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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NOTE

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7.1 Introduction: Brief history of FRL

The Food Research Laboratory (FRL) is one of the three laboratories within the Division of Food Research (DFR) in the CSIRO. The other two are the Meat Research Laboratory (MRL) and the Dairy Research Laboratory (DRL). DFR is the largest single institution carrying out food research outside the private sector in Australia [Meddings, 1983]. Within DFR, FRL accounts for approximately two-thirds of research effort both in terms of professional staff and financial resources. As pointed out in the methodology chapter, the FRL is selected for the case study as it provides a comparable scientific laboratory context to the Indian food research laboratory discussed in Chapter 6.

The origins of FRL go back to the period of the great depression when it was established as a small Section of Food Preservation (SFP) in 1931 in CSIRO, Melbourne. Despite the financial constraints imposed upon it by the depression, research on food was considered important because the Australian economy was greatly dependent on the export of primary agriculture produce. Moreover, the uneven distribution of the population in a large country needed improved methods in the preservation and the distribution of food.

During the 1930's, even though SFP conducted substantial research directly relevant to the export of primary, agriculture produce, under the leadership of Dr. J.R. Vickery (foundation head of FRL), major emphasis was given to basic or fundamental research on food. Vickery set out to expand SFP with this objective when the laboratory shifted its location from Melbourne to Homebush, New South Wales in 1940. As part of this expansion programme, SFP was upgraded in its status as a
Division of Food Preservation (DFP) in 1940. Vickery's efforts to develop a strong research group in basic food sciences, as we shall see in sections 7.3 and 7.3.1, was the product of CSIRO 'culture' which was set by David Rivett, CSIRO's (then CSIR) first chief executive office in 1926.

However, Vickery's plans to organise the expansion of food research with an emphasis on basic food sciences were foiled with the outbreak of the second world war in the Pacific region. The war meant enormous responsibilities on the part of DFP to undertake research that was directly relevant to the war time needs. As Bastian [1976:43] points out, "overnight...the food industry had become a war industry". Australia had the complex task of supplying food stuffs for armies in tropical climates and under adverse climatic conditions. The Australian government at this time agreed to supply 90% rations that were varied in character to the allied forces of the Dutch, French, British and American regiments in the south-west Pacific in addition to the requirements of Australian forces. What this meant for DFP was the rapid developments in new and improved techniques in dehydration, artificial skin coating of fruits and more importantly the canning of fruits, jams and vegetables. Although the existing food industry undertook some of this work, additional technological inputs such as canning of low-acid vegetables and fruit juices needed immediate research assistance from the DFP. Consequently, the entire group of research workers at the DFP and a Section of Dairy Research created during the war, were completely involved in advising the government and the industry on food related information as well as undertaking research relevant to war time needs.

The war provided an important stimulus to the ailing food industry but in effect the function of DFP was for it to be transformed into what was basically a service laboratory to the government, "vetting specifications, carrying out regular quality control checks, issuing certificates - all jobs that were anathema to the original concept of CSIR" [Bastian and Vickery 1976: 644, 645]. During war, very little basic
research was conducted at the DFP, but the division benefitted by the doubling of research staff and the corresponding increase in financial resources. Although DFP added little to its stature as a scientific research organisation during the war, as had Vickery intended, the division developed firm ties with a wider range of food processing industries than it ever had before [Bastian, 1976:59]. Historically speaking, the mid-1940's was the only period during which FRL remained closest to the needs of the food industry. After the war, close ties with the industry were shed and subsequently efforts were made to strengthen the research groups in basic research, an activity that was set aside during the war [Bastian and Vickery, 1976]. Three research groups in chemistry, physics and microbiology were established at the DFP and two groups on Plant Physiology and Physical Biochemistry were established at the University of Sydney in collaboration with the DFP. As Bastian and Vickery [1976:645] observe, "these groups carried out important basic research which earned the Division an excellent international reputation". In 1961, the DFP was moved to the new buildings at North Ryde, New South Wales and Vickery retired in 1967 after 36 years of service as Chief of the Division.

Given the wartime involvements of the Division with the food industry, although Vickery sought to expand research in basic food sciences, some sort of balance was maintained with research relevant to the industry. In 1947 Vickery worked out a report on the research policies for the post-war expansion of food research. As we shall see in section 7.3.1, after Vickery's retirement, this balance between the basic research and the research relevant to the industry underwent changes with further emphasis given to basic food sciences. This shift towards an increasing emphasis given to basic research is epitomised by the way in which the Division of Food Preservation's name was changed to the Division of Food Research (DFR).

DFR formed a head quarter for three laboratories including the FRL - the
major component of DFP. By 1970's the two research groups at the University of Sydney, namely, the Physical biochemistry group and the Plant Physiology group were moved to the FRL and Macquarie University (located close to the FRL) respectively. In 1970 the research work of FRL was organised in the following research groups. [see DFR, Report of Research, 1970-71].

- Microbiology
- Plant Physiology
- Biochemistry
- Physical biochemistry
- Food chemistry
- Flavour chemistry
- Physics
- Food Technology
- Fresh Fruit and Vegetables
- Engineering.

The 1970-71 DFR's Report of Research specified the objectives of the Division as follows:

"The aim of the Division's work in all these fields is to understand how foods can best be preserved from undesirable change; as a result of this understanding to suggest improved methods of preservation and treatment and to show how they may be applied. Another important task of the Division is to develop new food forms by processing stable foods in ways not hitherto used. Such new food forms find application in both specialist and general markets. These aims can only be achieved as a result of the closest contact with the food-based industries". (my emphasis)

Although these formal objectives concern the three laboratories, namely, FRL, DRL and MRL under the Division of Food Research, these objectives have an important bearing on the activities of FRL, because the FRL is a major component of the Division. FRL's professional staff in 1970 accounted for 58% of the total professional staff of the Division of Food Research. This figure has been quite consistent since
1970's. As the annual Reports of Research of the DFR indicates, the above objectives remained more or less unchanged up to 1981. From 1981-82 annual Reports of Research have shown the formal objectives of each laboratory separately in terms of individual research programs or groups, rather than presenting general objectives as the Division did from 1971 to 1981. The objectives of the FRL are as follows:

- The research program of the **Applied Food Science Group** is designed to develop new processes, equipment, products and knowledge for use by the Australian food processing industry.

- The aim of **(Chemical Bases of Food Acceptance)** program is to relate the chemical composition of foods to their flavour and other aspects of their acceptance by consumers (sic).

- The **(Food Safety and Nutritional Quality)** Groups' program mainly concerns microbiological safety of food and its nutritional quality (sic).

- The **Food Structure Group** is studying the intramolecular and intermolecular forces that control the structure of foods, and the relationship between the physical and functional properties of foods and their structure.

- The aims of the **Plant Physiology Group** are to improve the post-harvest handling, transport and storage of fresh fruits and vegetables and to develop an understanding of the fundamental principles involved in post-harvest physiology and biochemistry. Solutions to problems of immediate and practical concern to the fresh fruit and vegetable industry are being sought, and long-term programs are continuing with the aim of providing fundamental knowledge relevant to the more intractable problem of the industry.

- Requests for assistance and advice from the food and allied industries continue to dominate the work of the **(Liaison and Extension)** group. Whenever possible, assistance is given either by visits to the plan concerned or by undertaking limited laboratory investigations (sic). (all my emphasis).
As we can see from these objectives, research groups at the FRL were reorganised (in terms of formal titles) after 1978 as follows:

- Applied Food Science.
- Food Safety and Nutritional Quality
- Food Structure
- Plant Physiology
- Sensory Aspects and Trace Components of Foods (or Chemical Bases of Food Acceptance from 1979)
- Liaison and extension.

The exploration of the formal structure and function of FRL as briefly given in the preceding paragraphs shows that the activities of FRL are geared towards the promotion of both basic and applied research activities on food. In other words, Vickery’s report on the research policies for the post-war expansion of food research for FRL (then DFP) worked out in 1947 and which placed equal emphasis on applied and fundamental or basic research, appears to be reinforced from time to time in the formal objectives of FRL from 1970. Further, as the laboratory’s management claim, at least 45% of the research expenditure for 1982-83 is devoted to the development research and the rest for basic research.

Historically speaking, the closer ties with food industry that were established in the wake of the war period and the post-war efforts enunciated by Vickery in maintaining a balance between basic and applied research could not sustain for long after Vickery’s retirement in 1967. As pointed out earlier, the social history of FRL’s research activity after Vickery’s retirement, demonstrates a bias towards basic or fundamental research. However, the roots of this bias both in terms of the research policies espoused by FRL and their impact on the orientation of researchers may be traced to the very structural context within which the laboratory is located. That is, the research activities of FRL over the years have been subjected to various influences and
hence are conditioned by the forces acted upon by the laboratory's structural context as pointed out in (i) (ii) and (iii) below.

In order to draw a comparison with the Indian CFTRI/CSIR, I have elected to explore three main features of FRL's structural context in the sections that follow the present one. These are: (i) the nexus between science - politics in the context of FRL/CSIRO; (ii) the position of FRL in the broader context of the CSIRO system; and (iii) the interface between the FRL and the food industry. Even though these features are historically interrelated and any discussion on one of these will have its resonance on the other two, this need not necessarily prevent their discussion separately. These three features, as we shall see, have had the fundamental influence in shaping of the CSIRO's organisational research 'culture'. That is, the nature of social and historical relationships underlying FRL's structural context is a crucial element to an understanding of the cultural perceptions of researchers and the mode of organising scientific research at the FRL.

