certain estimates and specifications. The result was an utter blank.”

What even Yule evidently learned by that experience, however, was the preeminence of the form, order and consistency of the procedures and media through which a governmental engineer was required to act, over the matter of what particular information and solutions those actions delivered. The military engineer was not really instructed how to design, but rather how to produce designs according to the prescribed standards for organizing and documenting such submissions. Standard plans made

132 Memorandum by Lieut.-Col. H. Yule, Secretary to Government in the Department of Public Works, of 23rd April, 1857. Enclosure to Public Letter (PWD—General/Miscellaneous) No.40 of 1859, Fort William, 7th July 1859.
design production a less taxing, more dependable exercise.

The pragmatics and heuristics of design standardization in the PWD:

The bureaucratic motives for standardization that we have considered so far, in our examination of the information economy of the Indian PWD, applied indiscriminately to paper-work as to design. However, the fact that architectural and engineering design documentation consisted substantially of drawings indicates additional technical factors, specific to the production and utilization of such graphic documentation, which appear to have further encouraged the departmental predilection for standardized designs. We will briefly consider those below.

Reprography: practical and political implications

The basic exercise of replicating and diffusing design knowledge through the medium of standard plans introduced its own technological and political dynamics into the operation of the PWD system.

Type designs designated for general circulation were regularly issued from Calcutta and Simla by the Government of India. These were sent out in multi-copy sets to the public works secretariats of the various Provincial and Presidency Governments which would then relay them to their executive and superintending engineers in the field. Such general issues were usually prepared as lithographic or photo-zincographic plates which could be printed in series of several hundred, or even thousands, of copies by the Surveyor General’s office in Calcutta or by the official printers of provincial and presidency governments. Bombay, for example, operated its own photo-zincographic press at Poona.

These reprographic techniques imposed their own specific constraints on the manner in which departmental drawings were to be prepared; a further purely technical factor which circumstantially standardized the way designs were represented, visually, and possibly the way in which they were conceived. While the availability of printing and graphic reproduction technology were more or less taken for granted in British
India, by the second half of the 19th century, the actual techniques were not necessarily well understood by the bureaucratic functionaries who regularly availed themselves of such. It was therefore imperative to lay down rather specific and binding regulations for the preparation of any document or drawing slated for reproduction. In a PWD Circular of 1885, for example, the Department laid down exacting specification in this regard in the form of a detailed memorandum from the Surveyor General of India. In a covering letter to that document, the object of such constraints were explained as follows:

...in future, as far as may be possible, all drawings submitted to the Government of India in this Department may be prepared in accordance with the accompanying instructions issued by the Surveyor General.

It is desirable that, as a rule, the drawings should be on tracing cloth, and not on paper. Drawings have frequently to be printed by the heliographic process in this office, and have to be traced before that process can be applied. But the chief object, which the Gov't. of India had in view, is to ensure that drawings of important works will be received in such a condition that they can be satisfactorily reproduced by photozincography etc.,

The source of the designs reproduced in these printed series varied. Whereas the central authorities of the PWD secretariat in Calcutta, or its provincial counterparts, were the issuing agencies, the designers were still quite often ordinary engineers in the field (or the government architect wherever such rare appointments existed before 1900, as in

133 A range of reprographic techniques, including heliography, lithography and photo-zincography, were known and employed in the various governments and departments of the colonial administration throughout the period under study; and as early as the 1820's, private lithographic presses had been operating in India producing high quality graphic publications. (see, for example, the lithographs of the landscape artist, John Grantz (1772-1853), published at his own press in Madras in 1827 as a folio titled: Indian Microcosm. For a biographical sketch of Grantz, and other European artists associated with British India, see Mildred Archer, British Drawings in the India Office Library (London, 1969), among Archer's numerous other publications on that topic.

134 Surveyor General of India, "Instructions for the preparation of drawings for reproduction by photo-zincography". Enclosure to PWD Circular (General), No.1, Calcutta, Feb.16, 1885.

135 (signed) Col. G.C. De Free, S.C., in Ibid.
An interesting and potentially deterministic dynamic that came into play in this situation was the intra-departmental competition for power and influence that the practice of standardization created. When a design produced by a particular drawing office somewhere in the system was selected for general replication as the departmental standard, that office enjoyed both the recognition accorded and the sense of control they then exercised on their colleagues who would hence forward be obliged to follow their prescribed design.

The use of Standard Plans as a frame-based design system:

For all the constraints and impediments which the PWD system may seem to have thrown in the way of creative architectural design, a look at some actual plans produced by the PWD and its various branches reveals how design standards served, among other uses, as a cognitive tool for the efficient production of effective and even felicitous design solutions.

In the previous chapter we discussed the multiple applicability of the generic plan and section of the Anglo-Indian barrack as a form of prototype—or what we could call a "frame", in the sense of the term that Minsky has defined—\(^{136}\) from which a family of formally similar buildings could be developed. That principle is again clearly in evidence in the following two pairs of "standard plans" for typical military buildings—further examples from the corpus of standard plans prepared by Col. Crommelin, in the 1860’s. In the design of these modest scale buildings, the generic plan and section of the pukka bungalow provided the initial "frame" in which a particular solution, tailored to the

\(^{136}\) The notion of a "frame" employed in the field of artificial intelligence is defined by Marvin Minsky as "a data structure for representing a stereotyped situation." In everyday reasoning, he proposes, "when one encounters a new situation (or makes a substantial change in one's view of a problem), one selects from memory [such] a structure...to be adapted to fit reality by changing details as necessary." A "frame" is represented, theoretically, as "a network of nodes and relations" part of which are fixed for every situation to which it applies, the remainder consisting of terminals or slots which must be filled by specific instances of data. M. Minsky, "Frame System Theory", in P.N. Johnson-Laird and P.C. Wason, eds., Thinking: Readings in Cognitive Science, (Cambridge: Cambridge University Press, 1977), 355-356.
specific operational and performance criteria defined for each building type, could be worked out. Between the 2 variants of Sergeant’s Quarters (8.3) we see how an initial solution to the problem of subdividing the bungalow "frame" into a multiple dwelling structure becomes, itself, a "frame" in which further solutions to similar design briefs are efficiently generated. In this rather literal, architectural instance of frame-thinking, the variables are the relative branchiness of the "terminals" of the formal structure itself—rather than alternative choices of content, such as alternative building materials, for example—and the specific measurements assigned to the various spatial dimensions of the plans. Such "parameterization" is the sole design operation evident in the case of the two only slightly differentiated plans for officers' Mess facilities (8.4) (the more modest of the two designated, notably, for British officers of "native" regiments).

Even through these very cursory comparisons of official "standard plans" for military buildings we can see how much explicitly defined frames served as a form of hypothesis with which laborious and potentially redundant rethinking from first principles was effectively by-passed, in both routine and innovative design reasoning processes. The cognitive economy of design standards was vested in their use as text-book cases providing default assignments of pertinent design data as variables readily altered or replaced to fit the actual requirements of each specific case.

Whether an official standard plan for a particular building type existed or not, the PWD engineers were strongly predisposed to employ such heuristic case-based reasoning methods in their architectural design work, generally. In the case of the Railway officers quarters at Mahalaxmi (8.5) and the Satara hospital ward (8.6)—two quite distinct building problems almost half a century apart—we see the same distinctive spatial frame, in plan; but the actual assignments of the spaces are differentiated accordingly, and the conventional section and elevation are transformed in the later building to admit air and light to the upper volume of the roof—as per the evolving norms of roof construction which came into effect in the late 19th century.

Architectural design work in the Railway Branch of the PWD entailed a great deal of routine and often virtually identical design briefs for
STANDARD PLAN OF STAFF SERGEANTS' QUARTERS for ARTILLERY

APPROVED BY HIS EXCELLENCE THE COMMANDER-IN-CHIEF

FOR HEAD QUARTERS OF A BRIGADE OF EUROPEAN ARTILLERY.

Fig. 8.3. Standard Plans of Staff Sergeants' Quarters for Brigade of European Artillery. PWD (military works), 1865. Source: Enclosure to PWD Circular No. 46 of 1865.
Fig. 8.4. Mess houses for officers of British Infantry or Cavalry (upper), and for Regiment of Native Cavalry and Infantry (lower), PWD (military works), 1866. Source: Enclosure PWD Circular Nos. 71 of 1866, and 64 of 1867 respectively.
Fig. 8.5. Railway officers' Quarters at Mahalaxmi Station on the Bombay Baroda and Central India railway, 1882. A simple variation on the standard hipped gable bungalow prototype employed throughout western and central India. Source: BA-map No. 5453.
Fig. 8.6. Civil Hospital, Satara. Infectious Diseases and Observation Wards. Exec. Eng., Satara Dist., Bombay PWD, 1922. Source: BA-MAP-4960.
Fig. 8.8. Gangmens' Quarters, Tapti Valley Railway, Bombay PWD (Railway Branch, c.1899). Source: BA-map Nos. 4636, 4646 (opposite page); 4647, 4648, 4653, 4628 (above).
**Fig. 8.9.** Quarters for Police and Station Servants, Neemuch. Neemuch State Railway. Public Works Department (Railway Branch), 1879. Source: *BA-map No. 4937*. Note concrete vaulting.

**Fig. 8.10.** Menial's quarters, Rakhial. Ahmedabad and Parantij Railway. Source: *BA-map No. 4687*. 


Fig. 8.11. Traffic Staff Quarters, Nardana. Tapti Valley Railway (c.1899). Source: BA-map No. 4640 (above), and 4658, 4651, 4655, 4636 (following page). The largest units are designated for "Station masters", medium size units for "Assistant Station Masters" one room cells for "menial" staff. Note that the doorways of the latter open only to the rear. Note the affinity with J.M. Gandy Utilitarian formalism, in his farm labourers' dwellings proposals of the early 19th century.

Fig. 8.7. Standard "unit" plan for stations on the Tapti Valley Railway, Bombay PWD (Railway Branch), 1899 (upper); composite variant with passenger platform, at Nardana, (lower). Source: BA-map No. 4637, 4654.
the various service buildings and staff quarters at each station and maintenance point along the extensive network of railway lines for which the Department was responsible. It is not surprising, therefore, that the heuristic use of standards in a frame-based approach to design decision making is particularly well demonstrated in the corpus of mundane railway buildings designed by the PWD engineers. The preceding range of designs for basic buildings on the Tapti Valley Railway—a branch line of the Bombay, Baroda and Central India Railway, built in the 1890's under the superintendence of the Bombay PWD—should speak for themselves in this regard (8.7, 8.8, 8.12). In these distinct families of simple, nominally differentiated design solutions for menial staff quarters, and different classes of station buildings, we observe the results of a frame-like manipulation of standard designs and design elements, as basic building blocks with which novel combinations and variations could be composed.

In this spartan, expressly utilitarian approach to the design of buildings, the question of "Architecture" was not so much absent, as it was confined, at once, to the most essential and the most superficial levels of order. Whereas the rationale of economic efficiency in construction dictated that all quarters for "native" railway staff at minor stations, should be grouped contiguously, the almost equally important criterion of differentiating the particular grade of each employee was met by various subtle but effective formal devices. Note the conspicuously varied displacement of door openings in the range of otherwise identical concrete-vaulted living quarters designed in 1879 for railway police and staff at Neemuch, on the Neemuch State Railway (8.9). With these distinctive type quarters, the hierarchical status of the occupant could be accounted for spatially by simply extruding the

137 In the 1870's concrete was still a rather novel building material in India. By 1868, at least one factory was manufacturing a form of artificial cement, locally. Government of Fort St. George (Madras), PWD Proceedings, Oct. 19, 1968, Nos. 439/441, 1718. Concrete vaulted construction was employed quite extensively for minor service buildings and domestic quarters on the new state railways system then being extended into the desert regions of Rajasthan where clay and fuel for conventional brick making were scarce.

Note the distinct similarity between these utilitarian Indian railway buildings of the 1870's and the much admired concrete-vaulted menial staff quarters conceived eighty years later for Chandigarh by Le Corbusier and his collaborators—Drew, Fry and Jeanneret.
tube-like volume to a length proportionate with salary, relative to neighbouring dwelling units. However, twenty years later in the increasingly status conscious colonial polity at the turn of the century, a more conspicuous articulation of identity and status was evidently presumed to be necessary. In the design for traffic staff quarters at Nardana, for instance (8.11), we see how this was achieved simply but effectively through the intentional manipulation of symmetry, both in plan and in the subtle displacement of decorative elements on the facade. Note the similarities in intention, and to some degree in form as well, between these Indian railway buildings and Joseph Gandy's hypothetical project of the beginning of the century to assimilate Architecture to the utilitarian prerogatives of farm buildings. (8.12).

