Scientists in laboratories: a comparative study on the organisation of science and goal orientations of scientists in CSIRO (Australia) and CSIR (India) institutions

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CHAPTER 1 : INTRODUCTION

1.1. Overview of the intentions of the thesis

This thesis is a sociological investigation of scientists in laboratories. In more concrete terms, the thesis deals with the organisation of science and the way in which the orientations of scientists and their research activity are structured in the laboratories. The basic assumption behind this analysis is, that the action of scientists has a social dimension which is structured by the meaning context of the laboratory's social (organisational) structure, and which, in turn, is shaped by the social, political, cultural and the historical processes operating relative to the laboratory's context.

This general assumption in fact represents a sociological interest in the laboratory life world of scientists and is consistent with what one may call a 'sociological perspective'. In the sociology of science, since the seminal but internalist sociological contributions of Robert K. Merton, the above assumption concerning meaning context has however not received the substantial theoretical and empirical attention it deserves, when we look into the research material concerned with scientists in laboratories.

The recent trends in the 'sociology of scientific knowledge' [see Collins, 1983; and Knorr-Cetina, 1983] have made great strides in the social studies of science. The anthropological 'invasion' of scientists in to laboratory life worlds in recent years has created a tremendous awareness of the socially constructed and the contextually negotiated meanings of research activity and its products in the laboratory context. But, we know very little about the socio-historic and the political context of research activity in the laboratory context, the transposition of cultural and historic meanings into the laboratory's organisational structures and the way in which they influence the action of scientists\(^1\). This thesis has developed out of my interest in the above aspects of scientific research in the laboratories in the sociology of science.
and allied specialty interests such as the sociology of knowledge, the social history of science and the political sociology of science.

Even though this thesis generally deals with different aspects of the contemporary practice of scientific research such as the changing nature of science in its social and organisational context, the changing nature of social control in science across institutional settings, the processes in the socialisation of scientists and the social nature of scientist's action in the laboratory context, the thesis has a particular focus. The theoretical and empirical investigation in this thesis concerns the patterns and the meaning context of scientist's action. Meaning context and action are viewed within a cross-cultural perspective in an effort to draw a comparison between the western and a non-western laboratory context.

This particular focus has developed out of an awareness of the poverty of existing literature in the sociology of science which rarely concerns itself with the cross-cultural studies of scientists in laboratories. Sociological studies on science have grossly neglected an area of research that has to do with how scientific research, its organisation and practice varies across national and cultural contexts. For example, the single largest cross-national study reported so far is the UNESCO based "The International Comparative Study on the Organisation and Performance of Research Units" (ICSOPRU).[^2] [see Andrews, 1979]. Although this study deals with a number of organisational factors influencing the performance of researchers in the six European based countries, for obvious reasons this study does not touch upon those sensitive issues of the role of government policies, the role of laboratory leadership and the impact of the socio-cultural systems on the behaviour of researchers. This thesis has developed with the major objective of arriving at an in-depth level of theoretical and empirical understanding of the social nature of scientist's action across national and cultural contexts.

The laboratories selected for the comparative study are the Central Food
Technological Research Institute (CFTRI) under the Council of Scientific and Industrial Research (CSIR), India and the Food Research Laboratory (FRL), under the Commonwealth Scientific Industrial Research Organisation (CSIRO), Australia. Unlike Latour and Woolgar's [1979] case study of The Salk Institute for Bio Sciences, which has the distinction of producing a Nobel laureate, or the Sutton's [1984] case study of the Lawrance Livermore Laboratory, Los Alamos, where the world's deadliest weapon's potentials are 'realised', the CFTRI and the FRL represent the laboratory contexts where 'normal' science is practised in the Kuhnian sense. Metaphorically, these laboratories work on areas of research which support the survival systems of life, particularly the human beings - that is they carry out research on food. CFTRI and FRL form an integral part of the CSIR and the CSIRO respectively, which come under the mediative control of the government in their national contexts.