Just as in the case of the Indian CFTRI, the FRL constitutes an integral part of its larger organisation CSIRO. Thus, the way in which FRL functions and the research policies espoused by it must be understood within a total perspective of the CSIRO. Following the pattern adopted in the Indian case study, we shall begin to explore the feature of nexus between science and politics in the context of CFTRI/CSIRO.
7.2 The Nexus Between Scientist-Political Leadership: An Uneasy Alliance Between Science and Politics in the Context of CSIRO.

In this section what I seek to establish is that the nexus between science and politics in general and the nexus between scientific and political leadership in particular, in the context of CSIRO is constituted in terms of an uneasy alliance. The long standing nature of such a relationship, as we shall see, has in many ways served an important basis to the preservation of research policy autonomy in the CSIRO. It is this autonomy that in the ultimate analysis laid a foundation as basis to the tradition of CSIRO 'culture'. What follows then is a socio-historical exploration of the nature and some important phases of the uneasy alliance in the context of CSIRO.

Before we begin to explore the feature of the uneasy alliance between science and politics in this section, it is necessary at this stage to explain what I mean by CSIRO 'culture'. This is important to our discussion on the three structural features of FRL's social context where a recurrent reference is made to the CSIRO 'culture'.

Culture has been widely used concept in both anthropology and sociology for some time now. Following Kluckhohn [1951] and Kroeber and Kluckhohn [1963], culture concerns the meaning systems of society that provide a 'definition for living' in the "shared ways of thinking and believing that grow out of group experience and are passed from one generation to the next". That is, culture is a meaning system, that inculcates certain behavioural patterns in actors the continuation of which a tradition evolves over a period of time. The means by which the meanings are conveyed are the expectations, the norms, the rules, the symbols and even the structure of knowledge, Hill [1986]. Further, as Hill points out, culture is a universal property of human organisation and therefore is as useful as a concept for
understanding organisations as it is for any other form of social action. All cultures must have a beginning somewhere and during the process of its emerging phases the role of individual actors, particularly the elite or a leadership, who may or may not set the culture is as important as the interaction of group/s by whose efforts cultures are sustained and recreated.

Thus by CSIRO 'culture', I mean to refer to those meaning systems, norms, values, communicative patterns and traditions that have an important bearing on the action of scientists. As we shall see in Section 7.3, as a distinct product of CSIRO 'culture', set by its founding 'fathers' in the 1920's, the pre-eminence of scientific excellence in research and the promotion of basic research has come about in the context of CSIRO. Furthermore, as we shall see through sections 7.2, 7.2.1 and 7.3, the CSIRO 'culture' has a long standing basis as a tradition in the social history of CSIRO, as does the 'culture' of CSIR in India.

Returning to our exploration of the feature of the uneasy alliance, in contrast to the case of the Indian CSIR explored in Section 6.3 where politics and the development of Indian science were closely related, what an 'uneasy alliance' means in the case of Australian (CSIR) CSIRO is, that there existed a 'distance' between science and politics. There existed a relationship between the government and the (CSIR) CSIRO, but this relationship was an 'uneasy' one. Neither the political leadership (including the government instrumentalities) nor the scientific leadership of CSIRO entered into any sort of partnership both formal and informal as in the case of Indian CSIR. On the other hand, for a long period after 1949 the relationship between these two parties was more than the stipulations contained in the 'Haldane Principle'. For instance, the Liberal government both in principle and practice was completely hostile to any sort of interventionist policies as far as CSIRO's science was concerned. Therefore through government support for scientific freedom, the Liberal government legitimated CSIRO's autonomy to choose research goals and evaluate
success in isolation from any encroachment of political or economic pragmatism. This is fundamentally different to the situation in India. On the whole, in its various ramifications, the main part played out in the feature of uneasy alliance between science and politics in the context of CSIRO, is historically evident, first, from the side of CSIRO's scientific leadership and at other times from the political leadership. Following then we find different phases of uneasy alliance in the context of CSIRO.

Ronayne [1976] draws our attention to the uneasy alliance between science and politics by specifically referring to the way in which the Science Task Force Report (hence forth indentified as Philip's report) in 1975 presented arguments against the encroachment of science institutions by government instrumentalities into the areas of decision-making in science. However, this uneasy alliance from the side of scientists (elite) was not something that cropped up in the mid-1970's. In CSIRO, we can trace it to the very period of its establishment as CSIR in 1926.

Even before the Act of Parliament, in 1926, that established CSIR, Sir George Julius, Chairman of CSIR and David Rivett, Chief Executive Officer, CSIR, in a meeting with the Ministers of various government Departments who raised several questions on the usefulness of CSIR, emphasised that CSIR would be an institution for "scientific investigation; not a department for the dumping of awkward queries" [Rohan Rivett, 1972:88]. The Prime Minister S.M. Bruce who played an important role in the establishment of CSIR and in making selections for the executive of CSIRO, readily understood the view of nature of a relationship between science institutions and government instrumentalities that was held by Julius and David Rivett. For instance, as Currie and Graham [1974:233] observe:

"it seems unlikely that David Rivett, a disciple of Mason's, would have accepted the executive position in CSIR and left the Chair of Chemistry at the University of Melbourne
unless he had believed from the beginning that the Commonwealth (referring to CSIR) would develop its own research teams and manage its own laboratories".(sic).

Julius and David Rivett both had a certain vision of research 'culture' and the future role of CSIR, which in many ways was inimical to any sort of "the mating of knowledge and power" [cf. Salomon, 1972]. Although CSIR was totally dependent on the government for its resources, the scientific leadership, particularly David Rivett made it clear on several occasions during the 1920's and 1930's that the primary function of CSIR was to undertake 'scientific investigations', rather than become somewhat swayed by the innumerable opinions expressed by the government, industry and other interest groups. For instance, in 1927 the Prime Minister Bruce made a strong move to create a research division within the set-up of CSIR to assist the government in exploring tariffs and other economic issues. (The Australian economy in the 1920's and 1930's was almost wholly dependent on agriculture exports at this time). The leading economists were attracted to this move as CSIR would provide an atmosphere of freedom compared to other government departments. Even though Julius agreed with Bruce, David Rivett was totally opposed to any such move. As Rohan Rivett [1972:111] observes:

"David felt that....economics, was abundantly evident in the weekly, almost daily, controversies between leading economists at this period, was.....far from an exact science. Political philosophy and bias seemed capable of producing - from alleged experts - diametrically opposed conclusions. David (David Rivett) felt that for CSIR to intervene in a field where it was bound to become a party political football could be disaster; possibly a death blow".(sic).
However, eventually Bruce decided not to aggravate the tension with the CSIR and withdrew the move in favour of setting up a body outside CSIR. At this, David Rivett is reported to have remarked that "I for one shall throw up my hat with joy - though strictly in private (?)". A series of incidents were taking place between the scientific leadership and the government departments during the formative years of CSIR in the 1930's and 1940's that provide evidence of the uneasy alliance between the CSIRO and the government departments. [See Rohan Rivett, 1972; and Currie and Graham, 1967]. But there are two important episodes that deserve some attention here.

From the late 1930's onwards the government initiated a move to develop manufacturing or secondary industry. In this regard, even though the move began to establish an engine research laboratory outside the CSIR for which the government approached CSIR, this opened up a whole series of questions of CSIR's involvement in secondary industry [Currie and Graham, 1974:246]. At this David Rivett expressed utmost restraint for the government's move, but when it became inevitable David Rivett made it clear that CSIR would not become a 'handmaiden' to the industry and any additional support for research to the secondary industry should not in any way interfere with existing 'scientific investigations'. However, the war period brought CSIR closer to industry and the reservations held by David Rivett about secondary industry were suspended temporarily. (see also Section 7.2.1 for David Rivett's views on the secondary industry).

The other episode I have referred to earlier relates to the events that transformed CSIR to CSIRO in 1949 which resulted in David Rivett's relinquishment of the Chairmanship of CSIRO. During the war, CSIR's involvement in defence related research was substantial - from the development of a canning industry in food to radar related research and to the whole area of defence planning and co-ordination. When the war was over, 'secrecy' in research and security of information were to
become redundant from the scientific leadership of CSIR's point of view. David Rivett by this time became the Chairman of CSIR after the retirement of Julius. (ill health forced Julius to resign in mid-1945). Aeronautical Research Division (ARD), now a part of the Defence Science and Technology Organisation (DSTO), was under CSIR even after the war was over. From the government's Defence Department point of view it became essential to impose all kinds of security and 'secrecy' restrictions on CSIR's defence related activities carried out during the war as ARD was of strategic importance to the Government. As Rohan Rivett [1972] points out, even though David Rivett became a 'lynch-pin' during the war, the whole business of 'secrecy' and security for CSIR and science became an anathema for David Rivett in peace time. David Rivett held that "no one need labour the point that in today's world some measure of defence secrecy is tragically inevitable and unavoidable". David Rivett went further to add that the duty of the scientist was to explore and publish his findings and not to get tied up with government procedures. David Rivett firmly held that any deviation from this stand would amount to a betrayal of principle and disruption of the purposes (see section 7.3) for which CSIR was established [Rohan Rivett, 1972:200, 201]. David Rivett's open criticism of the issues that were of strategic importance to the Defence Department led to numerous disputes which eventually resulted in the transfer of ARD to the Department of Supply. David Rivett firmly held that while the Defence Department had a right to insist on 'secrecy' and security measures, these were no part of CSIR's scientific investigations.