The (non)question of aesthetics and aesthetic sensibility:

For all the emphasis on drawing in the engineers' training, the conventions of standard plans also diminished the significance of good draftsmanship for communicating design information. As the essential frame—or what in architectural parlance is referred to as the "parti"—of a given building design assignment was already embedded intrinsically in the standard plan on which it was to be based, (when such a plan existed), design drawings did not have to capture the imagination of the users and clients, serving more simply as basic notation for identifying presupposed norms and any specific alterations thereto.

From the departmental perspective this was a further bonus of the system, with respect to efficiency and dependability, where the quality and consistency of drawing skills among the subordinate establishment could not necessarily be counted on. But, of course, the principle worked two ways, and the evidence of the various PWD produced drawings surveyed in the course of this research suggests that the tracing of near identical plan after plan did little to encourage or develop the skills of the Indian clerks and sub-assistant engineers on whom its production of design drawings largely depended. (See fig. 8.13).

The deficit in design instruction, and even basic drawing instruction, in the engineering colleges had little cause to be remedied
with the system as such. As late as 1917, when the principal of Thomason College submitted his evidence on the state of the PWD to a committee convened to consider the reorganization of the Department, he had to confess that the design and drawing curricula at Roorkee were still far from adequate. \textsuperscript{138}

There was a notable contrast between this general inclination toward technical and artistic mediocrity under the systematic regime of the mature PWD system, and the often capable, on occasion refined, architectural work by individual engineers and others under the more loosely knit works system of the old Company regime. As we discussed in Chapter 4, those earlier builders had been no less inclined to exploit the at-hand knowledge of precedents. However, prior to efforts to codify their own home-grown standards, they had made workmanlike use of other largely imported standards and models taken from the various published "pattern books" of the day. Books and folios of that sort were certainly available to the PWD engineers as well, but it is striking how clearly the canonical examples of European architecture which they conveyed were eschewed as relevant precedents for modern Indian buildings, in the period in question.

The PWD library in the Calcutta Secretariat listed several of such pattern books in its catalogue ranging in sophistication from \textit{Vitruvius Britannicus}, the classic 5 volume portfolio of model exemplars of English Palladianism published in 1771, to an anonymous compendium, \textit{Villa and Cottage Architecture} of 1869. \textsuperscript{139} One presumes that such source books for design precedents, along with the more general practical and theoretical works comprising that library, played some role in backing-up the professional judgement exercised by the PWD Secretary and his senior-most staff in their assessments of new designs sent up for sanctioning. However, as reference works in the hands of the sanctioning authorities rather than "handbooks" in the hands of the designers, this published knowledge must have served essentially to support the proscription of

\textsuperscript{138} PWD Reorganization Committee Report (1917): evidence of W.G. Wood, Principal of Thomason College, Roorkee.

design proposals considered canonically or technically unacceptable. It does not appear to have continued to play the significant role that previous scholars have assumed in providing prescriptive guidelines or actual prototypes for architectural design in the PW& of the mature Raj.

The library of the Thomason College at Roorkee had much more extensive holdings and, indeed, a good number of pattern books of various descriptions, as was discussed earlier, in Chapter 4. The Roorkee collection was the more representative of the range of knowledge that both the civilian and the military members of the departmental staff could potentially have taken with them into service after their initial training. But again, it is unlikely that more than a small minority of departmental engineers, most obviously those working in the immediate region of the college in North-Western India—could have made a direct use of such sources for design. The quite exceptional size of that collection, by comparison to other Indian educational institutions of the 19th century, was in part a result of the amalgamation of the modest original collection of the Thomason College with the entire holdings of the library of Addiscombe, which were shipped out to India following the closure of that college in 1858. Most of the pattern books in question

This confusion would appear to stem from an insufficiently discerning extrapolation from the experience of the "Company Architects" of the late 18th and early 19th century—first documented and described as such by Mildred Archer in her seminal article "Company Architects and Their Influence in India." RIBA Journal (August 1963): 317–321—to the practices and prejudices of the engineer-architects of the mature colonial regime. See also Archer's subsequent monographic sketch: Indian Architecture and the British 1780–1830. (London: Country Life, 1968). What I hope this study has elucidated to some degree is the important changes in design methods, and in attitudes toward the use of design knowledge, which may be observed in the architectural history of British India over the course of the 19th century.

Approximately 3000 volumes, constituting the entire holdings of the Addiscombe library, were added to that of the Thomason College in 1862. The original Roorkee collection of approximately 3,500 volumes in 1856, was augmented by some 1400 volumes per year through the course of the second half of the century. By the time the fourth edition of the college library catalogue was published, in 1913, the collection had grown to 25,000 volumes on a wide range of both technical and general subjects. Catalogue of Books in the Central library attached to the Thomason Civil Engineering College, Roorkee, Part I, Science and Professional Works. 4th ed. (Roorkee: Photo-mech. and Litho. Dept., Thomason College, 1913), Preface.
date from the first part of the 19th century, and conceivably found their way to India by way of the Addiscombe bequest.

The limitation of the design responsibility of the subordinate staff:

The underdeveloped design capability of the departmental establishment as a whole was evidently a factor of no small significance in the development of its particular design procedures. Cognizant of its own deficit in this regard, on account of all the other pressing departmental business it was obliged to attend to, the engineering establishment was, nevertheless, reticent to rely on the subordinate staff.

In the crucial first few decades of departmental operations the upper subordinate cadre was still dominated by British soldiers recruited from the Sappers and Miners Regiment. Although these men attained some proficiency as draftsmen and estimators through the Overseers course at Roorkee, their competence to apply those skills with a modicum of professional responsibility was too frequently undermined by the bad habits of barracks life, to the frustration of their superior officers in the departmental cadre.  

The Indian members of the subordinate establishment (the few that there were before a more affirmative recruiting policy was put in place later in the century) were not prone to the profligacy of their military colleagues, but they too were denied the confidence of the engineers on account of the then increasingly strong held prejudice on the part of the British colonial community that "the native mind is eminently unpractical". Enunciated, as in this case, by the executive cadre of the PWD, this tenuous assertion said far more, however, about the stubborn, almost irrational obsession of the engineering profession with

For many years Murray’s Guide to India made a special note concerning this unique and sizable collection, from which travellers were informed they could borrow books while on tour, and return by post.

Among these was the respected Bombay engineer, Captain St. Clair Wilkins, who tabled his concerns over the unsatisfactory calibre of the European Overseers in the Bombay PWD at a conference of the Public Works executive of that Presidency held in Poona in 1864. "Poona Conference", PPIE 3, 10 (February 1866).

Ibid.
"practicality" as a value, in the Victorian heyday of Indian development, than it did about the actual potential of the Indian departmental staff. A particularly revealing case in point was related by William White in his critical report to his colleagues at the RIBA on the state of architectural progress in British India in the early 1870's:

It is declared that the Bengalee is bereft of the faintest trace of originality, and that as a copyist he is far inferior to the Chinaman. But it is necessary to be able to copy well before trying to invent. The Bengalee has not had the artistic opportunities of the peoples placed more directly under Pathan and Moghul influence; and it is much to his favour that he is a skillful copyist. More at least can be made of him than many of our countrymen seem willing to accomplish. While I was in Calcutta a few native students...were sent to the Department of Public Works, to be ultimately converted into engineers. They were all good draughtsmen, and had already acquired the rudiments of architecture, much in the same way they are learnt in the European schools of art. They were all utterly ignorant of even the existence of any style of indigenous architecture. The best one of them was placed under my charge... One day, to test his artistic ability I ordered him to copy, to three or four times the size, the engraving of an elaborate medieval fountain, designed by Mr. Burges. He not only made a good copy of it, but added the extra spirit it is necessary to give to an enlarged drawing; and I sent it to the Chief Engineer with some little exultation. The Recording Angel knows that my intentions were good; but so horrified was authority, so convinced was it that an artist, especially a brown one, in the Department of Public Works was an anomaly that precedent could not justify nor practice initiate, that means were instantly devised for driving the evil spirit out of him; and before I left India I was informed... that he had been sent to make bricks at one of the Government kilns!

White was not especially concerned with the advancement of the native subordinates of the PWD, though he evidently had faith that they could play a more comprehensive professional role in the Department's operations. His principal concern was that the cult of the "practical"

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144 White, William H. "On Government Architects in Bengal." TRIBA (1873-1874): 151-152. A few years later—for reasons will discuss in the final chapter—the Department softened somewhat in its defiantly anti-aesthetic stance, and two other young Hindu sub-assistant engineers were actually sent to England expressly to gain some expert architectural training. See: Papers concerning professional training in England for "native" PWD engineers: Native Assistant Engineers on Practical Course, 1882-84. (IOR: L/PWD/9/55, file No.15).
was an excuse for an increasingly unthinking approach to design: a resort to rote routines of practice rather than the innovative pragmatism that the notion implied:

An unqualified belief in the "practical", is a creed with which many of our countrymen are too happy to deceive themselves; and too many ignore the fact, that nothing practical has ever been accomplished, until theorists have expended a vast deal of time over its considerations.

Fig.8.13. Design for Cottages at Howrah, Burdwan and Raneegunge. East Indian Railway (c.1860). Note the crudely drafted elevations. Source: IOR/PWD/3/52. The basic structural and formal criteria of the generic classicism employed in such typical "pukka" buildings could largely be satisfied by default. Even the most approximate design 'sketches' would generally suffice in getting the basic idea across.

Fig.8.14. Cawnpore Memorial Church, Walter Granville, architect. Source: The Professional Papers in Indian Engineering, Vol.1/4, Aug. 1864. In the energetic but sober period of re-consolidation and technical development following the Mutiny "high" architecture was generally reserved for churches and funerary monuments memorializing the self sacrifice of the colonial community to its ideal of its civilizing mission in India.

145 Ibid.
Although the artistic capabilities of Indian draftsmen in the employ of the Company administration had been widely appreciated in the past, aesthetics, along with the more fundamental principles of individualism and liberty which such could be used to express, were distinctly ignored if not denigrated in the early building efforts of the new Raj. In the PWD in that period, the value of a draftsman was measured, not by his skill in representing design knowledge, but rather by the efficiency with which he could reproduce such a representation.

146 The Company opened new avenues of employment as draftsmen, surveyors and cartographers, for traditionally trained artists of the various regional schools of painting patronized in the past by the Indian princes and nobility. As Mildred Archer has described, European members of the colonial community became quite enamoured of the peculiar vision of these native artists in their application of Western drawing techniques to Indian architectural subjects and a lucrative market for such so-called "Company paintings" had actually developed in the first half of the 19th century. M. Archer, "Company architects and their influence in India", 317-321.
Summary: In this chapter we have examined various aspects of standardization in the organization and operations of the PWD. We first surveyed the PWD records chronologically to discern the pattern of departmental policy changes with respect to design, standardization, and its significant historical correlations over the half century of colonial development in question. We then considered the bureaucratic incentives for standardization in the normative practices and procedures through which information was processed in the day to day workings of the Public Works Department. These actual economies afforded by the bureaucratic standardization of practices were then contrasted with standardization and conformity as a conceptual system attributed to the PWD engineers, and embodied as a normative framework in their centralized, corporate institution. Finally, we examined how this conceptual system and these various bureaucratic modes of reasoning conjoined in the standard case based design methods, and techniques through which the Department's architectural designs were routinely produced.

Although there were precedents for standardization in the building practices of the British and East India Company Armies, it may be concluded that the primary compulsion to standardize was internal—a matter of cognitive efficiency. Despite the "departmentalism" of the PWD—a paradigm of authoritarian esprit de corps which, in the final analysis, could be regarded as the institutional embodiment of the latent conceptual system of the former military engineers corps of the East India Company—standardization was basically a heuristic tendency which enabled effective design problem solving and relative efficiency in design production, with a minimum of means and expert knowledge. However, the appreciation and exploitation of these efficiencies depended on more general conceptual factors. As we will now proceed to examine in the final chapter, this standardizing departmental design system came to be perceived in later years as an ossified institution of inefficient and unrepresentative conventions, increasingly associated with arbitrary regulation and control.
CHAPTER 9

CONTROL

We build 'em nice barracks—they swear they are bad,
That our Colonels are Methodist, married or mad.