The sociological significance of the comparative study between these two laboratory contexts is that they provide a fruitful comparative basis because both the laboratory organisations (CSIR and CSIRO) have their origins in the same British model - the Department of Scientific and Industrial Research (DSIR). From the point of socio-cultural significance, these laboratories provide a context where similar models of science organisations have been transplanted in the western cultural context of Australia and in the non-western cultural context of India. It may be pointed out that the goal in drawing a comparison between the two laboratory organisations is not to evaluate their effectiveness, but the goal is sociological. That is, the goal is to understand the processes of social change in the structures and functions of these laboratory organisations, which originated from the same original model, through the analysis of action and meaning context of scientists in laboratories.

Hitherto existing social studies of science literature, particularly in the context of scientists in laboratories, can be criticised from a number of points.
However, the major limitations that bound the theoretical basis of this literature that reduces its relevance for the analysis of scientific research, its organisation and the action of scientists in the laboratory context may be summarised as below.

(i) The sociology of science has tended to remain out of the sphere of the sociology of knowledge. Researchers in the sociology of science have failed to extend substantial attention to the social relations of scientific research and the orientations of scientists in their wider cultural context. The understanding of the sciences is inhibited by the analysis which does not regard scientific research as a dynamic social process which arises in particular social, cultural, economic and political contexts. Following Mannheim [1952], several influential writers have drawn our attention to this aspect, for example Mulkay [1979].

(ii) Researchers in the sociology of science have often accepted the traditional boundaries between pure, academic science as a role proper to the academic research settings and applied science as a role proper to the non-academic research settings (in government and industry). While the former is regarded as the 'genuine' science and as a 'paradigm' of rationality, the latter is relegated as something 'non-science' or 'bad science'. [see Whitley, 1972; and Sklair, 1973]. Under the assumption of such artificial boundaries, the social situation of scientists in laboratories under the direct control of government, under the 'mediative' control of government and in an industry context are lumped together to generalise the social situation of scientists in non-academic settings. The major theoretical consequence of the acceptance of such an assumption has been to imply an inevitable 'conflict' between the 'professional' and the 'organisational' norms or an explanation of the 'accomodation' and complete 'situational adjustment' to the 'organisational' norms for scientists in non-academic settings. Even though the 'conflict' hypothesis has been widely criticised, its basis - that is the acceptance of the above mentioned boundaries between the two settings is still widely accepted, particularly in the
Mertonian tradition [Barnes and Edge, 1982:13]. It is rather surprising that even Mulkay [1977:95] reflects the pure - applied distinctions on the basis of academic and non-academic settings. [see also Krohn, 1971; Cotgrove and Box, 1970 and Cole, 1979]. In this thesis I intend to challenge such generalisations, particularly in the context of scientists in laboratories under 'mediative' control. In the light of the exploration made of the recent situation in U.S. academic science settings and the case studies that will follow later in this thesis, there is no reason to accept the traditionally set boundaries between different research settings. The social conditions of scientific research present in one type of setting can be present in the other setting and vice-versa.

(iii) Consequently, flowing from the above point, the analysis of science and the orientations of scientists across institutional boundaries remain trapped within a framework of pure, academic science, where professionalism as the only source of social control in science is widely accepted both in the Mertonian and the neo-Kuhnian traditions in the sociology of science. Researchers in the sociology of science have paid very little attention to the changes in the nature and location of the centre of gravity in science from the pure, academic based settings to the mission oriented laboratories through the post-war period - a development which is associated with what Ravetz [1971] has identified as the 'industrialisation of science'. Scientists and their research activity across the institutional settings are influenced not only by other scientists as clients, but are also influenced by the clients such as industry, government, market forces etc.,. The consequences of this development have been described as the 'New politics of science' by Dickson [1984] and the 'De-institutionalisation of the scientific profession' by Weingart [1982]. [see also Blume, 1974; and Krohn, 1971]. As a result of these developments the acceptance of the traditional boundaries becomes irrelevant, because the pure, academic science is itself undergoing a tremendous change, by the gradual loss in its autonomy and hence
the social control exercised by sources internal to the scientific community. Correspondingly, social control in science is being replaced and supplemented by other forms social control relative to the contextual situation. Thus, what is reasonable to assume is that professionalism is but one important source of social control in science among others.