The 'uneasy' situation between David Rivett and the government departments created a great concern for the government because the principle of freedom upheld by CSIR's scientific leadership threatened to embarrass the ministry at any time by making public revelations about the government's involvement in war efforts. Moreover, the Liberal Party in opposition, attacked the government with accusations that CSIR gave shelter to people with Communist sympathies. David
Rivett became a target of criticism from many quarters. Without going into a detailed discussion on the nature of the dispute between the two parties, as Rohan Rivett's [1972] detailed study indicates, this episode led to the constitution of a committee in 1948 consisting of W. Dunk and H.C. Coombs to report on the types of organisation suitable for the post-war activities of CSIR. As a result of the recommendations made by this committee, CSIR became CSIRO in 1949 by the passing of The Science and Industry Act, 1949. This Act brought CSIRO under the subjection of the Public Service Board (PSB) entailing a number of issues such as secrecy of information and the working conditions of scientists in relation to public service rules. One year before the 1949 Act was formally declared, the placing of CSIR under the PSB and other related measures were discussed. This perturbed David Rivett to a great extent. On August 17, 1948 in a letter addressed to the concerned minister, David Rivett communicated:

"From our informal talk in the plane last Friday evening I gained the impression (I hope wrongly) that you are definitely inclined towards placing CSIR under the Public Service Board. To my mind, this would be so great a disservice to scientific research in Australia that I feel I must be perfectly frank with you and say at once that I shall feel compelled to do my utmost in opposition to any such move". [Rohan Rivett, 1972:203]

Eight months later David Rivett relinquished the Chairmanship of CSIRO as a matter of scientific integrity. As Ronayne [1978:371] pointed out, what led David Rivett to do this was not the transfer from CSIR to CSIRO but the new Act that was seen by David Rivett as an infringement of the autonomy of the organisation. However, as we shall see in section 7.3, during the post - 1949 period, CSIRO continued to command the same research policy autonomy as worked out by its
founders, particularly David Rivett until the early 1980's. Thus, David Rivett was
the person at the helm of affairs between science and politics in CSIR from 1926 to
1949 during which time he played an important role in preventing the organisation
from getting tied-up with government policies and instrumentalities. Even though the
war period entailed some sort of 'emergency' alliance between CSIR and politics, on
the whole the relations between science and politics in the context of CSIR exhibited a
situation of uneasiness and at times even conflict oriented interests. This was a phase
in the social history of CSIRO that was mainly characterised by the uneasy alliance
between science and politics, where, the scientific leadership of CSIR played an
important part.

In the next phase from 1949 to the middle of the 1970's, the gravity of the
debate between science and politics centred around the general arena of Australian
science which, however, involved CSIRO. The singular domination by CSIRO of
Australian scientific research system until the early 1950's needed to be balanced with
the fostering of other institutions of research in the universities and in the emerging
secondary industry after the late 1940's. Resources, both in terms of financial and
personnel were at a relatively very low level in these institutions compared with
CSIRO. As Ronayne [1984:164] puts it, "universities have long regarded (by
1950's) themselves as Cinderellas of the Australian scientific research scene".(sic).
Imbalance in funding between the universities and the CSIRO was a matter of great
concern to the universities. In such prevailing conditions, from the early 1950's,
opinions from the scientific elite, particularly the academic scientists, become recurrent
and were focussed on the government initiating some sort of scientific policy. But,
with the coming of Liberal government in 1949, that had a long tenure until the early
1980's, the government was almost totally uninterested in establishing any sort of
science policy machinery. The post-1949 period, thus began with the continuation of
the trend of an uneasy alliance in the relations between science and politics. But in
this phase the character of the trend was significantly different to the pre-1949 period. Here the scientific elite made consistent demands on the government for evolving some sort of policy framework for the promotion of science but the government remained unaffected for a long time for about two decades from the 1950's.

Given the low level of funding and support for the university system, the Australian National University (ANU) in 1951 organised a seminar on "Science in Australia". An important recommendation from this seminar was the establishment of an effective body to advise the government on science policy, but there was no support from the government for such an idea. In 1964, the Australian Academy of Science (an offshoot body from the ANU seminar) proposed a body similar to the U.S. National Science Foundation and Fredrick White, the Chairman of CSIRO made a specific suggestion for some type of science policy council. In the following year, consequent to the suggestions made by the Committee on the Future of Teritiary Education in Australia chaired by Sir Leslie Martin (hence forth identified as Martin Report), the government evinced an interest for some form of science policy machinery but later rejected the idea along with a similar body for economic growth. The continuing abhorrence by the Liberal government for any sort of science policy machinery is expressed by the Prime Minister Gorton in 1968 as follows:

"I don't know what a science policy is. The critics want an overall advisory committee to allocate funds, but I don't see the need for any advisory body. These committees are only a group of individuals pushing the barrow for their own discipline".5

In 1969, as a response to the Australian Academy of Science, Malcolm Fraser, then the Minister of Education and Science, indicated the government's preference for relying on informal processes rather than a formal body to advise the
government on scientific matters of policy. However, Fraser went on to indicate:

"We may then be wisest to continue our pragmatic evolutionary approach seeking advice from different people as different projects arise. In this way we can establish a network of formal and ad hoc relationships. Having obtained such advice, the decision needs to be made as it must be, at the ministerial and governmental level...we are in a stage of evolution. There will clearly be new initiatives in the future". [Fraser, 1969: 5, 12].

However, it was not until April 1972 that the Liberal government announced the creation of an Advisory Council for Science and Technology (ACST). Its main purpose was to co-ordinate the advice coming from various departments and institutions. As Rubenstein [1978] implies, what compelled the government to create such a body and thus counteract its previous commitment to non-interventionist policies, was the Labour Party's (in opposition) explicit Programme of Science Policy from 1965 onwards and the Australian membership of OECD in 1971. ACST was short lived because the Labour government came to power in 1972 and replaced ACST by the Australian Science and Technology Council (ASTEC). Despite the changes in the government from 1975 ASTEC still survives.

Thus the long tenure of Liberal government on the whole exhibited non-interventionist policies on science. A product of the Liberal government's non-interventionist policies a science policy (partly implicit) was pursued that did not (as in India) relate science to its use, but instead as Rubenstein [1978] observed, was a "policy for science", oriented towards the relatively undirected development of science and science institutions as such. As Rubenstein [ibid] continues, "yet, the use of science as a means relevant to the attainment of many societal goals is relatively underdeveloped at the infrastructural levels of government and industry in particular".
Such an approach to science by the Liberal government with its non-interventionist stance on science had an important bearing on the functioning of CSIRO, though in an indirect way. The sort of approach to science taken by the Liberal government helped CSIRO foster and strengthen its research 'culture'. I shall come back to this aspect in other sections of this chapter.

One of the important demands made by the scientific community in campaigning for some form of governmental science policy machinery was that they were seeking more financial resources for scientific research. Both the government (Liberal) and the elite sections of the scientific community were by and large 'critical' of the approach to science as a 'means' towards developmental processes. As referred to earlier, scientific research was viewed as an end in itself. Thus, after two decades of recurrent demands for the creation of a science policy machinery, when the government began to seriously promote and institutionalise science policy structures, the multi-disciplinary nature and practice of science policy came under attack by the scientific community. Given the social science basis of science policy studies, social scientists became the target of criticism by the elite scientists. Historically speaking, this change in the attitude of elite scientists is not unrelated to the change in the government in 1972 with the Australian Labor Party (ALP) coming into power. By this time, the ALP's inclusion of science policy in its platform from the mid-1960's, and the role assigned to science and technology as a means to economic growth was well known. [see Whitlam, 1970]. When Labor came to power in 1972, though for a short period, ACST was disbanded and plans were on the way to reorganise ACST into ASTEC. Meanwhile, a group of physicists offered the following recommendation to the government in 1974 on the reorganisation of ACST:

"Although social scientists are of value in gauging the social effects and consequences of scientific development in Australia, they are woefully unequipped to assess the
development of scientific research in the country and are out of their depth with respect to recommendation of overall or particular science policy".6

A similar version of recommendations were also submitted to government by the Australian Institute of Physics group. The attack on the social science basis of science policy was not only an attack on the social scientists (however ASTEC membership had a philosopher, a sociologist and an economist), but reflected the uneasy attitude of scientists on 'science for policy' - the use of science as a means in the attainment of broader economic and social objectives [see Rubenstein, 1978]. Thus the major part played by the Liberal government in the feature of uneasy alliance between science and politics for about two decades after 1949, was replaced by the scientific community (elite) with the coming of the Labour government in the 1970's. In the mid-1970's the part played by the scientific elite in keeping the government instrumentalities away from any sort of interference with the science organisations is clearly represented by the Philip's report submitted to the government in 1975. In dealing with science policy and related issues, this report spelled out its views as follows:

"Such [immature and ineffective] fields lack either facts or methodology for logically consistent prediction. They are clearly beyond the purview of the scientific ethos since they can satisfy the requirements neither of disinterestedness nor organised scepticism. They include much of the social sciences and of multi-disciplinary research. The pretence of their practitioners that these fields are part of science may be.....a device for survival, in the absence of which society would provide for these fields neither resources nor respectful attention".7

The essence of the Philips report's critique on science policy making is that it not only
exhibits the utmost uneasy attitude for any sort of alliance with the politics but it goes a step further to point out the boundaries between the sphere of 'science' and non-science related studies (science policy) on science, and the consequences such studies might have in inhibiting the advancement of science. Having considered that science policy studies place limits on science, in a rejoinder to the formal report, Philip [1978:404] has this to say:

"To call for clear recognition of the limits of science is not to deny the human importance of some "immature and ineffective fields". The cruel fact is that many of the most pressing problems of the day lie squarely in such fields. But the propagation of the illusion that these problems are scientific in substance retards, rather than advances, their solution. Politics takes over where science must leave off, and the resolution of such problems depends ultimately on political judgement".