—Rudyard Kipling ("Sappers")

Introduction: In preceding chapters we have examined the processes through which the building practices of the British Indian administration evolved into an increasingly well defined and self-regulating set of formal and methodological design institutions. We addressed in particular the self-consciously scientific rationality that the PWD engineers brought to bear on their efforts in the 1860's to rationalize the tacit building norms that the British and other Europeans had devised over the years to accommodate themselves in the extreme tropical climates of India. In the previous chapter we considered how that design reasoning, once made explicit, was subsequently institutionalized in the procedural codes and design standards of the PWD.

This final chapter of our study will take that analysis one stage further, seeking to enhance our emerging multi-functional explanation for the broad-based institutionalization of building design norms in Victorian India by considering the historical circumstances and changing conceptual parameters in which that utilitarian design paradigm was later challenged and at least partially rejected in favour of the predominantly aesthetic design criteria championed by the architectural profession. I will first examine the various objects and forms of the critique of the public works building practices that began to be articulated in the final quarter of the 19th century, culminating in the efforts of the first consulting architects to the various government works departments to redefine the criteria and methods for designing a technically and culturally appropriate official architecture for British India. I will then briefly reconsider the conceptual framework of imperial development in that crucial period, through which I propose a relationship may be discerned between the belated rise of aesthetics in local colonial building practices and on-going structural changes in the imperial world system. Finally, I consider how this critical urge to aestheticize the architectural product of the PWD was nevertheless consistent with the contrary commitment of the departmental engineers to utilitarian standards of form and performance, within the broader conceptual framework of colonial development, in which a compulsion to strictly define and control the parameters of action was an empowering cognitive basis for the temporally effective control that the authorities were able to exercise over the colonial society--both the "native" communities and their own.

The chapter closes with a concluding summary and discussion of the principal findings of the study as a whole.
1. AESTHETICIZATION

From means to ends:

The corpus of design standards of the British Indian Public Works Department arose from the rationalization of the Anglo-Indian building tradition. Ideally they can be seen to have brought order and system to a heuristically derived set of building norms and practices; to have made of these, as it were, a technology both for modifying and controlling an oppressive physical environment, and for controlling the efficiency with which that objective could be achieved. By the end of the Victorian era, however, that institutionalized design technology had come under fire. Increasingly the architectural production of the Department was to be depreciated on aesthetic grounds, as "artifacts" rather than means, inadequate to the more and more sophisticated task of cultural representation which an "imperial architecture" was expected to perform.

The advent of the twentieth century was a watershed in this regard. Within a year of Queen Victoria's death in 1901, amidst a general flurry of projects for monuments and memorial halls in honour of the late empress, it was decided to appoint a fully qualified professional architect to the PWD to serve the Government of India as its own in-house architectural consultant. Over the course of the subsequent decade—the final halcyon days of the British Empire—similar appointments were made in each of the provincial works departments. These measures constituted the first general recognition of the integral role that the architectural profession might play in the building efforts of the Indian PWD since the creation of the Department half a century before.¹ In the early years of the new century, the pioneering first incumbents in these new posts were to proceed methodically, sometimes passionately, to claim professional turf coopted previously by the engineers of the Department. In their capacity as designers and as consultants to the authorities on design

¹ With the exception of the Government of Madras, which employed a "civil architect" in its service throughout most of the second half of the 19th century, and several short-lived consultancies to the Governments of Bengal and Bombay in the 1860's, the colonial administration had never before retained architects on a permanent, salaried basis.
policy, they attempted to exercise the cultural and aesthetic expertise claimed by their profession, and to identify this with the evolving imperial agenda.

**Criticism of the PWD's design conventions and methods:**

The "poverty of conception" of the Public Works Department in the domain of architectural aesthetics—as Tilloston has deprecatated, in sympathy with most other recent commentators on the architecture of British India—was an issue of varying concern, throughout the history of the Department. Indeed, as we have seen, it was deeply committed members of the engineering cadre of the Department such as Major J.G. Medley who were among the first to try to raise critical awareness of a need for improvement.

The most aggressive invective against the buildings and methods of the PWD was launched—not surprisingly—from the fringes of the colonial building scene. By the same token, however, it had relatively little direct impact on the evolution of the Department's practices. The Quixotic campaign against the "tide of utilitarian barbarism" of the PWD which one particularly marginal character, the civil servant F.S. Growse, waged in the district backwaters of the North West Province in the 1870's and 1880's, was at least colourful. Growse's efforts to foster an alternative craft based mode of "modern Indian architecture" in the various districts he headed as an ICS collector, in defiance of PWD design standards and building procedures, were never to produce more than a handful of actual buildings. But the polemic he generated in print and through the sheer obstreperousness of his dealings with the system as a self-declared "apostle of culture" among the philistines of the colonial

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technocracy, was to prove perennially relevant and useful to other critics of the same.

Growse's efforts have been well discussed in other recent accounts, and the details need not detain us here. What like-minded antagonists of the PWD such as John Lockwood Kipling, and E.B. Havell a generation later, were to draw from Growse's decidedly eccentric polemic against the utilitarian departmentalism of the colonial administrative system in general was his salient critique of the deleterious consequences for the traditional Indian building industry of the division of intellectual and manual labour in the departmental building process.

When Growse had embarked on his Indian career in the 1860's he had taken with him an ardent enthusiasm for the neo-medievalist ethic of craftsmanship championed by the current Gothic revival in English architecture and social thought. In India he had come to regard the traditional Indian craftsman-builder or mistri as a "living" representative of that ethic, whose likes had long disappeared with the restructuring of labour relations in industrialized English society. It was folly, to his mind, to pursue the same course in India. But this was precisely what he believed the technocratic organization of the building process under the regime of the Indian PWD was leading to. In the hierarchical division of designing and executive functions, on the one hand, and basic manual labour on the other, the departmental system had generally excluded this class of men who, to his mind, were prepared by their traditional training to accomplish all aspects of the building process with an optimum of both economy and artistry. The prerequisite of formal academic training in the Indian engineering colleges for all the subordinate establishment of the PWD, was the principal factor and absurdity in this regard. As Growse expounded, sardonically:

The mistri, or indigenous architect, thus superciliously excluded from competition, may be a skilled craftsman, whose work is of sufficient merit to be transported at great expense across the sea and set up for admiration in New York or London; but in India he cannot be trusted to design or carry out the

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4 Tarapor, "Growse of Bulansahar...", and Tillotson, Tradition of Indian Architecture, provide the most thorough discussions of this intriguing case. Metcalf, An Imperial Vision, offers the most insight giving interpretation.
most petty work in the smallest village: the reason being that he has spent the whole of his life in acquiring a practical mastery of his art and therefore has had no time to study English and in due course obtain an Engineering certificate; having done so, he is at once qualified for an appointment of Rs250 a month, in which he will freely be entrusted with the design and execution of local works, though he may know nothing of architecture beyond the hideous "standard plans" provided by the Public Works Department.  

The "standard plans" of the PWD were a tidy object on which Growse was repeatedly to focus his eloquent wrath, as the quintessence of all the "stereotyped conventionalities" with which he perceived that "chartered anti-aesthetic society" was methodically extinguishing the talents of the traditional Indian builders.  

As a teacher of architectural sculpture, and one of the earliest and most directly committed exponents of the Arts and Crafts Movement in British India, J.L. Kipling had a particularly strong and informed appreciation for Growse's arguments concerning the depredations of the PWD system on the "native" building crafts. Above all, he echoed Growse's indictment of design standardization. "The highly centralized departmental system," he wrote, "which prescribes the form of all buildings in one uniform pattern, is fatal to right movement in art..."  

It was Kipling's disdainful description of the generic "modern" buildings this system was prone to produce, through which we first encountered that humble canon, in the introduction to the case study (Chapter 3):  

...a long low wall pierced with round-headed cavities, entirely without architectural sense of mass, with no distinguishing feature and no details to speak of except the cornice and the impost from which the arches spring... There are hundreds of such buildings in India cut up into larger or shorter lengths, they serve for law courts, schools, municipal halls, dak bungalows, barracks, post offices, and other needs of our high civilization.

5 Growse, Indian Architecture of To-day..., iii. As quoted in Tillotson, Tradition of Indian Architecture, 90.  
7 J.L. Kipling, "Indian Architecture of To-day", in the Journal of Indian Art, 1, 3 (1886):1. As quoted in Stamp, "British Architects in India...", 368.  
8 J.L. Kipling, "Indian Architecture of To-day", The Journal of
In these critical impressions of the "Indian architecture of To-day", Kipling was speaking to a select metropolitan readership of other aesthetes interested in Indian arts and crafts. Along with later crafts enthusiasts, his polemic was to steer the critique of the PWD more and more toward the aesthetic issues of artistic and architectural production, in which engineers no longer claimed a place. As a sculptor and art teacher, his own professional interests lent an obvious bias to his arguments in this regard, whereas Growse, the professional bureaucrat, had articulated his critique in terms of the institutional and methodological conflicts he perceived to be at the root of this unhappy situation.

In a rare note of present day appreciation for what the PWD engineers and their design methods were about, Gavin Stamp reads the above description of the Department's ersatz modernism, at face value. Within the parameters and objectives of the design tasks they responded to, the semi-applicable utility of these simple, standard elements and compositional strategies "...was precisely their virtue", he suggests; "the military engineers had evolved a standardized architecture analogous to that proposed by the French Neo-Classical theorist, Durand."9

As far as I have discerned, J.N.L. Durand's methodical system for architectural composition, based on a simple repertory of building elements and combinatorial principles, did not play any direct role in the curricula of the engineering colleges that supplied the PWD with its staff, although the library of the Thomason College at Roorkee possessed copies of both the Precis des lecons d'Architecture, vols. I-II (Paris, 1923), and the Partie Graphique des Cours d'Architecture (Paris, 1921), possibly from its very inception.10 As our discussion in the previous

Indian Art, 1, 3 (1886): 1. As quoted in Tillotson, Tradition of Indian Architecture.

9 Stamp, "British Architects in India ...", 359.

10 Catalogue of Books in the Central Library of the Thomason Civil Engineering College, (Roorkee, 1913). The first two volumes of the Precis des Lecons...... were first published in 1802-05, and frequently reprinted up to around 1840. Gwilt's Encyclopaedia of Architecture, Historical, Theoretical, and Practical (London, 1851), of which both the Roorkee Library and the PWD Secretariat Library had copies, provided a synopsis of Durand's system in English, which may well have been used as a
chapter of the critical dialogue between the different engineering traditions of England and France has indicated, however, the British engineers certainly felt a growing empathy, through the second half of the 19th century, with the professional conceptual system of their French colleagues. This was the general case, to some extent, but particularly so for British engineers in colonial service. That conceptual system was emphatically represented in Durand's doctrine—a mechanizing, corporate rationality which confidently subsumed architecture, along with all other technical pursuits, into the single universe of precision that the modern engineer had every expectation of taming and controlling through his own overriding technical competence.

By the later years of the 19th century the old inter-fraternal squabbles of the military and civil engineers within the PWD had subsided (if not entirely vanished). In the meantime, the utilitarian norms and design standards they had mutually devised had indeed developed into a pervasive, institutionalized "system". Increasingly, their challenge lay outside the problem domain they had dominated with their system; that is, in fortifying and defending that institution itself against the claims of other professional groups and classes disfranchised by the hegemonic professional interests of the engineers. Ostensibly the critique of the Department's architectural efforts was aesthetic, but for those on the margins of the colonial building scene such as J.L. Kipling and the architectural profession the underlying issue was really "turf".

A comprehensive description and analysis of the distinctly "architectural" building designs that began to emerge from the PWD in the early years of the 20th century under the aegis of British India's first official architects, would exceed the scope of the present study. But we

reference more accessible to the Indian staff and trainees, who generally would not have had any French language skills. Catalogue of Books in the Library of the Public Works Department Secretariat, (Calcutta, 1886).

11 A pedagogical system in fact which, as Professor of Architecture at the Ecole Polytechnique, he prepared expressly to equip engineers efficiently with a necessary and applicable knowledge of architecture. Antoine Picon, French Architects and Engineers in the Age of the Enlightenment (Cambridge: Cambridge University Press, 1992), 322-328.