(iii) In the context of scientists in laboratories, although researchers have paid substantial attention to 'intra-organisational' variables by treating research laboratories as 'formal organisations', very little attention has been paid to the political and historical bases of laboratory research. That is, scientific research and the laboratory life-world of scientists are highly influenced by distinctive research 'cultures' as a product of the laboratory's social and historic traditions. Some important considerations in this regard are revealed by detailed laboratory studies, for example, from Anderson [1975, 1981]; Hill [1977] and Loren Graham [1975].

(vi) Researchers in the sociology of science have not adequately conceptualised the orientations of scientists within the perspective of action and meaning theories. The local - cosmopolitan dichotomy, for example, remains trapped within the Mertonian paradigm in the sociology of science, without any recourse to the negotiation of meaning context of scientists in the laboratories which stretch into the social history, 'neighbourhood effect' and the prevailing research 'cultures' extant in the laboratory contexts.

This thesis demonstrates that a fruitful way of responding to many of the above criticisms, particularly (iv), (v) and (vi), is to proceed through an interpretive perspective in the sociology of science [see Law, 1974; and Law and French, 1974] combined with an historical analysis, wherein, scientific research as a social activity in
the laboratory context is treated as dynamic social process having interconnections with the societal sub-systems of political, economic and cultural institutions. The analysis on the orientation of actors towards action must be examined from the point of actor and his/her meaning context in the laboratory environment. As Law and French [1974] point out, the central focus should be laid on the empirical analysis of the taken-for-granted notions about actor's behaviour in the 'normative' tradition in the sociology of science. In the context of laboratory studies (particularly, the laboratories under 'mediative' control) some understanding of the mediation process is necessary because the laboratory structures mediate the negotiation processes between the scientists and various clients, interest groups and bodies and agencies both in the world of science and those which belong to the social world but which influence the actors in the laboratory.

Towards the development of the theoretical framework for this thesis, the analysis is however not restricted to any particular school of thought. The choice to draw upon the existing disparate but relevant theoretical tools has been rather instrumental in the sense that a selection of appropriate theoretical works was made to allow a comparison of the scientific research and the orientations of scientists across laboratory contexts in the two different national and cultural contexts. While the initial stimulus has been provided by Hill's [1974] work on the relevance of symbolic interactionism to the context of the adult socialisation of scientists (reference group theory), the meaning and social action of scientists from the sociology of knowledge perspective of Mannheim, and Jagtenberg's [1983] work on the phenomenological groundings for the meaning and action context of scientists (Schutz's structures of relevance), my theoretical debt however stretches to others. Particular mention may be made of Weber, Merton, Johnson [1972]; Law [1974]; Law and French [1974]; Anderson [1975, 1981]; Hill [1977]; and Blume [1974]. In summary, it may be said that the use of theoretical tools drawn from the above sources
has not been put to more and more theorising but to draw out relevant empirical threads in an effort to relate them meaningfully to the theoretical framework constructed.

In this thesis I have used the methodological and theoretical tools that provide an insight into the scientists laboratory life worlds across two national and cultural contexts. Given the task of drawing a comparison at a sub-macro level of analysis, it has not been possible to 'deeply' penetrate into the laboratory life as implied by Law [1974] and Law and French [1974]. But the theoretical and methodological tools employed have been quite adequate to de-mystify the 'black boxism' of the way scientist action is located within formal laboratory structures, and within the laboratory's historic, social and cultural frame. The theoretical and methodological tools have therefore been quite adequate to answer such questions as:

- in what way do social and historical factors constrain or induce the achievement of stated laboratory objectives within the action of scientists?

- how do dominant ideas within the laboratory culture influence the construction of meaning in research activity of scientists?

- why do scientists choose to act towards producing different types of research product, oriented towards local or cosmopolitan audiences?; and

- how is what scientists say they do at variance with what they actually do and what is the role of intended legitimation in this conflict?

In other words, whilst not 'deeply' penetrating to the micro-level of meaning construction that Law [1974] and Law and French [1974] advocate - but which is yet to produce meaningful analysis, the interpretive approach has been followed in spirit and method in this thesis. And, whilst focussed at a higher order of abstraction and historic breadth, it is fruitful in addressing key sociological questions that have not yet
been resolved in the literature.