Without going into the details of the philip's report, that are thoroughly discussed elsewhere[(see Hill and Jagtenberg, 1977], the way in which the whole report was based on the ideas of Karl Popper, Michael Polyani and Robert K. Merton, suffices us to confirm the bias the report had for a pure, academic science model of science development which assumes complete autonomy devoid of any political or external mediation for science organisation. The Philip's report argued that:

"creative productive science depends on the autonomous operation of self-imposed values and controls. It is ultimately self-defeating for a society or government to erode the autonomy of the scientific community". [Philip's report, 1975:6]

The Philip's report was produced essentially as a political reaction to what
was perceived by the report as a threat from government and bureaucratic encroachment upon science organisations. The basic thrust of the report was aimed at defending the autonomy of science. The Philip's report which strongly reinforced the non-interventionist stance of government policies on science and science organisations may be taken as a view from CSIRO in proxy. Five out of the eight members constituting the Philip's report committee were either former or incumbent members of CSIRO. Philip was the Director of the Institute of Physical Sciences, CSIRO, that has at least ten divisions of CSIRO under it. Further, Philip [1978] himself at length tracing the origins of the CSIRO 'culture' from David Rivett's period goes on to express concern over the increasing pressure for centralised control, the emergence of hierarchial structures, and a general increase in bureaucracy in CSIRO's 'culture' during the mid-1970's. Having done that, Philip himself observes that "this was the background against which the task force in science undertook its work".

Other recommendations of the Philip's report that were aimed at diffusing the centralisation in science policy structures, which existed in their most embryonic stage [see Ronayne, 1979:453], were: the elimination of all units or R & D establishments under the control of government departments; dissolving the Department of Science and redistribution of its responsibilities to other Ministries; reporting of all major science organisations to the Prime Minister or minister without portfolio rather than to the Minister of Science; and the prescription of independent statutory status to all science agencies at par with CSIRO. The only recommendation of the Philip's report which was in favour of the continuation of the existing science policy body related to ACST, but in its most diffused form as a co-ordinating body rather than as an advisory body.

However, the Philip's report was criticised from both within and outside the government circles. The New South Wales government reacted sharply against the Philip's report and commissioned two academics from the University of Wollongong
to produce an alternative view. [see Hill and Jagtenberg, 1977]. The thrust of Hill and Jagtenberg’s report was that "autonomy is not required for research to be the most productive either in basic or mission oriented research" although it is of precious value to the scientists. Hill and Jagtenberg’s report was close to the principle of the ‘customer-contractor’ basis of scientific research as found in the Rothschild Report [1971].

By 1976 the Liberal Party came into power and notwithstanding the Philip’s report, constituted an Independent Inquiry Committee into the CSIRO headed by Professor Birch (henceforth identified as the Birch report). As we shall see in Section 7.3, although the Birch report in principle argued for the status quo of CSIRO in many ways supporting the Philip’s report, it contained several recommendations by which CSIRO was expected to become more accountable for its research. Following the Birch report, from the late 1970’s questions of accountability for CSIRO’s research were raised from several quarters [see Peres, 1980:389]. The late seventies was also a period when the Australian economy showed signs of economic deterioration. In the prevailing circumstances, by the early 1980’s, the ALP formed the government and immediately embarked on reversing the existing Liberal approach of ‘science as an end’. The main rationale given by the Labor government for economic recovery was based on the approach which considered ‘science as means’. The policies on encouraging the ‘sunrise industries’ is an example of this shift in the government policies on science. The economic deterioration on the one hand, and the public criticism on the relevance of CSIRO’S research for economic development, on the other, forced the government (science minister) to make CSIRO more responsive to the immediate socio-economic needs. In the prevailing circumstances, the CSIRO’s scientific leadership made a strong move to secede from the science minister (Mr. Barry Jones). In line with the recommendations of the Philip’s report, CSIRO’s leadership (Dr. Paul Wild) proposed to the government its intention to join the
Department of the Prime Minister to report directly to the Prime Minister's Office. The growing uneasy alliance between CSIRO and politics was clearly expressed by Paul Wild, the Chairman of CSIRO in 1983. As Scitech [1983:8] reports,

"he maintained the move would remove conflicts of interest and budget competitiveness and improve relationships between CSIRO and the Department of Science and Technology (DST) - which have been strained for some time. He argued that DST concentrated its efforts on technological development while CSIRO's work covered a much wider range of interests".

However, CSIRO's move failed and it continues to operate under the portfolio of the Science and Technology Minister (since 1984 the Minister for Science).

So far, this section has been useful in delineating some salient features of the character and phases in the relationship between science and politics with particular reference to CSIRO. In that the Australian case presents a total contrast with the Indian CSIR dealt with in Section 6.3. both in terms of its variable character and its different phases. The relationship that emerged between science and politics in the case of CSIRO is manifested in terms of an uneasy alliance right from its inception in 1926. What comes out of this section is that CSIRO as a totally government financed organisation has emerged with the unique distinction of maintaining an independent relationship with the political processes. It is evident that its scientific leadership laboured hard to prevent CSIR(O) from getting tied-up with government instrumentalities and influences during its first two decades setting a precedent for the future leadership of CSIRO. In this endeavour of CSIR(O)'s scientific leadership, even though the uneasy alliance served an important basis for the preservation of CSIRO's autonomy, there is no evidence to suggest that this relationship in any way inhibited the growth of CSIRO and the drawing of support from the political system.
On the other hand, in relation to other sister scientific organisations, CSIRO occupied a predominant position both in terms of resources and personnel that on several occasions became the subject of science policy discussion and a matter of great concern for the universities, because the universities did not get the same support as CSIRO.

The way in which the uneasy alliance between science and politics was manifested in the context of CSIRO is however not unrelated to the approaches to science adopted by the two major Australian political parties which have assumed government from time to time alternatively. As the foregoing exploration in this section suggests, the leading role (in fostering distance to politics) played out by the leadership of CSIR(O), in the feature of the uneasy alliance between science and politics came about prominently during the Labour government. The events which relate us to this trend are: David Rivett's fierce resentment over the promotion of research relevant to the manufacturing industry when the government pressurised CSIR to this effect in the 1940's; David Rivett's relinquishment of the Chairmanship of CSIR in 1948-49; the Philip's report in 1975; and Dr. Paul Wild's move to secede from the control of the Science and Technology Minister in the early 1980's. The prominent role played out by the CSIR(O) leadership in the maintenance of an uneasy alliance underwent a change during the Liberal regime.

The Liberal Party for the most part during its long tenure in the government from 1949 to 1980 (with a lapse of about three years in the 1970's), adopted an approach which varied from 'no policy in science' to pragmatic 'evolutionary approach'. From 1949 for about two decades, the trend of recurring demands made by the scientific community (elite) for the establishment of some sort of science policy machinery, for which the Liberal government had consistently exhibited its unfavourable attitude relates us to the part played out by the Liberal government in the feature of the uneasy alliance between science and politics. Both of these above trends
provided an important basis for CSIRO's research autonomy. Firstly, the trends demonstrate the emergence of CSIRO as a unique scientific organisation totally funded by the government, yet, maintaining a relatively independent relationship with the government. Secondly, the trends have been historically crucial for the separation of CSIRO's research policy autonomy from political instrumentalities. Research policy autonomy was an element of cardinal importance to the ideological philosophy of CSIRO's founding fathers which was the basis of CSIRO 'culture' (see Section 7.3). With regard to the research policy autonomy in CSIRO. Peres [1980:389] observes, "in CSIRO policy autonomy (research policy) was parcelled into little pieces, distributed widely almost on an individual scientist basis, thus leading to the individual determination of research programs within a very broadly defined mission for a laboratory as a whole". This distribution of research policy responsibility is a distinct product of ideological philosophy of CSIRO's scientific leadership.

So far in this section, we have examined the nexus between science and politics in the context of CSIRO. It is evident that this relationship had many different phases which may be broadly characterised as a feature of uneasy alliance. The result of the different phases of the uneasy alliance is that the CSIRO was a beneficiary in many ways by drawing an independent relationship with the political instrumentalities and preserving its research policy autonomy.

Under the CSIRO system, even though researchers in the laboratories such as FRL are given substantial autonomy to perform research, it does not follow that the goals and the mission they set out to achieve are unrelated to the larger organisation of CSIRO. Just as the position of CFTRI in the framework of CSIR, FRL is an integral part of the CSIRO system and therefore in many ways it is subjected to the limitations of being part of its larger organisation. Towards the end of Section 7.1 it was observed that the research activities in FRL during the post-war period were steered more and more towards basic research at the cost of research relevant to the secondary
industry. If FRL functions with the limitations of being part of CSIRO, then in order to understand what FRL does and is expected to do we must look into the broader context of its organisational location and the forces that prevail upon it. The reasons for the increasing emphasis given to basic research by FRL, derive from the way CSIRO's growth has taken place over the years tuned to the needs of primary, agriculture industry rather than secondary industry. What was essential to this was the generation of basic scientific knowledge.