12 a domain that has been surveyed with varying degrees of analysis
can usefully conclude our inquiry at this distinct point of transition in the colonial architectural history of India by attempting to explain the phenomenon of cognitive change that had evidently taken place in the architectural imaginations of the British colonial builders and policy makers by the close of the Victorian era, precipitating their departure from the unabashedly artless building tradition we have been examining so far.

2. THE IMPERIAL DELUSION

To explain the increasingly ostentatious and aesthetically self-conscious architecture that the colonial Indian builders began to conceive and execute in the early years of this century, in pointed contrast to the homogenizing design standards which the PWD had earlier devised, we must consider the important conceptual change that both the metropolitan society of late Victorian England and its colonial sub-culture in India had undergone since the middle years of the 19th century.

The broader pattern of conceptual change we have been charting incrementally in this study, in the background of our inquiry into the evolving intentionality of the colonial builders in India, might be usefully summarized at this point.

Up to the beginning of the nineteenth century, we observed, India had entered only nominally into the conceptual sphere of British political life. Under the East India Company's administration it remained largely removed from the partisan issues and interests of Parliament; a distant business venture that had little purchase on the "spirit" of any but those investors who held stock in its trade. But that commercial interest had steadily declined, paradoxically, as British dominance in the Indian subcontinent was consolidated in the first half of the century. Apart from the brief-lived idealism with which Liberal and Utilitarian reformers had sought to extend their Anglo-Saxon models of ethical rationality and cultural progress to India in the 1830's, the obligation to rule the vast territory that the Company had almost

in most recent studies of British Indian architecture, but which still awaits a comprehensive account.
inadvertently conquered, was increasingly perceived as an uneconomical and unwanted encumbrance. Although the Company service held lucrative career opportunities for a small number of individuals, the enterprise had never really given seed to an ideology which could unify those colonial servants in their endeavour, moreover link it to the beliefs and aspirations of the home society.

The Mutiny and ensuing popular uprising of 1857-58 was a shock to which the flagging colonial undertaking might well have succumbed. But the call to order it had provoked had lead, alternatively, to not only the reconstruction and further aggressive development of the political and technical framework of the British Indian administration, but the "construction" of a collective ideology of Empire with which that costly enterprise could be justified and sustained.

Among the more symbolically significant acts that had ensued with the restoration of British authority in 1858, was the trial and expulsion of the last living King of Delhi—the seat of the former Mughal Empire and the center-point of the essentially nostalgic revolt of the preceding months. Provoked to flex its military muscle, the British regime had come finally to oust the feeble potentate it had previously opted, on strategic grounds, to preserve and prop up as the figurehead of the revenue collecting enterprise of the Indian state, for which the Company administrators had been content merely to keep the books (and the profits). The common judicial trial of the deposed Emperor, together with the official annexation of his title by the British Crown through the Government of India Act of 1858 and the Queen’s Proclamation of 1 November 1858 (see Chapter 7), had effectively desanctified the previous political order of the society, by the same token ending the ambiguity of the position of the British in India. The desanctification of the person of the Mughal Emperor was a contemptuous demonstration of the fact that the Indian peoples had been well and truly conquered. In Cohn’s view it marked not only the beginning of a new political order, but the formal establishment of a myth of the superiority of the British character over that of the Indians.  

13 E.S. Cohn, "Representing Authority in Victorian India", in Hobsbawm and Ranger, eds., The Invention of Tradition, (Cambridge: Cambridge University Press, 1983).
This message was directed at the British themselves, as much as it was calculated to demoralize their disloyal Indian subjects. Recognition that they had ultimately captured the Indian throne by *force majeure* had stirred them to perceive their exploits in a more heroic light than previously, in terms of martial superiority and imperial destiny. Flattering parallels with the great imperial powers of the past could now be openly and confidently entertained. To influential colonial officials such as Alfred Lyall, Rome offered a compelling and seemingly appropriate precedent, in its imperial administration of its eastern territories, for the role Britain had come to play in India. 14 Others, such as Lord James Bryce, concurred in that comparison but were rather leery of its implications. In his *Studies in History and Jurisprudence* (1901) 15 Bryce proposed that "[t]he government of India by the English resembles that of her provinces by Rome in being virtually despotic. In both cases, whatever may have been done for the people, nothing was or is done by the people." This rather un-English state of affairs stemmed from the essential military composition and disposition of the Anglo-Indian society, as he perceived it. With the possible exception of Bombay, he remarked, "the traveller from peaceful England feels himself... surrounded by an atmosphere of gunpowder all the time he stays in India." But there were other less problematic comparisons between the nascent British Empire and that of the Romans, with which colonial officials could flatter themselves without scruples. Despite his distaste for the martial trappings of empire, Bryce believed that both the Romans and the British had actually triumphed "by force of character". 16 On a similar note, Sir John Lucas of the Colonial Office proposed that, alike, they "...had an innate capacity for ruling which grew by use." 17 Most significantly, from the point of view of our present inquiry, the British perceived themselves to be like the Romans in their pragmatism, turning

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14 Metcalf, *Imperial Vision...*, 56.


17 Ibid., 153.
knowledge and technique to concrete problems such as engineering. The triumphant works of British engineers in India had embodied the knowledge and power of the conquering civilization both explicitly and reassuringly from an ethical standpoint.

While the shock of the Mutiny had lingered, the boldly militaristic affinity with Rome could hold sway in the imagination of a British public temporarily captivated by the violence and pathos of current Indian affairs. Meanwhile, to those troubled by the contradictions such an imperial vision presented for a nation that regarded its belief in Liberty as its principal virtue, it could be argued that British conquest had brought progress to India, of a distinctly practical sort. As the imperial ideology matured, however, this notion of progressive intervention was superseded by a more sustainable and essentially conservative ideal of the imperial destiny of Britain: "to guarantee order and stability in a world of jostling and expansionist nations driven by Machiavellian desires." In the global scramble for empire in which Britain found itself engaged with the other principal European powers, along with Russia and America, in the final quarter of the 19th century, it was anxious to differentiate its motives from those of its competitors and thereby to legitimize its own rapidly expanding colonial interests beyond India, in South East Asia, Africa, the Caribbean and the Pacific. To that end force was portrayed as necessary rather than desirable for the prosecution of what was perceived as Britain's humanitarian and commercial agenda as an imperial power; the latter contrasted, with increasing conviction as the century closed, to the exploitive tyranny of Rome and those other modern-day empires seemingly destined to repeat its folly.

The scramble for Empire: economic and conceptual factors

The age of full-blown European imperialism which spanned the four decades

18 Ibid., 152-153.
19 Bette, "the Allusion to Rome...", 153-154.
20 Ibid.
preceding the First World War was instigated, in Hobsbawm's view, by an unforeseen crisis in the world economy in the 1870's, when the advancing bourgeois civilization of the industrialized states was confronted with the first compelling indications of its limits to growth. This crisis correlates closely with the cognitive changes manifested in both metropolitan and colonial societies in this period. It will be useful to digress briefly at this point to consider that relationship more fully.

After a generation of unparalleled economic expansion, and a full century after the American Revolution had first put into action the Liberal ideal of unshackled social and economic development, an unprecedented disturbance and depression of trade was experienced almost universally in the 1870's. The dramatic acceleration of industrialized economic development through the first half of the 19th century with its unprecedented impact on both the production and distribution of goods in all economic sectors, had resulted in an untenable surplus by the early 1870's at which point prices, and with them interest and profits, had finally collapsed. Although production continued to grow, this depression in profitability compelled the world economy "to change gears". From the abstract and optimistic notion of an open and infinite "global" market, the reality of compromising competition between rival economic blocs identified with "national interest" was finally to be recognized and actively exploited.

Among the tactics employed at this point in an effort to regain economic momentum was protectionism, the worried producer's instinctive political reaction to international competition. A second, and what proved the most significant response of capitalism to this Depression, was the concentration and rationalization of economic organization in the form of corporations and trusts, to widen profit margins within the national economies. A third tactic was imperialism. Although the relation between the economic troubles of the 1870's and the take-off of the colonial division of the globe by the European powers cannot be reduced to simple cause and effect, Hobsbawm cautions, it is undeniable as he explains "...that the pressure of capital in search of more profitable

investments, as of production in search of markets, contributed to policies of expansion—including colonial conquest."

The more specific significance of these developments for our present discussion of the evolving imperial ideology of the British in India in this period, was the opportunity that the economic malaise of the 1870's provided for more conservative and skeptical voices vis-a-vis "progress"—long in the shadow of bourgeois liberalism—to be heard, and indeed to be reinforced in principle by the hard-nosed new economic strategy to which industrial capitalism was gravitating. As it moved to control markets through the consolidation and rationalization of economic power along the lines of increasingly exclusive national and elite corporate blocks, a view of a non-egalitarian human society articulated along similarly exclusive lines was regaining credence.

The biological notion of evolution had long been embraced under the ideal of progress, but Darwin's controversial theory of "natural selection" in the development of biological organisms, (introduced in 1842 in the first draft of his *Origin of Species*) had provided a strong argument, empowered by science, for a distinctly partial and non-egalitarian model of progress which could, it seemed, be easily applied by analogy to the development of human society. The novelty of the theory for biologists was that it attributed evolution to a positive selection of existing species (or, rather, the elimination of obsolescent

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22 Ibid., 45.
24 Darwin's own hypothesis may well have derived, in part, from Malthus' earlier notion of "the struggle for existence" among populations. Hobsbawm, *Age of Empire*, 254.

The social implications of Darwinism were perhaps especially apparent to the older guard of the British Indian administration for many would have imbibed the Malthusian thesis directly from Malthus himself, who had served in the 1830's as Professor of History and Political Economy at Haileybury, the administrative staff college of the East India Company. Bernard S. Cohn, "The recruitment and training of British Civil Servants in India, 1600-1860". B.S. Cohn, *An Anthropologist Among the Historians and Other Essays*. (Delhi: Oxford University Press, 1990), 526-527.
ones) by Nature herself. In the social analogy that soon took hold of a less than scientifically rigorous popular imagination, the theory discounted the possibility of effecting any truly consequential changes in a scheme of social progress that was regarded more and more as intrinsically predetermined. One was what they were, and no amount of moral improvement or rational enlightenment could really controvert Nature.

With the centenarian reassessment of the faltering Liberal model of social and economic progress that ensued in the crisis of the 1870's, the vulgarized Darwinian notion of the "survival of the fittest" gained new credibility in its apparent capacity to explain the unequal performance of that model, specifically the apparent intransigence to change of large segments of humanity—which decades of exposure to the "progressive forces" of industrial civilization, both within the most advanced societies as abroad, had so far failed to move. Moreover, Darwinism could be construed to condone as "rational" the abandonment of belief in universal progress and, hence, to sanction the concentration of productive resources under the control of those "naturally" predisposed to develop them most fruitfully. These latter were perceived to be the energetic and talented stock of the middle classes of the industrialized European nations (of course) while the poor supine masses were doomed to inferiority, it could now be argued, by their innate (genetic) deficiencies.

If it could be believed that such a fundamental biological differentiation existed even within the ethnic collectivity of the advanced metropolitan societies, the "racially" distinct peoples of the imperial colonies were tacitly beyond hope; to be virtually excluded by default from a scheme of "progress" which was more and more confidently

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26 Hobsbawm, Age of Empire, 30–32. The science of "genetics" did not come into existence, by that name, before the first years of the twentieth century, but the pseudo-scientific movement of "eugenics", which sought in essence to apply the principles of animal husbandry to the selective propagation of this idealized (white) middle-class, had already acquired its name and considerable popular and political following, on both the Right and the Left, as early as 1883. op.cit., 253.
regarded as the unique destiny of those northern European peoples, and their New World progeny, who had evidently come quite "naturally" to dominate the rest of the planet. The idea of "race" was therefore to penetrate the ideology of the period almost as deeply as "progress"; in British India, the former increasingly to the exclusion of the latter, from the 1870's onward. The (re)construction of a traditional India:

The shift from the paradigm of "nurture" to the Darwinian emphasis on "nature" is an apposite representation of the important conceptual change expressed in colonial Indian policy and cultural production between the early and the late 19th century. From the campaigns of educational and moral improvement of the 1830's and the subsequent endeavours of the PWD engineers to advance the technical development of the Indian subcontinent—a paradigm of belief in progress promulgated by the active nurturing of development through learning—an ideologically transformed regime was manifested in the final quarter of the century, fixated on the idea of a "traditional" India, obsessed with the racial nature of that ostensibly timeless civilization and with the description, classification, and conservation of its myriad facets of ethnicity.