Thus in the theory sections that follow, the thesis develops a platform for analysis through addressing the theoretical criticisms pertinent to interpretive analysis that were raised above. And in the two case studies and empirical data analysis chapters, the thesis applies the resulting interpretive perspective to the level of questions suggested above.

On the basis of the theory and the two case studies which follow, it has been possible to arrive at some broad conclusions. The major finding of the thesis suggest that the scientists in the CFTRI/CSIR and FRL/CSIRO are governed by two distinct traditions in research 'cultures' specific to the laboratory's national and cultural context. Historically speaking, towards the development of specific 'cultures', the two laboratory organisations were found to be in constant negotiation with the socio-economic and political environment surrounding the institutions. Whereas the scientific research in the CFTRI was found to be highly influenced by the 'utilitarian' based research culture of CSIR, the scientific research in the FRL was found to be highly influenced by the CSIRO 'culture' of scientific excellence. Correspondingly, the empirical investigation of the orientations of scientists and their research activity in the two laboratories suggests, that the meaning of research was a product of the influences routed through the research 'cultures' extant in the respective laboratory contexts. Even though the scope of the thesis is limited to the above two laboratories in their social and national contexts, the above findings do however go beyond the limitations of the small scale empirical investigations. In other words, the case studies contained in this thesis directly challenge the controversial assertion that 'science is universal and culture-free'.
1.2 Trajectory of the thesis

In attempting to deal adequately with the complex pattern of historic cultural, and professional influences that form the contextuality for research practice, the thesis confronts a daunting task in presenting the full range of material. To confront this task, the thesis progresses in the following trajectory:

1. Chapter 2 presents a theoretical analysis of the dynamic nature of science within a continuously transforming social and organisational context. This Chapter refers back to the classical formative work of Merton and Kuhn, identifies their limitations in dealing with the dynamic and context dependent nature of scientific activity, then moves on to demonstrate the relevance of more recent interpretive accounts of the science phenomenon.

2. Chapter 3 moves on from this base to explore one key feature of the negotiations that locate the scientist - actors within their social and professional context - that is: the feature of social control. In particular, a critique is developed of the singular attention that much of the literature has paid to professionalism as the dominant mode of occupational control in science. The critique is mounted through demonstrating - in detailed analysis - the increasing interpenetration of pure and applied research within contemporary research practice, the consequences of which is a considerable limitation of the pure science based 'professional' paradigm for analysis of the real social context for research. Professionalism as a form of control is therefore related to the wider social contextuality of research.

3. Chapter 4 draws on a synthesis of the conclusions of both Chapters 2 and 3. Its objective is to develop a theoretical frame that addresses and interprets contextuality of scientist action, and therefore deals with the problems identified in the literature critique that was presented in the two previous chapters. The theory frame draws heavily on theories of the constitution of meaning in action - and hence on the
phenomenological account of Alfred Schutz and the interpretation of levels of meaning by Karl Mannheim. Theory development progresses through an exploration of the socialisation of scientists (during scientific training) whereby the basic structures of relevance for scientist action are laid down. The chapter counterposes the more plastic "situational adjustment" hypothesis of Howard Becker against the more stable "experiential framework" model of Stephen Hill.

The link between subsequent personal meaning construction and the scientist actor's institutional setting is explored through explication of the concepts of reference groups theory (and in particular, the notion of "orientational reference groups"). The thesis posits that the "orientational" concept is central in drawing wider social, cultural and historic forces into the "world - within - reach" of the scientist - actors through the embodiment of orientations in institutional structures of experience. Through an exploration of the literature on scientists in laboratories across different cultural settings, the thesis establishes the utility of the "neighbourhood effect" as a device for understanding the dynamics of institutional contextuality. Chapter 4 therefore lays a general and interpretationist theoretical frame for specific hypotheses presented subsequently in Chapter 7.

Chapter 5 presents the methodology employed in applying this theoretical frame to a comparative cross cultural analysis of the two case-study laboratories studied, that is, the food research laboratories of CSIR in India, and the CSIRO in Australia. The two cases were chosen to provide maximally similar institutions - in terms of history (both being based on the same original UK, DSIR model) and discipline and problem areas of professional research. The two cases at the same time provided maximally different comparison in terms of social, political and economic context in which they were located. The case studies therefore furnish criterion tests of the influences of social contextuality on ostensibly similar (universalistic) research activity. The frame for the methodological approach that was
selected, sought to align in its interpretationist epistemology with the interpretationist structure of theory the methodology was designed to test. The method of "multiple feedback" was developed to provide this framework.