7.2.1 Position of FRL in the broader context of the CSIRO system

As shown in Figure 6.2, the organisational structure of CSIRO consists of constituent Institutes, Divisions and Laboratories. All these units in principle are expected to operate on the basis of a decentralised research management with substantial research policy autonomy delegated to the downstream units from the CSIRO executive. But in actual practice, all units under CSIRO system are structurally integrated with the the CSIRO Head Quarters. All policies on research in the first place are set by the Executive. The Executive is supported by the management committee comprising executive members and directors of institutes. Institute Directors are responsible to the Executive for the management of their institutes, with particular emphasis on priorities and objectives for research programs, resource distribution and organisational arrangements. Chiefs of divisions and officers-in-charge of the laboratories such as FRL are responsible to their respective directors for research management, "with particular emphasis on scientific leadership and the day-to-day allocation of resources to achieve agreed objectives and implementation of the results of research", (my emphasis). In this sense, structurally, FRL functions as an integral part of the CSIRO system and is therefore conditioned and influenced by general policies on all matters of research that evolves from its
CSIRO (as CSIR) was established in the 1926 at a time when primary industry, particularly agriculture and pastoral activities played an important role in the Australian economy. By 1950-51 while primary industry accounted for 23.5% of GDP, its proportion contributed to more than 90% of income derived from Australian exports. The first Chairman of CSIR, Sir. George Julius argued that given the role of primary industry to the economy, the major focus of CSIR should be on areas relevant to this industry [Ronayne, 1984:169]. This rationale provided an important basis for CSIR's role and its subsequent growth as CSIRO [Johnston, 1982:22]. The early work of CSIRO was therefore focused on the preservation of losses caused by animal disease, on the improvement of the productivity of the pastoral industry, on the development of the sciences such as entomology because of their relation to agriculture management, and on the improvement of livestock by the sciences of physiology and genetics etc. As Sir Fredrick White [1968:123] later observed:

"the choice of these areas of agricultural research supported by deep scientific investigations was a natural one for an institution such as CSIRO. The country at that time was surely in need of new ideas and new knowledge to permit the agriculture industries to cope with the many problems that were encountered".

The natural choice to focus on agriculture also derives from the absence of a significant manufacturing industry base in any considerable extent before the 1950's. The manufacturing industry was mainly developed after 1945, almost two decades after CSIR's establishment. However, as observed earlier, from the late 1930's there was a move in CSIR to direct some of its activities to manufacturing industry, but this
work began with a certain degree of anathema for that industry. Because, there were persisting fears that CSIR would become a 'handmaid' to industry. As David Rivett, second Chairman of CSIRO observed:

"Am I unreasonable in expressing a fear that to most people the justification for our various national laboratories is to be found in the belief that science is to be the ever-ready handmaid to industry, standing by to help when dividends fall, or a machine fails to function, or a greater yield is wanted, or a better finish? Rare and precious as handmaids are nowadays, I venture to hope that this rather restricted view of the functions of the scientific research institutions will not persist. The raison d'être of such laboratories is much more than that. What we need to develop amongst ourselves is the faith that knowledge is worth seeking and worth getting at even though any immediate connection between it and industrial profit may be completely invisible". 8

When it became inevitable that CSIR would have to devote a certain proportion of its research efforts towards solving the problems of the manufacturing industry, David Rivett held the view that research for that industry should not in any way interfere with the existing activities of CSIR (obviously, the primary agriculture oriented research) [Currie and Graham, 1974:241]. Eventually, even the recommendations of a committee (Wimperi's report) set up by the government in the late 1930's on the development of secondary industries clearly reflected David Rivett's cautious view on secondary industry. In one of its recommendations, the committee9 stated:

"The Committee desires strongly to emphasise the point that it would be most undesirable in the interest of national efficiency and development if the appropriation of any sum
for the purpose recommended in this report were permitted prejudicially to affect the division of funds for the further prosecution of the important work which the Council for Scientific and Industrial Research had so successfully conducted during the past 10 years and which has proved to be of such outstanding value to Australia's primary industries".

Thus David Rivett, whose policies and actions as head of CSIRO paved a foundational basis for what is generally understood as 'CSIRO culture' set a clear cut bias in promoting scientific research in favour of primary industry. This bias in fact has a long historical tradition when examined from the data on CSIRO's research expenditure from 1950-51 to 1980-81 as shown in Table 7.1. Even though the proportion of the primary sector's share both in GDP and exports registered a downward trend in relation to the relative share of the manufacturing sector from 1950 to 1980 (see Table 7.2), the research related to the objectives of manufacturing sector in CSIRO declined as a proportion of the organisation's activities.

The continuation of a long standing bias towards the primary sector was confirmed by Dr. J.P. Wild, CSIRO's chief in 1983:

"CSIRO's ability to help an industry is proportional to the effectiveness with which the industry can identify its strategic research problems. For this reason, CSIRO interactions with the rural and mineral sectors are smooth......but interaction with the fragmented manufacturing sector is difficult.... The needs of manufacturing industry especially, pose problems, for they are likely to be satisfied by CSIRO conducting tactical (problem solving) research rather than that requiring a longer time scale". (my emphasis).
TABLE 7.1

CSIRO research expenditure by sector (percent).

<table>
<thead>
<tr>
<th></th>
<th>Primary</th>
<th>Mining</th>
<th>Manufacturing</th>
<th>Tertiary</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-51</td>
<td>41</td>
<td>8</td>
<td>22</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>1955-56</td>
<td>43</td>
<td>9</td>
<td>23</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>1960-61</td>
<td>44</td>
<td>10</td>
<td>22</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>1965-66</td>
<td>44</td>
<td>10</td>
<td>23</td>
<td>9</td>
<td>14</td>
</tr>
<tr>
<td>1970-71</td>
<td>45</td>
<td>10</td>
<td>21</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>1975-76</td>
<td>42</td>
<td>10</td>
<td>20</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>1980-81*</td>
<td>42</td>
<td>8</td>
<td>21</td>
<td>21</td>
<td>8</td>
</tr>
</tbody>
</table>


*figures for 1980-81 are estimated from Department of Science and Technology, Science and Technology Statement 1981-82, AGPS, Canberra, 1982, using the classification description from Hansard.
TABLE 7.2

CONTRIBUTION OF PRIMARY AND SECONDARY INDUSTRY TO GDP AND EXPORTS.

<table>
<thead>
<tr>
<th>Selected Years</th>
<th>Primary Industry</th>
<th>Manufacturing Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Exports</td>
<td>%GDP</td>
</tr>
<tr>
<td>1950-51</td>
<td>90</td>
<td>29.0*</td>
</tr>
<tr>
<td>1968-69</td>
<td>59.1</td>
<td>9.6*</td>
</tr>
<tr>
<td>1978-79</td>
<td>43.8</td>
<td>7.3*</td>
</tr>
<tr>
<td>1882-83</td>
<td>47.7</td>
<td>3</td>
</tr>
</tbody>
</table>

* at factor cost

Sources: [Boehm, 1979:10,11]  
Australian Bureau of Statistics (ABS), Cat. No: 5404.0, 1980  
ABS, Cat. No: 5203.0, 1981  
ABS, Cat. No: 5410.0, 1982-83  
CSIRO's close ties with the primary agriculture sector was reinforced partly by the way in which the development of manufacturing industry from 1945 took place, primarily in accord with an import substitution strategy. As Johnston [1983:10] observes in this respect:

"This (manufacturing industry) required little local R & D, as the technology could be imported. Such a strategy placed no very great premium on developing the capability to compete. Whether in terms of price or quality, for export markets. Hence there is a long tradition of dependence on imported technology, and of conservative attitudes on the part of managers, government officials and politicians to the need for new ideas or products.

Hence the S & T system developed in the context of a need and government responsibility to support rural industries, a lack of interest or demand from the manufacturing sector, and an academic orientation to research objectives and problems set by the international scientific community". (sic).

Further, by locating CSIRO in the broader social context it appears that there were no great compelling reasons for the organisation to deviate from its traditional role - tuned to the needs of the primary sector. For two decades from 1949-50 during the 'Menzies millennium' Australia witnessed a 'boom' period [Catley and McFarlane, 1981]. The income levels registered for Australia were among the highest in the world. The steady flow of foreign capital, and the competitive international markets for minerals and agriculture were in Australia's favour in an economy endowed by vast natural resources. Surplus agricultural output to support a
small population and a steady inflow of immigrant labourers which maintained wages at relatively favourable level - all these aspects relate to what Donald Horne calls "The Lucky Country". In such circumstances science and its support acquired a 'welfare' function rather than an 'investment' one. All through the period of the Liberal government up to Fraser, the type of science policy followed by the government was "policy for science". Under this policy there was no great need or pressure experienced by the government to make science and technology a prime mover of economic development, particularly, to give the manufacturing sector a central role in it. Even some science policy analysts were opposed to any sort of policy which considered science as a 'means' towards economic development. For instance as Professor Sol Encel [1971:30] expressed:

"Australia is in a special situation and not all the arguments for a governmental science policy which are made in other countries fit Australia's needs. Most of the arguments... (making science and technology as the key to economic progress) are mainly appropriate to countries which are major industrial and military powers. Australia is not one of these and its prosperity does not depend on the export of industrial manufactures". (sic).

The sector from which economic benefits were readily seen by the Liberal government was the primary industry and this was the sector that remained the main focus of attention by CSIRO. To a large extent, this aspect explains the non-interventionist policies on science institutions adopted by the Liberal government.

Consequently, we find a long tradition of bias towards the primary industry. What this preoccupation with primary industry also meant was an emphasis on deep scientific investigations and the generation of new knowledge [see Fredrick White, 1968; and Rubenstein, 1978]. It may be also said that CSIRO's preoccupation with primary industry provided an important basis for the development of and the
continuing tradition of CSIRO 'culture'. Basically, this 'culture' represents the ideological philosophy of developing scientific excellence in CSIRO through the promotion of basic or fundamental research. We shall examine this feature in some detail in Section 7.3.