As we have seen (see Chapter 7), a process of conceptual consolidation had already been on-going in India since the local crisis of the late 1850's. But the cognitive change that attended the global crisis of the 1870's, lent a new political significance to the ethnological knowledge that the colonial administration had been methodically gathering and cataloguing. What had been perceived in the aftermath of the Mutiny as an expedient endeavour—"to know" the enemy they had now conquered and desired to rule—became an altogether more earnest and instrumental exercise under the parametric rationality that

27 Ibid., 32.

28 Even among the imperial powers, as we saw in the previous chapter, the competitive pressures of this era provoked serious, strategic speculation on the "race" characteristics of the different European peoples.

29 To reiterate the definition given in Chapter 1, "parametric
underscored the mature imperial ideology. The hardened notion of racial
determinism which the Darwinian thesis had spawned had the effect of
transforming the knowledge the British had amassed of their colonial
subjects, from the merely descriptive to what could thereafter be
regarded as natural laws of "native" behaviour, belief, and cultural
potential. Increasingly, these were to be used to prescribe the
officially sanctioned view of what "traditional" Indian society was
supposed to be, and to proscribe as radical or deviant that behaviour
which did not conform. It was of no small significance in this regard
that comprehensive census data for the whole of India became available
for the first time at precisely this moment, following the publication in
1871 of the report of the first Census of India. The very process of
defining and accounting for India's huge, heterogeneous population had,
in itself, directly contributed to the "construction" of its diversity
and the specific identities of which it was presumed to be comprised.30

The notion of a timeless, culturally stagnant Orient had a much
longer history in European thought, of course. The cognitive
"construction" of a traditional indigenous social order, by the British
in Victorian India can be read as a comparatively recent instance of what
Said31 calls "Orientalism", a discursive tradition (in its own right)
which can be traced back to the earliest encounters of Christian Europe
with the emerging Islamic civilization of the Mediterranean basin. Over
the centuries the evolving civilization of Western Europe had in a sense
"constructed" its own identity, with its belief in its predisposition to
progress and expand, through the perennial representation of the various
"others" it encountered through trade and colonial conquest in "The
East", as its opposite—militarily feeble, culturally debased,

rationality" is rational behaviour within an environment that the agent
assumes to be constant (i.e. natural objects ruled by causal laws),
and/or sufficiently unsophisticated in its adaptive behaviour such that
the agent believes he is the only entity able to adapt to all others. In
such a parametric belief system the agent is rational if he tries to do
as well for himself as he can. Jon Elster, Explaining Technical Change,
75-76.

30 See B.S. Cohn, "The Census and Objectification in South Asia", in
B.S. Cohn, An Anthropologist Among the Historians, 224-254.
"irrational": "an unchanging, uniform and radically peculiar object."

With time and increasing engagement in colonial enterprise, a discourse had developed to mediate knowledgeably between the ostensibly incommensurable world-views of progressive Europe and the changeless East. The crux of the phenomenon, as Said stresses, was the ultimate necessity of a permanent, uncontrovertible, notion of the Orient, to legitimize the discourse that had invented it. As politics, science, and cultural production, including architecture, were all productively engaged in this discourse, there was therefore a considerable will to believe in the "East" and the "Eastern mind" as it had been defined, and to standardize its representation—to force it to conform to the prescribed mold, as it were.

In the immediate aftermath of the Mutiny the allusion to the soldier-engineers of the Roman Empire had given form to an ideology of a Britannic Imperium that could inspire the support of the Home society for Britain's redoubled commitment to its colonial venture. With time and steadily growing conviction in the notion of empire, however, apologists for British imperialism began consciously to downplay their earlier analogies to the sword, as a rhetorical defense, appealing alternatively to "custom", to "race", and to "responsibility". In India itself the authorities were increasingly eager to transcend their image as foreign conquerors and the destabilizing notion of their rule as a force for change. If spontaneous social progress could not be expected of inherently tradition-bound societies such as India, according to the doctrine of Orientalism, then—the cynical conclusion was hard to avoid—it was hardly in their interest to enforce changes that might ultimately undermine the social foundations of an imperial order that had every prospect, as it was, of sustaining itself indefinitely.

By the late 1870's colonial policy-makers intent on cementing the ideal of a permanent Raj had appropriated the nascent notion of a British Indian Empire and began reframing it in terms calculated to inspire the fidelity and cooperation of the traditional indigenous society the colonial regime had defined and toward which it styled itself in a more

32 Ibid., 98.
and more conspicuously paternalistic role, as a responsible and knowing guardian of familial harmony and prosperity.

This conservative new posture was visibly manifested in a forthright and unambiguous manner for the first time in the Imperial Assemblage at Delhi in 1877, an invented ritual of unprecedented splendour and fabulation for which the entire imperial "court", as it were, including all the native princes of India, Viceroy and colonial power elite, with all their multitudinous entourages, was gathered together "en masse" for the first time ever to collectively confirm imperial solidarity. Although the incorporation of the former Mughal Empire into the aegis of the British Crown had been officially enacted by Parliament two decades earlier, it was not until this time, significantly, that it had been deemed necessary, or indeed politic, to solemnize that fact publicly in India. Only in 1876 had the conservative government of Disraeli been able to convince Parliament to sanction an according aggrandizement of Queen Victoria's constitutional authority. The ostensible object of the Imperial Assemblage was to formally celebrate the Queen's assumption of her new imperial title, "Kaiser-i-Hind". However, as Cohn has proposed,34 the grand theatrics of the spectacle were a sophisticated, consciously contrived exercise through which the whole feudal "tradition" of Indian political authority and social order was re-invented for the purposes of the new imperial power. Through the elaborate protocol of the two week long event, the ceremonial audiences, tributes, and honours bestowed, and even the mapping of the ephemeral imperial tent city that the military logistics officers and Public Works engineers had pitched for the event, each of the Queen-Empress's princely Indian vassals was, in the same exercise, given their own new title and corresponding slot in the imperial hierarchy. Indeed, by this token they were given their own imperially constructed history, and entrusted to preserve it as such from then on.35

This first ephemeral manifestation of the imperial illusion of a permanent British Raj was, with increasing delirium, to be made by

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34 B. Cohn, "Representing Authority...". See also T.R. Metcalf, *An Imperial Vision*, 56.
35 Ibid.
degrees more and more concrete in the following decades. The native princes were the first to commission professional architects, and engineer-architects such as Col. Swinton Jacob and Major Mant, to render their new hybrid identities as urbane feudatories, in appropriately ostentatious indic palaces and other modern public buildings such as colleges and hospitals, representing their progressive munificence. The British authorities had, meanwhile, come to rely all the more on the sober conventionalities of the PWD as a bulwark of certainty and indeed—I conjecture—a fitting representation of their own cultural identity, and "difference" from their native subjects, as responsible, rational, and (ostensibly) selfless servants of the colonized society.

Without ever really abandoning that conceit, the turn of the century, and the coronation of a new Emperor a year later, were to inspire a much more assertive approach to public architecture. Significantly, under the patronage of Lord Curzon—the most zealous and flamboyant of Governors-General since Dalhousie—this moment saw both the appointment of the first permanent consulting architects to government in the PWD, and the resuscitation of the Archaeological Survey of India with an aggressive mandate to salvage and restore India’s historic architectural heritage. Architecture, both ancient and modern, was to be made an active discursive instrument of the colonial technocracy, in the articulation of the various historical and cultural identities of the imperial Indian mosaic, and their respective relations to authority. The new imperial architecture that the government architects set about developing was to be more sophisticated and culturally demonstrative than the simple utilitarian idiom furnished previously by the departmental engineers. As the symbolic and aesthetic aspects of that design challenge came to the fore, the architectural profession orchestrated cultural themes which diverged more and more conspicuously from the path of progress (i.e. development and change) toward politically expedient notions of a permanent imperial order with India secured in its identity, monumentalized in architectural finery as a peripheral dependent of the British mother culture. (fig. 9.1)

By the time the New Delhi was put on the drawing boards, in 1912, the engineers of British India were willing to concede eclipse by their architectural colleagues, in the domain of building. Nevertheless, as the
official service historian of the Royal Engineers in India was to record, they confidently believed that the lasting triumph of the Raj would prove to be, not the splendid artifice of the architects' "great white city", but rather the utilitarian works of the engineers:

...the constructional monuments to British rule in India are to be found mainly in the humbler public buildings with which every large station is liberally supplied, and many of these give evidence of the labours of the military engineers of the last century. They form the foundation, as it were, on which the pinnacle of New Delhi has been raised. 36

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DETAILS of CHHATRIES in INDIAN STYLE of ARCHITECTURE.

PLATE No.: LXXVII.

GUJARAT COLLEGE HALL,
AMREDA BAUL. OMTE. ARCHITECT.
Beliefs concerning colonial mandate and cultural destiny no longer rational in themselves.

Optimization no longer consistent with evolving beliefs and norms (Order, System, Stability).

Sub-optimal design solutions regarded as "good enough" for "traditional" performance criteria of the colonial community. As institutionalized design standards these operate substantively to prescribe, conserve, and represent the parametrically fixed social environment in which "control" is sustainable.

Fig. 9.2.

Design standards employed as a dominant strategy in a context of interdependent decision-making. A heuristic device to initiate design "decision-making".

Design agents believe they have complete information, hence control of parameters. Design standards are regarded as the final "optimal" solution in a design "problem-solving" process.
3. CONCLUSIONS

From the strategic rationality of conquest, to the parametric rationality of a permanent colonial administration:

The conceptual change that we have charted in this study, through the shifting pattern of intention of the British Indian builders, can be seen, broadly, as a movement from a state of strategic rationality in the prosecution of a growing but unstable colonial enterprise, to the parametric rationality that prevailed as the British Empire reached the zenith of its power and wealth in the late 19th century. In this concluding chapter we have noted the architectural indices of a further shift or "slippage"—as the case may more accurately be described—in the intentionality of the British colonial community, from a parametrically rational drive to optimize solutions from an engineering point of view, to a merely "satisficing" concern with operational efficiency in a paradigm of colonial social control in which matters of "form"—in behaviour as in architecture—and the performance of buildings as representations of identity and authority, had assumed priority.

The basic schema of the different types of rationality introduced in Chapter 1 (fig. 1.1) will be useful now in summing up and explaining this evolving intentionality on the part of the colonial builders, and of the European colonial community to which they belonged. In the figure opposite (fig. 9.2), that schema is restated as an historical diagram depicting the successive shifts and slippages in the rationale with which design standards were employed in the design reasoning of the FWD engineers, from the middle of the 19th century through to the beginning of the 20th.

The factors contributing to this conceptual change were multifarious as were its manifestations, in architecture as in other domains of colonial production. The crisis of 1857 had shocked the colonial regime into recognition of its need to wrest control of the obstreperous physical and social environment it had come to rule; to rationalize its administrative system such as had been impossible while command of the subcontinent remained incomplete. However, it was only by degrees that they could achieve that parametrically rational state of mind and action.
In the production of infrastructure and the built environment, the engineers of the PWD mobilized technique to consolidate, facilitate and familiarize the alien Indian environment; to secure a space in which the colonial regime could operate with order and system in full confidence of its power to dominate. But the trying climate, and the mortal threat of disease in particular were a perennial and imposing challenge to the survival of the European colonial community which their technology was ultimately only able to temper but never really to conquer.

It would be forcing the argument to suggest that the urge to rationalize was exclusive to the immediate aftermath of the Mutiny. As we saw in the case of the British-Indian irrigation engineers and the beginning of the railways, the rationalization of the colonial environment was already well in motion by the time of the Mutiny. The events of 1857 were, however, a fillip which compelled the administration to strive to complete that endeavour in the following decade. In turn, the momentum of that process led to a further stage of change—in some regards a parallel process but ultimately a further transition—which we have discussed in terms of "standardization".