5. Chapters 6 and 7 then move on to present detailed analyses of the social, political, economic, cultural and institutional context of the two case study laboratories. What becomes clear in this comparative analysis is the way in which two apparently similar members of the same organisational species were transformed into quite separate institutional contexts. Their separate relationships to political influences, their separate traditions and ideologies laid down by founding leaders ('fathers'), their separate economic contexts and cultural environments - all had a significant bearing on the development of quite distinct institutional contexts and structures of orientation in the present. Thus, whilst research areas may be ostensibly similar, the meanings of this research, the orientations of research, the products and reward patterns are very different indeed. Taken together, these two Chapters provide a detailed exposition of just how important the social context is for the conduct of scientific enquiry, and how limited universalistic notions of science are. It follows then that analysis of science activity must be interpreted within social context, a validation of the underlying assumption of the thesis. Within this specific social context frame, the general theory that was drawn together in Chapter 4 is applied to the development of specific hypotheses (in Section 7.6) which guided the intra-laboratory and inter-laboratory empirical exploration and analysis of Chapter 8.

6. Chapter 8 presents the empirical data derived from the combination of quantitative and qualitative tests that were applied in the surveys of the two case study laboratories. The data are specifically focussed on scientist action and meanings within their respective social contexts. Thus the chapter commences with analysis of the detailed impingement of the institutional context on scientist orientations and action. It subsequently explores the underlying orientations for action, and orientational
reference group relations of scientists. Furthermore, it tests these orientations against the products of action - embodied in research results, reports, publications, patents, applications and so on. Thus, whilst the research could not study action directly - a task that would require detailed and continuous micro-level observation of behaviour, what it could do was to triangulate between pre-dispositions and products of action to identify the intervening process of action, and the meanings it conveyed, both in terms of what scientists said they did, as well as what they actually achieved. The empirical results clearly demonstrate the influence of varying social contexts on scientist action and meanings.

7. Chapter 9 presents the conclusions drawn from the research and theory embodied within the thesis. It is not the task of this introduction to summarise the conclusions at this stage. Suffice to say that the conclusions reinforce the general theoretical analysis presented in the first half of the thesis, and assert the significance of analysing scientists action within its social context.

8. Finally, the reader will find in the Appendices at the back of the thesis, a presentation of the research tools used in analysis, and of the detailed data (e.g. on research project orientations, publications and research products within the laboratories) that were used in summary analysis within the text.
Footnotes to Chapter 1

1. I am specifically referring to "laboratory studies" such as Latour and Woolgar [1979]. As Shinn [1982:262] points out, these "laboratory studies" are based on the reductionist approaches in the sociology of science which completely ignore the "contextual" parameters of political and economic impingements on the laboratory life of scientists. However, I do consider Knorr's [1981] work as an exception to these reductionist tendencies in the sociology of science.

2. So far, the UNESCO's ICSOPRU project progressed in two rounds. Whilst the first round was based on the European context, the second round included India (CSIR laboratories) together with European based research institutions. The point in raising the criticism here rather constructive, in the sense that studies such as the present study demonstrates that there is more to the approach of being concerned merely with questionnaire-based analysis.

3. I am aware that one of the members of Salk Institute was awarded a Nobel Prize during or after Latour and Woolgar's study.

4. During the course of developing a theoretical framework for this thesis I have referred to this literature.

5. I am specifically referring to the role of leadership in laboratories. Anderson's [1967, 1975] work on Tata Institute of Fundamental Research (India) and Saha Institute of Nuclear Physics (India), stands as an excellent example of the role of leadership in laboratories and its impact on the research practices of scientists.

6. I have preferred to use Mannheim and Schutz's works at the partial expense of Weber because of Weber's over emphasis on subjective and intersubjective meanings.

7. The term culture is a very diffused concept which is widely employed in the literature. The way I have used the term 'culture' in the context of two case studies is explained in Chapter 4.