As pointed out earlier, the need for an understanding of certain developments in FRL within a total perspective of its larger organisation is inescapable - given the structural relation of FRL to the CSIRO. Thus we may conclude that the conservative orientation of FRL towards the secondary food industry or the increasing bias towards basic food sciences derive in part from the laboratory's structural relation to its parent organisation. This is so, particularly, given CSIRO's decentralised management system within an autonomy umbrella - that is the structural framework sets context for culture (interactions and meanings) - this in turn allows variations at the laboratory level, but within an overall ideology and culture extant in the larger organisational context of FRL. However, FRL does not operate only within the confinement of its larger organisation - CSIRO. In order to understand what FRL does, we must also consider it in its food industry's context and the extent to which its research activities are conditioned by the status of the food industry in Australia.

7.2.2 Food Research - Food Industry Interface

This section is basically intended to explore the structure of the private food processing industry in Australia and to examine the extent to which this industry context constrains or directs the research activities of FRL. In doing so, we shall also examine the factors specific to the food processing industry that have led to the conservative attitudes both on the part of the industry and the laboratory as well.

The food processing industry in Australia in the 1980's is a big business worth $15 billion a year [Sargent, 1985]. All through the post-war period, particularly from the 1960's, the food processing industry experienced a rapid growth. Behind
every agricultural product that came into the market was the food processing know-how. In Australia, the rise in number of migrants entailed a range of product lines and the demand for European-based cuisines. The Australian Consumer's Association traces the growth of food products in large stores from about 1000 in 1938 to little less than 4000 in 1958 that increased to over 10,000 in 1984 [Sargent, 1985:111]. The reason for the phenomenal increase in the number of food products is also due to the rapid expansion of multi-national corporations in the business of food and the international commodification trends in the food products that found their way into Australia's consumer purchases through various sources, in particular, the burgeoning mass media. Despite the levelling of migration intakes in the 1970's and 1980's and the loss of food export markets in the post-1970 period after Britain cut off its traditional role as an importer of Commonwealth products, when it joined the EEC, the food processing industry in the 1980's continues to be the most dynamic sector of manufacturing industry [Braddock and Cooper, 1985]. In terms of value of output in 1981-82, the food processing industry is larger ($17 billion) than agriculture ($13 billion) and mining ($10 billion). From 1968-1982, the food processing industry registered a faster annual growth rate (2.4%) than the rest of the manufacturing industry (1.8%). What then is the relation to CSIRO's food research?

It is evident from the exploration made in Section 7.1, that the function of FRL, as prescribed in its formal objectives from time to time since the post-war period, involves a substantial obligation to meet the needs and demands of the food industry in particular and the Australian community in general. Ironically, FRL's social history [see Bastian, 1976; and McG. McBean et al, 1977] shows that it was only during and just before the second world war period that the laboratory's research aligned closely to the food industry's direct needs. It was during this time that the FRL (then DFP) grew in relation to the food industry and "had a finger in almost every pie"[McG. McBean et al, 1977:209]. For example, the twentieth century's
modern canning industry in Australia is understood to have been built on the technical support rendered by the DFP in conjunction with the American technologists [Bastian, 1976:59]. This valuable 'close' interface between the food industry and the FRL all through the post war period withered - not altogether and suddenly - but slowly and gradually. As noted in the earlier sections, even though the reason for this state of affairs may be related to other structural as well as historical factors that we have examined in Sections 7.2 and 7.2.1, the very structure and the growth of the food processing industry over a period of time has further contributed to this conservative attitude on the part of FRL.

One of the most significant characteristic features of the food processing industry is that it is predominantly controlled by foreign multi-national corporations (FMNC's). Historically speaking the foreign control in food business had taken place in three specific waves [Sargent, 985:138]. The first wave began with the FMNC's investing in the development of farming properties from the 1950's reaching a peak in the 1970's. The second wave from the 1960's was characterised by a tremendous growth in food processing. The third and the current wave (since 1970) has been in the growth of fast food outlets, McDonalds and Pizza Huts entering Australian markets from 1970. As the tables 7.3 and 7.4 shows, both in terms of corporate concentration (by shares) and market control in processed foods, the food processing industry is now dominated by FMNC's.

Four top companies account for about a 55% share of the total turnover for the thirteen major processed food companies, indicating the oligopolistic nature of control in the industry. (see table 7.3). Further, about 57% of the consumer market for the 27 major processed foods is controlled by the FMNC's. This percentage is much higher for items of mass consumption. For instance in breakfast cereals, baby food, milk additives, salad dressing, soups, chocolate, bread and soft drinks the
TABLE 7.3
MARKET EXPANSION & CORPORATE CONCENTRATION IN SOME FOOD PROCESSING INDUSTRIES.

Please see print copy for image

Source: Sargent, 1985 p.113

Notes: * Calculated from pre-tax turnover and adjusted for inflation
** The percentage decrease in the number of corporations.
*** Share of pre-tax turnover.
TABLE 7.4

THE EXTENT OF FOREIGN CONTROL IN MAJOR PROCESSED FOODS BY THE MULTINATIONAL CORPORATIONS IN AUSTRALIA.

<table>
<thead>
<tr>
<th>Processed food</th>
<th>Name of company</th>
<th>Nationality or country of origin</th>
<th>Estimated total market value in $A millions</th>
<th>% of control by the company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast cereals</td>
<td>Kellogs</td>
<td>USA</td>
<td>100</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>Nabisco</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sanitariam</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bread</td>
<td>Fielder-Gillespie</td>
<td>UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Associated British Foods</td>
<td>UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clifford Love &amp; Co.</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baby food cereals</td>
<td>Heinz</td>
<td>USA</td>
<td>N.A.</td>
<td>70%</td>
</tr>
<tr>
<td>Baby food, cans/bottles</td>
<td>Heinz</td>
<td>USA</td>
<td>27.5</td>
<td>72%</td>
</tr>
<tr>
<td>Milk additives</td>
<td>Nestle</td>
<td>Switzerland</td>
<td>48</td>
<td>68%</td>
</tr>
<tr>
<td></td>
<td>Cadbury</td>
<td>UK</td>
<td></td>
<td>13%</td>
</tr>
<tr>
<td>Coffee instant</td>
<td>Nestle</td>
<td>Switzerland</td>
<td>189</td>
<td>54%</td>
</tr>
<tr>
<td>Chocolate</td>
<td>Cadbury</td>
<td>UK</td>
<td>N.A.</td>
<td>60%</td>
</tr>
<tr>
<td>Confectionery</td>
<td>Cadbury</td>
<td>UK</td>
<td>888</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>Nestle</td>
<td>Switzerland</td>
<td></td>
<td>3%</td>
</tr>
<tr>
<td>Soft drinks</td>
<td>Coca Cola</td>
<td>USA</td>
<td>1999</td>
<td>43%</td>
</tr>
<tr>
<td></td>
<td>Cadbury</td>
<td>UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Schweppes</td>
<td>UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amtail</td>
<td>UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>Kraft</td>
<td>USA</td>
<td>306</td>
<td>45.5%</td>
</tr>
<tr>
<td>Salad Dressing</td>
<td>Kraft</td>
<td>USA</td>
<td>25</td>
<td>80%</td>
</tr>
<tr>
<td>Canned Soup</td>
<td>Heinz</td>
<td>USA</td>
<td>42.3</td>
<td>44%</td>
</tr>
<tr>
<td>Packet soup</td>
<td>Unilever</td>
<td>UK/Netherlands</td>
<td>29</td>
<td>71%</td>
</tr>
<tr>
<td>Product</td>
<td>Company</td>
<td>Origin</td>
<td>Quantity</td>
<td>Percent</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------</td>
<td>--------</td>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>Cake mix</td>
<td>Fielder</td>
<td>UK</td>
<td>12</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td>Gillespie</td>
<td>UK</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Margarine &amp; oils</td>
<td>Unilever</td>
<td>UK</td>
<td>357</td>
<td>40%</td>
</tr>
<tr>
<td>Baked Beans</td>
<td>Heinz</td>
<td>USA</td>
<td>30.8</td>
<td>53%</td>
</tr>
<tr>
<td>Fast food</td>
<td>McDonalds</td>
<td>USA</td>
<td>760-1200</td>
<td>44%</td>
</tr>
<tr>
<td></td>
<td>Kentucky</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pizza Hut</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biscuits</td>
<td>George Weston</td>
<td>UK</td>
<td>390</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Nabisco</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poultry Meat</td>
<td>Arntail</td>
<td>UK</td>
<td>600</td>
<td>25%</td>
</tr>
<tr>
<td>Snack foods</td>
<td>Arntail</td>
<td>UK</td>
<td>200</td>
<td>56%</td>
</tr>
<tr>
<td>Tomato sauce</td>
<td>Unilever</td>
<td>UK</td>
<td>26.3</td>
<td>36%</td>
</tr>
<tr>
<td></td>
<td>Heinz</td>
<td>USA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tea bags</td>
<td>Liptons</td>
<td>UK</td>
<td>58</td>
<td>49%</td>
</tr>
<tr>
<td>Tea leaf</td>
<td>Unilever</td>
<td>UK</td>
<td>54</td>
<td>55%</td>
</tr>
</tbody>
</table>

Note: This is only a list indicating some important processed foods for which data is available. Also see Sargent [1985], appendix C and Nankivell [1979]

Source: Sargent [1985] compiled and rearranged from the data presented by Sargent.
corresponding percentage of the market controlled by the FMNC's are 95%, 71%, 81%, 80%, 71%, 60%, 60% and 74% respectively. Given such a heavy penetration of FMNC's in the food processing industry, it will be worthwhile to examine what are the factors which undermine the local R & D potential generated by host institutions, particularly under the government science agencies such as FRL. Some relevant arguments presented for and against the FMNC's operation by the Foreign Investment Review Board (FIRB), Australia, are as follows:\(^{12}\)