The standardization of the newly rationalized range of solutions for the common building requirements of the British Indian community was among the more telling indicators of the general shift, in the second half of the 19th century, from a strategic to a parametric mode of reasoning in colonial development. In the self-assured general belief system of the late Victorians in India, far from the madding competition of metropolitan Europe, the anxiety for "efficiency" had been superseded in time by "authority" and "system", as the highest standing norms of reasoning and action. The standards the PWD engineers had devised to consolidate their design knowledge and enable rapid and reliable progress on the technical front, ultimately came to play an essentially conservative role. Holding constant the rules by which the colonial social environment was to grow and be renewed, these standards inadvertently helped define a cultural space in which the illusion of a permanent British Raj might be sustained.

Such conservative intentions were almost inevitably illusory, however, when it came to the sustainability of the actual social conditions that these design standards were perceived to shape. The
innovative intentionality of the PWD engineers, abundantly in evidence in
the moment of aggressive design rationalization in the 1860's, was
effectively suppressed thereafter by the standards it established.
Alternative propositions of a modern "Indic" building tradition
eventually emerged in reaction to the standardized building practices of
the PWD, which were thereafter to be clearly distinguished from
"Architecture" per se. Our story ends at that point, where architecture
had ceased to be a tool of development and change, and was now merely a
reflection of colonial politics; a representation of a state of control
founded on an increasingly irrational and untenable set of beliefs.

The paradox of progress in a paradigm of control:

The slide from optimizing to satisficing rationales for the use of design
standards in the PWD, and ultimately to the irrational folly of the
full-blown imperial architecture of the early 20th century, may best be
explained as a consequence of the paradox inherent in the notion of
"progress" in a colonial social context believed, and ever more
strenuously compelled, to be "unchanging". If, in a parametrically
rational manner, the PWD had continued to pursue genuine optimization in
the physical design and technical development of the Indian social
environment, a far more substantive impact would likely have ensued. In
exercising their ingenuity to design an ever more accommodating
environment, the solutions of the PWD engineers would conceivably have
come in time to alter the basic parameters of the problem "space" in
which they worked; and the assumptions, beliefs and expectations of those
it accommodated, in due course. But, the willful belief in the timeless
and unchanging state of social order in India, on which the parametric
rationality of technical development in the post-Mutiny era had depended,
stood to be undermined by the progress it encouraged.

In this light the design standardization of the Indian PWD in its
maturity, later in the 19th century, can be seen to have worked
ultimately as a means of dampening or restraining progress in design. The
focus of control had, in effect, been shifted from the practice of design
production, in which standards had operated as productivity enabling
constraints, to the institutional framework in which that practice took
Schema of the conceptual system of the PWD engineers with respect to design standardization:

Fig. 9.3.
Norm Shift in Institutionalized Conceptual System w.r.t. "Standardization":

1N - seek efficiency in building
1F - greater consistency of design w.r.t. needs and resources is cost-effective
1B - experience has demonstrated this
1D - rationalize design practices

1D = 2N

2N - seek consistency of design practices
2F - standards enable consistency of practices
2B(1,2) - standards (1) define consensus
          (2) proscribe solutions inconsistent with criteria
2D - standardize designs

2D = 3N

3N - seek standardized design practices
3F - standards are ineffective if not regulated systematically
3B - experience demonstrates that - ditto -
3Base - case of works management under the Military Boards - ditto -
3D - control standards

3D = 4N

4N - seek conformity to standards
4F(1,2,3) - the use of standard plans within well defined rules of constraint, in a bureaucratic framework of agency, allows for a systematic hence dependable adherence to general design standards, with no cause for conflict
4B(1) - precedent-based design is an effective method to proscribe unfelicitous design possibilities
4B(2,3,4) - in a bureaucratic framework of agency;
          (2) obligatory prescription of standard plans insures conformity with collective standards of orderly architectural appearance
          (3) systematically codified and regulated procedures insure conformity with collective standards of orderly conduct
          (4) explicitly constituted authority encourages stability and control
4D(1) - constrain design reasoning with standard plans
4D(2) - prescribe (optimal) design solutions through standard plans
4D(3) - institutionalize procedures systematically
4D(4) - respect authority
place, and to the performance of the artifacts produced. Epiphenomenal consequences of design standardization such as the aesthetic uniformity of the built product, and the further consolidation of the bureaucratic framework of authority in the Department—which any such explicitly codified description or guideline for practice could add to departmental regime of procedures and regulations—were increasingly to be associated with design standardization as if they were its actual objectives. Efficiency in design had been sufficient but not necessary to obtain these virtual objectives. As the broader social situation of late colonialism invited the almost willful adoption of the self-legitimizing belief in the parametric stability of the colonial Indian social order—its radical "otherness" with respect to mainstream European civilization, its freedom from competition, its "natural" inequalities—the affirmation of that belief in behaviour and in the ostensive permanence of the established built environment (among other indices) assumed ever greater priority.

Standardization: from conceptual system to ossified mode of reasoning

This regression in intentionality—from an optimizing to a satisficing rationale for design standardization—and the various shifts in norms and beliefs that attended it, can be depicted alternatively with respect to the particular conceptual system of the PWD engineers in that regard. In this case, the components of the basic reasoning model (fig. 2.5) introduced in Chapter 2 may be applied—as in the following diagram (fig. 9.3)—to represent schematically a chain of the various generic arguments of the PWD engineers concerning standardization that we have observed in the historical analysis. In particular, this schema indicates how relatively minor shifts in intention in the translation of a directive at one stage of this reasoning process into the norm(s) of the next, may account cumulatively for quite major shifts in reasoning. The schema also indicates the multi-functionality of design standardization in the final analysis, in terms of the several different directives (4D1, 4D2, 4D3, 4D4) through which the single norm of standardization in design practices (3N) was directly or indirectly sought and for which "standardization" was a justification.
As the colonial context of development evolved, the "local" rationale for standardization became, by degrees, increasingly detached from the original norm of efficiency in building. As the schema indicates, a virtually autonomous mode of reasoning emerges from this conceptual system, forming a closed-circuit of a sort between the intermediate norm of standardization and certain directives compatible with that goal but linked ultimately to higher standing norms, such as Order and Authority, which had little if any immediate relation to Efficiency. This mode of reasoning ossified, we may conclude, as the general system of beliefs concerning the permanent colonial mandate of the British in India took hold. Whereas a prescriptive notion of design standards (4D1) as a heuristic device for efficiently initiating and guiding design reasoning had directed the dynamic, strategic situation of interdependent decision-making that prevailed in the early years of the Department, a prescriptive use of standard plans (4D2) was to preclude the former as the default assumption in the routine mode of reasoning concerning standards, regulations and procedures, which took hold later on.

Among other issues and sub-plots that we have followed in this study, the evolving relationship between civil and military engineers in the service of the Public Works Department is rendered more explicable, in the light of this explanation of conceptual change. In the end, surprisingly, the civil engineers were incorporated seamlessly into the PWD. The norms of authority and systematic conformity, in which the colonial community came to place ever higher value over time, were traditionally those of the Military. The optimizing rationality of the innovative efficiency-minded civil engineers had soon enabled the Department to reach a local optimum with respect to satisfactory design solutions for the building needs of the colonial administration. But it was a satisfying rationality with which both the civil and the military engineers in the Department were to operate from then on as the growing illusion of permanence of the colonial community at large came to influence their own increasingly conservative and authoritarian belief system, as vested members of the colonial regime. Although the Royal Engineers were actually to begin retreating from the colonial scene in
this period, of their own accord, paradoxically it was only by adopting the esprit de corps of their military colleagues that the civil engineers of British India were finally to gain their just dues of power and privilege in the Public Works Department.

**Belief change and belief choice in the framing of design rationality:**

The key conclusion we may draw from this case study is couched felicitously in this last observation of the preceding paragraph. Reasoning and action—or "aspiration", in this instance—are invariably constrained within some set of limits. However, as this study has explored, such constraining frameworks may be a key to productivity as much as they may, alternatively, be perceived or used to confine or restrict freedom. What we have have learned from the case of design reasoning and action in a framework of formally institutionalized procedures, regulations, and precedent knowledge is that such explicit normative frameworks must be distinguished from potentially wholly independent implicit frameworks of a conceptual nature. Such conceptual frameworks—particularly the "beliefs" of which such are constructed—may be the most consequential and possibly the only genuinely compelling constraints determining behaviour.

Organizations are not intentional entities themselves. But the intentionality which an individual or a collective may believe to be vested in such conventional or institutionally constituted frameworks may significantly determine the mode and the objectives of the reasoning processes carried out within them. Moreover—and this is really the crux of the matter—beliefs are not necessarily "given" a priori; they can be elective. One may, in this respect, chose or indeed design the conceptual framework in which they then subordinate their reasoning; in which the rationality of their decision making is defined and controlled.

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Discussion:

The case of institutionalized design reasoning we have studied here may be said, above all, to have been productive. The various practices, arguments, and conventions that have been described and interpreted in these pages—though at times more constricting than constraining in their effects, in the half century we have surveyed—cannot be seen to fully corroborate the Weberian notion of the bureaucratic "cage". Nor can the particular behaviour of the PWD technocracy be interpreted adequately as simply a classic bureaucratic organization of knowledge and personnel. 38 The conflicts between the formal and substantive rationality of the PWD system with respect to design production, that we have observed, were not consistent and certainly not fundamental. They varied with time and with relative states of belief.

With a view to these cognitive and historical factors, we have avoided the conventional (and in certain respects illogical) question: "What do organizations do?", to ask alternatively: "how do people reason through organizations?" What we have observed in this regard is multiple and, moreover, changing rationalities in play in design decision making; rationalities consistent and coherent with beliefs and norms, but varying historically and contextually with according conceptual changes or local practice-specific beliefs.

This study has demonstrated that efforts to rationalize and standardize design knowledge and methods through explicit modes of organization (institutional or otherwise) do not necessarily result in "control" of an inherently constricting and impeding manner, or the ulterior power games which such may engender. In a moment of

38 For a classic Marxist argument concerning the function of rationalization/mechanization in the workplace with respect to the division of labour, the preservation of hierarchy and, hence, the power of those on top, see: Stephen A. Marglin, "What Do Bosses Do? The Origins and Functions of Hierarchy in Capitalist Production." Review of Radical Political Economics 6, 2 (Summer 1974): 33–60. The fundamental difference between the case of mechanization in the industrializing metropolitan society, as studied by Marglin, and the case of rationalized production in the colonial situation we have observed was the joint interest of all employees of the colonial technocracy in the power (which they at least believed to be) vested in the order and stability of their corporate hierarchy.
re-evaluation and restructuring of organizations and practices, generally, this is a finding of particular consequence. Within the PWD organization, the rationalization of design knowledge and methods served as much to distribute decision making power as widely as possible in the departmental system, as it did to consolidate the authority of the key decision makers whose particular design principles, convictions and tastes were invested in the standard plans and regulations which they had the responsibility for framing. The preponderance of power relations in any such bureaucratic organization evidently varies with the prevailing conceptual norms of the particular society in which it operates.

The study has elucidated a largely productive interaction between explicit forms of essentially heuristic constraints at the level of organizations, and implicit conceptual constraints of a more compelling order. Moreover, it indicates the multi-functional nature of such reasoning-through-organizational-constraints. Rigidly controlled design production may have significant social implications outside the "space" of the actual design problem, but the study has shown that such depends on equally extrinsic conceptual factors rather than any intrinsic malignancy in institutionalized knowledge systems, or organizational thinking, as such.

The Public Works Department of British India has provided a particularly significant and revealing case history of the development and application of institutionalized design constraints, for the purposes of this study. Colonial building and planning, along with most other aspects of the colonial cultural interaction of Imperial Britain with India, were an extreme case—or, as some have argued, the original formative case--of "modern" social engineering. The paradox of progress, which European engineers began consciously to confront in the 19th century in their efforts to take control of the environment through technique,\(^\text{39}\) was especially acute in the inter-cultural context of

\(^{39}\) The paradoxes inherent in the technical and technocratic progress promulgated by French engineers and colonial administrators, beginning in the 18th century, could be considered the shared problematic of Rabinow’s and Picon’s excellent studies. See A. Picon, *French Architects and Engineers...*; P. Rabinow, *French Modern.*
colonial development. From an historical point of view, the institution and the built legacy of the British Indian Public Works Department hold considerable significance both for the social and architectural histories of "modern" India, and for the history of European architecture and planning generally.