<table>
<thead>
<tr>
<th>Against</th>
<th>For</th>
</tr>
</thead>
<tbody>
<tr>
<td>- may restrict competition and export performance</td>
<td>- may result in more managerial efficiency and new technology</td>
</tr>
<tr>
<td>- may be undesirable for R &amp; D in Australia</td>
<td>- may introduce new products or services for consumers</td>
</tr>
<tr>
<td>- danger that Australian technology is exploited by foreign agent.</td>
<td></td>
</tr>
</tbody>
</table>

As the FIRB arguments against the FMNC's goes, the dominant mode of control in the food processing industry by the FMNC's not only undermines the locally available R & D know-how, but in various ways pre-empts the indigenous R & D potential. As McG. McBean et al [1977:204] identify reasons for the gradual loss of contact by FRL with the food industry, "one of the most significant reasons was the growing influence of foreign-owned companies that import much of their research and technology", (incidentally McG. McBean was the leader of the Applied Food Science Group at the FRL). The payments for the import of know-how to overseas agents by the FMNC's in food processing is estimated at about $4 million in 1978-79 [Meddings, 1983]. However, such figure should be taken only as a conservative
estimate. [see Sanjay Lall, 1980, 1973]. Even so, the available figure of $4 million accounts for 57% of the total money spent by the whole of CSIRO's Division of Food Research in 1978-79. [which is $7 million, see Table 7.5]. In the same year the contribution from the food industry to the Division of Food Research accounts for a mere $9,600. Furthermore, even though the private food processing industry in Australia accounts for two-thirds of total R & D investment, as we shall see, the proportion of its investment in R & D compared to the turnover is very much less. For instance, in 1978 the turnover of food processing industry accounts for $12,545 million, whereas the percentage of R & D investment to the turnover stood at 0.13%.

Table 7.5

Australian and U.S. Food R & D Expenditure as a Proportion of Turnover

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Food R &amp; D expenditure by companies ($millions)</td>
<td>Australia</td>
<td>9.9</td>
<td>9.9</td>
</tr>
<tr>
<td></td>
<td>U.S.A.</td>
<td>269</td>
<td>323*</td>
</tr>
<tr>
<td>Food industry turnover ($millions)</td>
<td>Australia</td>
<td>6,820</td>
<td>9,652</td>
</tr>
<tr>
<td></td>
<td>U.S.A.</td>
<td>67,250</td>
<td>80,750</td>
</tr>
<tr>
<td>Proportion of R &amp; D to turnover (%)</td>
<td>Australia</td>
<td>0.15</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>U.S.A.</td>
<td>0.4</td>
<td>0.4</td>
</tr>
</tbody>
</table>

* Data for 1975.
Source: [Meddings, 1983:93]

The comparative figure for the U.S. food processing industry for the same year is 0.5%, (see Table 7.4). This data, though limited, gives a strong impression that the food processing industry which is dominantly controlled by the FMNC's, while
undermining the indigenous R & D potential, also exhibits very little or no interest in supporting public research institutions such as CSIRO, but favours the importation of foreign technology. In the light of the arguments proposed by the FIRB, there are aspects such as the level of know-how or technology in the food processing industry and other success related factors of the industry that are relevant to our discussion on the relationship between the FRL and the industry.

As the FIRB suggests, it is often argued that foreign multi-nationals are potential agents in the transfer of new technology. As far as the food processing know-how in the Australian context is concerned, even though the FMNC's do import new technologies to a large extent, there is no evidence to suggest that these technology transfer practices bring in new technology as such. The available evidence [see Sanjay Lall, 1982] indicates that the food processing industry controlled by big MNC's trades in terms of very 'low technology' and the innovation made by these companies is relatively 'trivial' as far as the basic properties of the food products are concerned. Further, innovation is concentrated in the development of products rather than processes. Therefore, what is imported as 'new technologies' may incorporate a large component of simple modifications and extensions of the existing product lines. Even though the global trade in food processing takes place with 'low technology' component, a necessary feature of FMNC's operation is that they exhibit reluctance to buy or draw know-how from local sources other than their parent or subsidiary companies. This is due to the fact that the importation of technology, whether it is of 'low' or 'high' technology type is a major source for FMNC's to repatriate profits by means of transfer pricing and other related practices [see Sanjay Lall, ibid]. The Australian situation may be a relevant case to the Sanjay Lall's point, wherein most of the FMNC's that operate here in food processing maintain R & D establishments in the countries of their origin. What is true about the 'low technology' argument about the MNC operation at a global scale has to be relevant for FMNC's operating in
Australia. Meddings [1983] in fact indicates that 60% R & D activities in the Australian private food processing industry involves modifications and extensions to the existing product and process lines.

The major reason for the 'low technology' level of R & D in food processing is due the fact that the success of the industry in its growth and corporate profits lies not so much on the generation of new knowledge about foods as in advertising coupled with the monopoly and oligopoly practices. These factors are borne out from the Australian case. The food advertising industry in Australia is estimated at $195 million a year which constitutes one-fifth of the total advertising industry [OECD Observer, September, 1980]. Compared to the expenses incurred on advertising the industry's investment in R & D on food as shown in table 7.5 accounts for a nominal sum of $9.9, $9.9, $16.1 millions in 1973-74, 1976-77, 1978-79 respectively. Further as table 7.3 shows, the practice of oligopoly is evident in major items of the food processing. Sargent [1985] shows that 1969 to 1980 was a period of rapid trends in the take-over business in food processing.

For the reasons which follow, there is a strong imperative on the part of FMNC's in Australia to conduct in house research. In the 1980's the government's scheme of 150% tax deductions for R & D investment by the manufacturing sector adds to this imperative. It is very strategic from the industry's point of view to undertake substantial research by itself because the success it achieves is also dependent on the extent to which it can control the process know-how, secrecy in recipes and formulae in food processing. Given these reasons, it is not surprising that the private food processing industry in Australia accounts for on an average 70.5% of the total R & D investment in food processing for the decade between 1969 and 1979, and the rest comes from government sources channeled through DFR (see Table 7.6).
TABLE 7.6

R & D in the Australian Food Industry by Performer.

<table>
<thead>
<tr>
<th>Year</th>
<th>Industry</th>
<th>%</th>
<th>Government</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sector</td>
</tr>
<tr>
<td>1968-69</td>
<td>5.8</td>
<td>77</td>
<td>1.7</td>
<td>23</td>
<td>7.5</td>
</tr>
<tr>
<td>1973-74</td>
<td>9.9</td>
<td>74</td>
<td>4.0</td>
<td>29</td>
<td>13.9</td>
</tr>
<tr>
<td>1976-77</td>
<td>9.9</td>
<td>61</td>
<td>6.2</td>
<td>39</td>
<td>16.1</td>
</tr>
<tr>
<td>1978-79</td>
<td>16.1</td>
<td>70</td>
<td>7.0</td>
<td>30</td>
<td>23.1</td>
</tr>
</tbody>
</table>

Note: figures $A millions

Source: [Meddings 1983:93]
These trends in the R & D investment by sector-wise (government vs. private) is at variance with the overall situation where about two-thirds of the total investment in R & D comes from the government sources.

It follows that the private food processing industry, by spending 70% of the total R & D funds together with its concomitant ability of ready access to know-how available at its overseas agencies suggests, the industry's self-dependent nature of operation. As pointed out earlier, there are also other imperatives which adds to this self-dependent nature. However, the research effort by the industry compared both to its turnover and the relative effort pursued by other countries such as the U.S.A. (see table 7.5) is very low. It is for this reason that Meddings [1983:94] - an industry representative suggests that the Australian industry, including the food industry, must buy in technology from overseas. What is also true, apart from the Meddings point, is the aspect of the intra-firm linkages between FMNC's and their parent agencies. That is, FMNC’s in food processing import technology not because the required technology cannot be developed (or is not available) locally, but because the importation of technology is an important feature of the transfer of profits through the practice of hidden transfer pricing. Australia pays in much more for technology payments than it receives from the sale of technology, including the food sector.

In the light of the above discussion, it is clear that while the food processing industry in Australia undertakes a substantial proportion of R & D compared to the government sector, it also has ready access to the know-how conducted by the parent organisations of Australian FMNC's in the U.S. and the U.K. On both counts the structure of the food industry that is dominantly controlled by the FMNC’s undermines the linkages between the FRL and the industry, and to a large extent pre-empts the R & D potential available at the local institutions such as FRL/CSIRO. As pointed out earlier, the factors which relate to these aspects are the importation of technology by FMNC’s, 'low' level technology and the perceived need felt by the
industry to become self-dependent for the know-how which is crucial for the control over markets. Furthermore, what appears to be essential from the profit motive aspect of the industry is the product diversification and multiplication with slight modification in the already existing know-how.

The nature of R & D work that is essential to the monopolistic and oligopolistic tendencies extant in the food industry (FMNC's) involves factors such as: protection of research results from open publication, maintenance of secrecy in food processing formulae and recipe, which in the ultimate analysis determine the market control of taste, flavour etc., over their competitors; and whatever research work is undertaken the industry necessarily subsumes the consumer and market oriented goals. These are the features of private food processing industry that remain antithetical to the CSIRO 'culture' based on scientific excellence and 'publish or perish' as we shall see in Section 7.3 and Chapter 8. From the FRL's scientist's point of view, the needs and demands of the food industry as above are considered as 'trivial' and by and large the opinion does not fit into their conception of 'scientific research' and 'science'. It appears that the lack of appreciation of industry's needs and demands both by FRL management and scientists accounts for the conservative trends inherent in the food industry for sponsoring research projects at FRL/CSIRO.