The major significance of European colonialism in the broader phenomenon and problems attending the notion of "modernity" in contemporary social history is only now beginning to receive due scholarly attention. This study constitutes the first substantial historical inquiry into the architectural design practices of the British Indian PWD. As a case study of design reasoning and methods, its contribution to the colonial and modern history of architecture is essentially empirical and has consisted in opening the archives of the Department to close scrutiny. I have not attempted to address the case with any critical sophistication, with respect to the currently evolving discourse of colonialism and its various spatial, social, and epistemic legacies. Further valuable research might now be undertaken in that regard. The present study has examined issues and processes largely from the evidence of "official" records and documentation, hence the colonizers' point of view. Valuable alternative studies might be attempted from the "subaltern" viewpoints of the subordinate Indian members of the Department who, as draughtsmen, overseers, clerks of works, and manual labourers, could be regarded as the substantive authors of the Department's architectural output, behind the formal attribution of such designs to their pen-pushing British bosses.

Also important is the need to examine the long term impact of the product of the PWD -- both the physical environments it continues to plan and build, and the norms of design and procedure that it has served to institutionalize over the years. Whereas the "style" of the official buildings, which the PWD proceeded to build in the postcolonial era, was among the most immediate and conspicuous traditions to change with the advent of Indian Independence, the deeper set formal conventions and categories prescribed in the departmental "schedules of accommodation" and modes of reasoning, have been much slower to change. Sociologists have identified and tentatively described the profound impress on present day Indian society of norms of spatial classification, building
morphology, nomenclature, etc., descended from colonial planning through the ossified modes of reasoning of the Public Works system. Architects need to examine these also.

The present cognitive historical study of design reasoning in the PWD of Victorian India was delimited by two specific concerns: (1) to describe and explain the uses of institutionally prescribed constraints in design reasoning, using the specific institution of the "standard plans" of the Indian PWD as the paradigmatic case; (2) to discern and explain the basic conceptual system of the British Indian engineers, and any perceptible changes in that system over the period in question. With our model of the basic components of reasoning--norms, beliefs, and directives--an informal content analysis of the mundane records of the Public Works Departments in the archives of the "supreme" colonial Government, and those of various "local" governments, proved fruitful in inferring the historical conceptual system of the PWD engineers, and in accounting for its various shifts and transformations at critical points over the period investigated.

The findings of the case study may be categorized similarly: (1) cognitive economies afforded by design standards, (2) conceptual factors in the reception and application of design standards.

In the cognitive analysis of the case the systematic methodology of the Public Works engineers, employing standard plans, was interpreted as a prototypical case-based design system offering a variety of observations of potential relevance to the cognitive modeling of professional reflection in action. These include the heuristics of design thinking in a narrowly circumscribed domain of expert knowledge; the role of design theory and methodology such as canons of spatial composition, design routines, and architectural program stereotypes, as conceptual frameworks in structuring and delimiting the design reasoning process;

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the codification of precedent knowledge in the form of codes of regulations, standard plans; and the function of such conceptual "institutions" in short-circuiting "deeper", potentially more inventive processes of design thinking; the implications of a bureaucratic (corporate) versus professional (individualist) organization of expert knowledge in the systematization of design thinking.

Our historical observations, with respect to the implications and consequences of conceptual change in institutionalized design reasoning, are summarized in the final overview of the specific findings of the study, which follows below.

Summary of the principal findings of the case study:

The case study of the British Indian Public Works Department and its institutionalized modes and design reasoning commenced in Chapter 3. The principal historical developments analyzed in later chapters were surveyed, and a preliminary cognitive historical interpretation of the relations between the increasingly institutionalized design practices of the British Indian engineers in the second half of the 19th century, and changes in the respective general belief systems of the colonial and metropolitan societies, was outlined.

In the principal three chapters of Part II, we established the preliminary grounds for the preceding interpretation through further, detailed description of the design content and historical issues surrounding the case. We considered, respectively, the buildings and culturally specific built environment produced by the PWD engineers; the development of the "normative" social and institutional frameworks in which those engineers operated; and, thirdly, the basis of their conceptual frameworks in the ideologies, pedagogies and "traditions" of the rival civil and military engineering professions of mid-19th century Britain.

Chapter 4 examined the general corpus of "typical" buildings constructed by the British in India, in the Victorian heyday of the Raj. We considered the historical and practical relationships of that distinctive built environment with the evolving colonial community and identified a basic repertory of elements and spatial configurations to
which that architecture broadly conformed. In a brief historical discussion of the development of the Anglo-Indian "bungalow", we considered the appropriation of an indigenous architectural precedent and its gradual transformation into the quintessential dwelling type of the expatriate Europeans in India, with a view to the cognitive praxis of that historical process of inter-cultural design innovation. The bungalow had already substantially evolved its classic configuration by the mid 19th century, when the present historical study begins. The increasing range and scale of institutional and residential building types developed by the PWD in subsequent decades owed much to this generic building type. This can be explained by the development of the repertory of Anglo-Indian building norms from the implicit rules of composition, and the rationalizations of building construction and performance, embodied in the mature design of the bungalow.

Chapter 5 examined the development of the normative frameworks--social, political and institutional--in which the Public Works Department of the Government of India was established and in which the technical development of Victorian India was prosecuted. We considered the moral and administrative crisis in Indian affairs caused by the civil and military uprisings of 1857-58. The contemporary perception and explanations of the Revolt, and the remedial actions taken by the government, were interpreted as an index to the predominant political philosophies at play in the shaping of colonial policy at that crucial juncture in British Indian history. The reorganized colonial administration that emerged from this crisis revealed the Utilitarian cast of mind that was to have such an important bearing on the moral and material progress of India in the following few decades. We then briefly traced the antecedent of that conceptual system in the evolution of the British Indian polity under the regime of the East India Company.

The consolidation of the new Raj after 1858 was a paradoxical bid both to preserve and to progress. From a brief discussion of this paradox as it manifested itself in the bureaucratic development of the Indian Civil Service, we proceeded on to the question of technical progress itself. The traditional resistance to technical development by the Company and its Army was slowly eroded in the final years of Company Rule. We briefly reviewed the heroic early history of the Irrigation
Department, and subsequent initiatives in road building, technical training, and railway development that finally ignited both public and official enthusiasm for an organized strategy for the technical development of India. We concluded with an overview of the institutional background of the Public Works Department in the former Military Board of the Bengal Army, and an outline of the structure and mandate of that department in its first years of operation.

In Chapter 6 we proceeded to discern the knowledge, beliefs, norms and values that comprised the professional conceptual systems of the PWD engineers. To that end we examined the recruiting protocol of the Public Works Department in the crucial first two decades of its development with due consideration of broader contemporary issues in the rise of the professional classes in England, and the technical disciplines in particular. Furthermore, we began to consider how the conceptual system of the departmental engineers became by degrees a practical mode of reasoning and ultimately a normative framework, institutionalized in the bureaucratic structure and codified procedures of the Department.

It was observed that the bureaucratic organization of knowledge in the PWD had an internal logic which tended to ramify "procedures" of all sorts, including standardized procedures for design generation, through which the culturally and conceptually heterogeneous department staff could manage to function with consistency and system. Practically, the hierarchy and division of labour in this bureaucracy enabled inter-professional and inter-racial competition within the Department to be reasonably controlled. The challenge to the established authority of the military members of the engineering staff, which was posed by the accelerated incursion of civil engineers into the department in the 1860s, was evidently counter-acted conceptually through an augmentation of discipline and procedure in the operations of the Department. This tended to devalue the intellectual agency of the individual professional, stressing a para-military corporate way of thinking—what we have called "departmentalism"—in its stead. This departmental conceptual system was manifested variously in management reforms within the department, and in its output of architectural designs and settlement plans, among other works, in this period.

In Part III of the dissertation we synthesized insights gained from
the various discrete perspectives on the PWD and its architecture—artifactual, institutional, and conceptual—of the preceding three chapters, in an historical analysis of the actual process of institutionalization in the design reasoning of the PWD engineers, and of conceptual change generally; from the optimizing rationalizations of the design problem-solving of the 1860's, to the satisficing rationale of design decision making in a departmental practice of standardized procedures and case-based design routines, to the increasingly conservative if not authoritarian predilection of the Departmental engineers late in the century in their role as the technocratic custodians of an ossifying institution. In these three final chapters the inquiry has focused in some detail on the departmental records and original design documentation through which we have attempted to discern the interplay and conflicts between the conceptual and normative frameworks of design reasoning of the PWD engineers.

Chapter 7 examined the immediate conceptual implications of the Indian Mutiny with regard to colonial settlement planning and architectural design in British India, in the period of administrative consolidation and vigorously renewed technical development that followed that crisis. We considered the consequent anxiety of the British colonizers to consolidate their knowledge of India, and how such knowledge and prejudices were applied in the rationalization of colonial settlement planning. The case of the post-Mutiny redevelopment of Allahabad provided insights on the strategic, economic, and ethno-medical norms that dominated the professional conceptual system of the Departmental engineers in that period.

As anxiety over military security gradually subsided, we observed, the "scientific" criteria, disease models, and ethical concerns of the Sanitary Reform movement of the mid 19th century took precedence in the conceptual system and design reasoning of the PWD engineers. However, this was no clear-cut case of conceptual change. Our interpretation of departmental design discourse concerning Colonel Crommelin's rationalization and standardization of designs for all the military buildings of colonial India offered particularly revealing insight into the multi-functional considerations that constrained such design reasoning; weighing the heuristic advantages of convention and precedent
solutions against the first principles of a problem-solving scientific rationality. Similar conflicts and compromises were observed in parallel efforts to accommodate local and universal rationales in the design of "modern" civil hospitals and penitentiaries suitable for India.

In Chapter 8 the focus of our inquiry shifted from the problem-solving intentionality of design reasoning in the immediate aftermath of the Revolt of 1857-58, and the conceptual frameworks of the PWD engineers which that exceptional event caused to be unusually well articulated in the design discourse of that moment, to the routine practices of the established Department and the increasingly institutionalized modes of reasoning, or "normative frameworks", that came to constrain their designs in the later decades of the 19th century. Our chronological survey of the PWD records to discern the pattern of departmental policy changes with respect to design standardization, revealed certain anticipated correlations with significant historical developments.

More significant, perhaps, was the evidence of a general demand for or expectation of standards, on the part of the regular departmental engineers where, in fact, the higher ranking authorities did not necessarily have cause or intention to impose any. In design reasoning practice, as in the various forms of normative bureaucratic practices and procedures which we examined, through which information was processed in the day to day workings of the Public Works Department, a submission to contextual constraints on reasoning was evidently willingly accepted by the engineers in question. Again, however, the potential explanatory factors for such normative reasoning preferences were evidently multiple. Along with the cognitive economies afforded by the standardization of bureaucratic practices, or the use of standardized precedent design knowledge in the form of generic case-descriptive sample plans, there were surely subtle and not so subtle internal power relations between the different members of the PWD, of different grades and in different localities, which these various normative frameworks for the standardization and control of the intra-departmental flow of information served to mediate. The "departmentalism", or esprit de corps, of the PWD was a further significant factor in this regard. We observed that membership in this corporate colonial technocracy—though anathema to the
conventional libertarian ideals of the entrepreneurial civil engineers of mid century—became an increasingly attractive prospect with the disconcerting changes in the global economic system, beginning in the 1870’s, which undermined the old certainties of the Rational Enlightenment and particularly the political economist’s naive notions of unbounded competition in an infinite market of services. The modicum of power and security which service in the PWD eventually afforded both its military and its civilian engineer officers, was evidently sufficient to counter the indignation of submitting to the corporate yoke, and willfully embracing—with the British colonial community at large—its increasingly compulsive system of beliefs concerning the destiny of the British to dominate and control a timeless, unchanging India; above all to demand of themselves strict conformity to the norms and standards of behaviour and appearances that the European colonial community had devised.

The above argument has been developed in this final chapter, in which we have sought to interpret the conspicuous signs of the pending demise of the paradigm of technocratic utility and control in colonial development at the turn of the 20th century, which the PWD engineers had managed to sustain conceptually, practically, and institutionally since the major rationalization of departmental norms and methods in the 1860’s. The rise of a new architectural sensibility, and according disdain for the utilitarian banality of the engineers’ typical building designs was the harbinger of significant changes within the PWD, and the ultimate sea-change in the general belief system of the colonial community as a whole, when their illusion of permanent dominion in India inevitably collapsed a few years later. As the aesthetic and representational qualities of Architecture were foisted, with growing popular empathy, in challenge to the official building monopoly of the PWD, the engineers dug in to defend their paradigm. In classic fashion, their once flexible, productive and efficient system of formalized precedents, conventions and routines became a brittle and uncompromising doctrine, perceived in later years as an ossified institution of inefficient and unrepresentative conventions, increasingly associated with arbitrary regulation and control. Engineers would henceforward define and defend a more precisely delimited patch of professional turf;
architects were to begin assiduously to build on the foothold they had finally gained in India; and those military engineers who remained in Indian service were to retreat from civilian duties altogether. In future, professional roles—like all others in the meticulously categorized and graded colonial social hierarchy—were to be performed strictly as prescribed.

This concluding summary has brought us full circle to end with a description of the normative design practices of the British Indian engineers in terms similar to Kuhn’s model of "normal" reasoning practices, with which this study was introduced. Standing now outside the case, I close with a note on general implications of the use of collective norms and standards in design and the particular limitations of the present study.

Concluding remarks: standards and responsibility in design

Thirty years ago Christopher Alexander wrote about what he perceived to be the essential problematic inherent in canonical structures of conventional architectural knowledge, such as styles and the normative practices such have supported historically. "...[A]rchitectural decisions made within a style are safe from the nagging difficulty of doubt, for the same reason that decisions are easier to make under traditions and taboo than on one's own responsibility." "By leaning on correctness," in the attention to such norms, he suggested, "...it [is] possible to alleviate the burden of decision." 41

Alexander was then among the earliest advocates of a computational approach to design, and eager to see the architectural profession embrace the pending revolution in knowledge engineering that the computer would enable. "Conventional" thinking was what he believed the architects of the time were responsibly obliged to transcend, if they were to be part of that future and magnify their intellectual and inventive capabilities, accordingly. With hindsight, however, there is an obvious need to accept

the inevitability of routine thinking, and to understand and exploit this mundane mode of cognitive economy, as a preponderant mode of design reasoning in practice.

The present effort to enhance understanding in this regard has been conceived as a contribution to interdisciplinary research in architectural history and theory in relation to engineering, as well as design methods and cognitive science. The findings we have derived from the historical case of design reasoning in the Public Works Department of British India are not necessarily generalizable, but should be useful as hypotheses, if not explanations, in the interpretation of similarly complex cases of socially mediated decision making in institutional frameworks. Better understanding of the fundamental role of constraints in design reasoning may improve our capacity to control and exploit our own implicit knowledge and conceptual frameworks to more creative ends, ultimately diminishing the need to depend on externally institutionalized frameworks of control. Toward that end, these findings may be of most immediate use in efforts to model the reasoning of design professionals, in "expert systems" for design support.

We need standards, but not to prescribe correct form, thought or behavior. Such is the problematical potential of reasoning surrendered "mindlessly" to normative institutions; an essentially irresponsible mode of behavior on the part of designers from which irrelevant if not oppressive environments may result. Designers need standards not to direct but to constrain their reasoning constructively. As we have observed in this study, design standards can be used as conceptual constraints through which design decision-making can be rationalized, and with which the efficiency of the design process and the utility of the design product can be effectively controlled. By constraining reasoning, rather than determining form, standards enable designers to cope reliably, productively, and sustainably, with the ever increasing complexity of problems that architects, planners and other design professionals must address today as social beings in a socially complex world; to enable responsibility, not to defer or deny it.
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Rationalization, Standardization, and Control in Design

SUMMARY

Reasoning and action are inevitably constrained within certain conceptual frameworks. This study concerns architectural design reasoning within the conceptual framework of organized practices. It explores how such reasoning may be constrained by explicitly defined conventions, and institutionalized regulations and procedures; and to what purposes. The relative practical and social utility of such institutionally constrained reasoning is investigated through an historical case.

The inquiry takes a cognitive approach, addressing knowledge, and the conceptual systems in which it is organized, as the most direct and compelling constraints on reasoning. It defers from the conventional analysis of "what organizations do?", and asks, rather, "how do people think through organizations?". This question oblige a detailed study of a pertinent case.

The Public Works Department of British India provides a case of design reasoning within well defined institutional constraints, of considerable independent significance historically. Created in 1855, this technocratic organization was responsible for the unprecedented technical development undertaken by the British colonial administrition in India during its Victorian heyday, including the design and execution of a wide range of civil and military architecture. As a bureaucratically organized system of design standards and procedures it enabled a small number of engineers and subordinates, widely dispersed geographically, to generate a large volume of formally consistent and serviceable architectural designs, with relative efficiency. The case is especially instructive historically, however, as the formal and the substantive conceptual rationale for such strictly controlled design measures became increasingly incongruent as the colonial regime achieved its authoritarian maturity.

From the evidence of original departmental records and design documentation, the cognitive historical interpretation of the case describes how design conventions and precedents were explicitly standardized, and how "standard plans", in particular, were used as conceptual constraints through which design decision-making could be rationalized, and with which the efficiency of the design process and the utility of the buildings designed could be effectively controlled. The study finds that significant cognitive economies were afforded by such design standardization. It also indicates the paramount consequence of
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conceptual change at the level of general belief systems, in determining the particular type of rationality by which design reasoning may be constrained in a particular historical context.

In a moment of re-evaluation and restructuring of organizations and practices, generally, these findings partially counter the prevailing assumption that organizations "control" in an inherently constricting and impeding manner. The study elucidates a largely productive interaction between explicit forms of essentially heuristic constraints at the level of organizations, and implicit conceptual constraints of a more compelling order. Moreover, it indicates the multi-functional nature of such reasoning-through-organizational-constraints. Rigidly controlled design production may have significant social implications outside the "space" of the actual design problem, but the study suggests that such depends on equally extraneous conceptual factors rather than any intrinsic malignancy in institutionalized knowledge systems, or organizational thinking, alone.

This study contributes to interdisciplinary research concerning cognitive science, design methods, and the history and theory of architecture in relation to engineering. It interprets a case of significant methodological and historical interest, which may be useful in explaining similar cases. Better understanding of the fundamental role of constraints in design reasoning may improve our capacity to control and exploit our own implicit knowledge and conceptual frameworks to more creative ends, ultimately diminishing the need to depend on externally institutionalized frameworks of control. Toward that end, these findings may be of most immediate use in efforts to model the reasoning of design professionals in computerized "expert systems" for design support.
Rationalisatie, Standardisatie, en Control in het Ontwerpen

SAMENVATTING


Gekozen is voor een cognitieve aanpak, wat er op neerkomt dat kennis - in samenhang met de conceptuele systemen waarin die kennis wordt georganiseerd - wordt begrepen als de meest directe en dwingende inperking van ons redeneren. Het onderzoek ziet af van de conventionele aanpak van de analyse in termen van de vraag 'wat organisaties doen', en beantwoordt veeleer de vraag 'hoe mensen door middel van organisaties denken' denken. Een dergelijke vraagstelling vereist een gedetailleerd onderzoek van een relevante casus.

Het Public Works Department van Brits Indië is zo'n voorbeeldige geval van ontwerpendenken dat plaats vindt binnen duidelijk omschreven institutionele limieten - een casus die op zich al van een aanzienlijke onafhankelijke historische betekenis is. Deze uit 1855 stammende technocratische organisatie was verantwoordelijk voor de ongekende technische ontwikkeling die het Britse koloniale bewind in India tijdens haar Victoriaanse bloeitijd te weeg bracht, onder meer in de vorm van ontwerpen voor, en de uitvoering van een groot gamma van civiele en militaire architectuur. Omdat het ging om een bureaucratisch georganiseerd systeem van ontwerpstandaarden en ontwerpprocedures, kon een betrekkelijk klein, over het hele land verspreid aantal ingenieurs met hun staf betrekkelijk efficiënt een grote hoeveelheid formele samenhangende, goed bruikbare gebouwen ontwerpen. Dit voorbeeld is echter vooral ook historisch verhelderend, omdat de formele en inhoudelijke gronden voor een dergelijk strikt gecontroleerde ontwerpstandaard steeds minder samenhang ging vertonen naarmate het koloniale regime in autoritaire zin 'volwassen' werd.

Gebaseerd op het originele materiaal van de verslagen van het Department en de beschikbare ontwerpdocumentatie, beschrijft de cognitieve historische interpretatie van de casus hoe conventies en reeds verworven ontwerpkenis expliciet werden gestandaardiseerd en hoe meer in het bijzonder de standard plans werden gebruikt als conceptuele beperkingen door middel waarvan de besluitvorming tijdens het ontwerpproces kon worden rationaliseerd, en door middel waarvan de efficiency van het ontwerpproces en de gebruikswaarde van de ontwerpen gebouwen effectief kon
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worden gecontroleerd. Het onderzoek komt tot de conclusie dat een dergelijke standaardisering van het ontwerpproces doorslaggevende cognitieve voordelen opleverde. Verder wordt duidelijk dat een conceptuele omwenteling op het maatschappelijk nivo van de heersende waardensystemen een doorslaggevend effect heeft op het bijzondere type rationaliteit door middel waarvan in een specifieke historische situatie de ontwerpredenatie kan worden beperkt.

Op een moment dat nu her en der organisaties opnieuw worden beoordeeld en geherstructureerd, kunnen de resultaten van dit onderzoek kritiek leveren op de heersende opvatting dat organisaties doorgaans op een intrinsiek beklemmende en hinderlijke wijze menselijk gedrag 'controlieren'. Het onderzoek maakt helder zichtbaar dat er sprake is van een grotendeels produktieve interactie tussen enerzijds expliciete vormen van in essentie heuristische beperkingen op organisatiennivo, en anderzijds impliciete conceptuele beperkingen van een meer dwingende soort. Een meer rigide gecontroleerde produktie van het ontwerp heeft wellicht belangrijke sociale implicaties die liggen buiten de 'ruimte' van het feitelijke ontwerpprobleem, maar het onderzoek suggereert dat een dergelijk effect ook afhankelijk is van extrinsieke conceptuele factoren, en niet louter en alleen van een of andere intrinsieke, verderfelijke eigenschap van geïnstitutionaliseerde kennisystemen of van het georganiseerde denken op zich.

Deze studie vormt ook een bijdrage aan het interdisciplinaire onderzoek naar cognitieve wetenschap, ontwerpmethoden en de geschiedenis van theorie en architectuur in hun verhouding tot de ingenieurskunst. Het interpreteert een casus van groot methodologisch en historisch belang, waardoor de analyse van nut zou kunnen zijn bij de verklaring van gelijksoortige gevallen. Een beter begrip van de fundamentele rol die dwingende beperkingen in de redenatie van de ontwerper spelen, zou ons vermogen om onze eigen impliciete kennis en conceptuele kaders op een meer creatieve manier te beheersen en te gebruiken, kunnen verbeteren waardoor uiteindelijk onze afhankelijkheid van extern geïnstitutionaliseerde controle-kaders zou kunnen afnemen. Teneinde dit te bevorderen, kunnen de onderzoeksbijdragen wellicht onmiddellijk ingezet worden bij pogingen om de redenatie van ontwerpers in de beroepspraktijk in modellen om te zetten, in de vorm van gecomputeriseerde 'expert-systemen' die het ontwerpen moeten ondersteunen.
ABOUT THE AUTHOR

Peter Scriver (b. 1959) was raised and schooled in Montreal, Canada. Following his college matriculation in 1978, in pure and applied science, he served for a year as a Canada World Youth volunteer in a rural development and cultural exchange program with Sri Lanka. He subsequently entered the McGill University School of Architecture where he earned his professional degree in 1984.

As the recipient of a graduate travel fellowship, he returned to Asia between 1984 and 1986, journeying extensively in Japan, China, South-East Asia, and India, where he subsequently worked professionally with the architectural firm of Stein, Doshi, and Bhalla. It was during this extended period of work and observation that the author began to write about critical and historical issues in the global diffusion of architectural norms and form; themes he has subsequently developed in several publications including a book, After the Masters, concerning the development of post-colonial Indian architecture, which he co-authored with Vikram Bhatt.

In 1988 Peter Scriver joined the Design Knowledge Systems research group at the Faculty of Architecture of the Delft Technological University, as a doctoral research fellow. He had previously taught architectural design at the McGill School of Architecture, and has continued to lecture widely in North America, Europe and India, on historical and critical aspects of his past and present research.