Three structural features of FRL's context delineated so far in the three preceding sections have served a dual purpose for this chapter. While the exploration in Sections 7.2.1 (Position of FRL in CSIRO system) and 7.2.2 (Food Research and Food Industry Interface) demonstrate the limitations imposed upon FRL's research activity relevance for secondary industry and a corresponding bias towards basic research, the Sections 7.2.1 and 7.2 (uneasy alliance) have demonstrated the ('ideological') underpinning of CSIRO's research 'culture', albeit, in an indirect manner. As we have observed towards the end of Section 7.2, in many unexpected ways the different phases in the uneasy alliance between science and politics in the
context of CSIRO have contributed to making CSIRO a unique scientific organisation, which has maintained a relatively independent relationship with the government on the basis of an autonomy worked on by its founding 'fathers'. What also comes out of Section 7.2 is that the scientific leadership of CSIRO was indeed successful, particularly, during its formative years in the 1930's and 1940's in preventing the organisation becoming aligned with political processes and goals. Sometimes the efforts of CSIRO's leadership and at other times the nature of approach taken by the government on science policies, the effects of action by both sides have resulted in the preservation of the autonomy in of the CSIRO. And Section 7.2.1 substantiates that the CSIRO's preoccupation with primary industry related research - in effect meant a preoccupation with basic research rather than applied research.

It is evident from Section 7.2 that the autonomy commanded by CSIRO through its long history was worked out by its founding 'fathers' as early as 1926 whilst the organisation was being set up. But, as we shall examine in the next section, the efforts and struggle waged by CSIRO's scientific leadership (David Rivett) in drawing an umbrella of substantial autonomy around the organisation's scientific research was not simply an end in itself. It was also a foundational means in David Rivett's view of science, its organisation, practice and evaluation which has come to be recognised as CSIRO's research 'culture'.[see Philip, 1978; and Ronayne, 1978,1979]. Following, then we find that the emphasis on basic or fundamental research in CSIRO that was earlier described as a part of CSIRO's preoccupation with primary industry, in fact has its origins from the CSIRO 'culture' the framework for which was set by David Rivett in 1926. Historically speaking, even though the need of the country has fortuitously coincided with the development of the primary industry, it was by all means a chance that the CSIRO's preoccupation with primary industry came about because it entailed the generation of basic scientific knowledge, which in fact was the policy guide line from the research 'culture'. As an almost
totally government funded scientific organisation, what is also unique about the
CSIRO 'culture' is that it is based on developing a scientific excellence in the
organisation and, as we shall see in the next section, this feature has a long historical
tradition in CSIRO. Although the notion of scientific excellence has been in vogue for
some time now in the literature, its reference to CSIRO very closely falls in line with
the explanation given by no less a historian of science than Gerald Holton [1979:231],
which is as follows:

"In scientific research, the scientist is usually motivated
and measured by the standards of 'pure' or 'basic' science
rather than public need. It is the product of a largely
autonomous, self-governing system, not directed by the
calculus of risk and benefits. If there are other affected
interests, most of these are placed at a distance, and the
scientists are insulated from them. The hope for social
utility as a by-product of one's discipline-oriented research
may be in the background. But the ruling motto is that
'truth must set its own agenda'".
7.3 CSIRO 'Culture': The Principle of Scientific Excellence in Administering Scientific Research with an Emphasis on Basic Research at CSIRO/FRL.

The role played out by Nehru in shaping the policies of scientific research in the Indian CSIR, that we have examined in Chapter 6, has a parallel to the Australian CSIRO. The person here is no other than David Rivett. The nature of influences exerted by David Rivett seem diametrically opposite to that of Nehru. David Rivett may be accredited with a similar status to Nehru, for the profound impact David Rivett had on setting the path for scientific development within the framework of certain principles that constitutes the research 'culture' of the organisation. In this section I shall trace the genesis of CSIRO 'culture' and seek to establish its continuing tradition in the context of FRL/CSIRO. While doing so, I shall also substantiate how the 'culture' that was set by David Rivett in 1920's became a principle both in the administration of scientific research and its evaluation over a period of time.

In 1926, by the time David Rivett was selected by the then Prime Minister Bruce as Chief Executive Officer of CSIR, he had a distinguished scientific career: first as a Rhodes scholar from Melbourne; three years of research at Oxford; friendship with Fellows of the Royal Society (later in 1941 he was chosen as a Fellow of the Royal Society); connection with the Nobel Institute in Stockholm; and as a Professor of Chemistry at the University of Melbourne. Given this background, it is not surprising that David Rivett on taking over the charge of Chief Executive Officer in 1926, set out to propose arrangements with the political leadership so as to acquire an independent status from the direct governmental interference into the organisation of research and the research policies of CSIR. This arrangement also resulted in acquiring a relatively considerable degree of freedom or autonomy for building the research organisation. In designing the role of the Executive and its relationship to the bench level scientist, as early as in April 1926, David Rivett set out to specify the
functions of the Executive as follows:

"not to act as scientific directors or judges of results; to determine, on the best available advice, what problems should be attacked; to find the best man to put in charge of the investigation of such problems; (and) to provide full opportunities to such men to solve their problems".

[Rohan Rivett, 1972:87]

Having laid the functions of the CSIR Executive as above, David Rivett set out to organise research on three basic principles. The first was that the best scientist chosen for a particular line of research should have absolute priority and all obstacles that might have come in the way of scientific research should be eliminated. The second principle was that when financial resources became limited, then demands for financial support should be subordinated to the support of scientists doing research. The third and most important principle was to assign unlimited 'trust', that is autonomy to the scientist. In a way David Rivett was a scientific 'puritan' in the sense that he placed scientific research (which he singularly interpreted as 'pure' research) above all alternative types of research. As Rohan Rivett observes, "he was basically a man of research, a seeker after truth. Only a superficial survey was needed to see that this scientific executive was going to become immersed in administration". Thus, basic to the principles of research organisation, what David Rivett set out to promote was scientific research that was unfettered by purely secondary industry oriented goals, towards the advancement of knowledge. In this respect David Rivett's views are clearly encapsulated in the following remarks made by him once advising a colleague:

"...(Your laboratory) will contribute to the knowledge the world wants and can use, rather than merely to the solution of the problem of the moment in the paddock down the
road. Yet, incidentally of course, the paddock problems will be cleared up......Whenever you want to shed the blinkers that would limit your view to the track favoured by our rulers.....you can be certain that I shall enjoy anything I can do in assisting the process of blinkers removal and the resulting bolt down the road-without-a-signpost!" [Rohan Rivett, 1972:177]

During the formative years of CSIR's establishment, its scientific leadership was fortunate to derive adequate support from the government despite the bias shown towards basic research. In fact the academic scientists were greatly concerned at the government's outright support for fundamental research in the CSIR and even resisted the creation of CSIR. In response to such criticisms coming from the university and pure research scientists, Prime Minister Bruce went on to convince them by proposing that the government appreciated the necessity of fundamental research and in this direction was desirous of helping and not hindering them. During the 1930's the government extended unilateral support to the leadership of CSIR, particularly David Rivett, who worked out with the government to draw substantial autonomy for CSIR to prevent its direct interference of government departments into CSIR. But such support by the government did not last very long.

As dealt with in previous sections, the question of CSIR's involvement in the secondary industry during the late 1930's and later the wartime the demands made on the CSIR greatly contributed to the change in government's attitude. Although the scientific leadership of CSIR was successful in preventing the organisation from being closely aligned with governmental instrumentalities before the war, it became inevitable for CSIR to compromise with the principles (CSIR 'culture') during the war. CSIR's 'handmaid' role both to the industry and the government, consummated in the wake of the wartime period, threatened to diffuse the 'culture' of CSIR after the war. It was this problem that David Rivett set out to eliminate. In a definition of
CSIR's stand given to the press, he stated:

"CSIR has definitely set itself against encouraging any industry, great or small, to farm out its day-to-day running problems. Admittedly and unfortunately, war has forced CSIR (and not CSIR alone) into evil ways; there was no option. But we are struggling hard and successfully to emerge from the position of general practitioner for minor woes". [Rohan Rivett, 1972:178]

In waging the struggle against CSIR's 'handmaid' role to secondary industry, David Rivett confronted his Chairman, Julius on the one hand and the political system on the other (refered to in Section 7.2.1). The conflict between Julius and David Rivett over the question of CSIR's involvement in secondary industry was neatly expressed by David Rivett himself during the war period in 1943.

"CSIR seems to me to be getting increasingly stiff in some of its joints. I find myself more and more out of line with Julius. He is tending towards the conversion....into a mob of testers for industry and I just hate it. If we are not careful our whole secondary industrial side will just become a mechanised crowd of housekeepers for factories".

Although Julius was close to the view that CSIR should undertake considerable work related to the secondary industry, it was David Rivett's views that mattered in the ultimate analysis. As Rohan Rivett [1972:90] quoting Vickery, points out, "Julius, while impressed with his own views was extremely susceptible to (David) Rivett's advice. He never pretended to be a scientist and generally accepted wholly ACDR's (David Rivett) representations on behalf of working scientists". (sic). Following this, we find that the 'culture' David Rivett set out to promote and for
which he consistently campaigning was a 'culture' in which the needs and demands of secondary industry played a very minor role in favour of a bias towards basic research. Even in the case of CSIR's pre-occupation with primary agriculture industry, CSIR had taken the view that the application of scientific results in the industry as a function of CSIR was limited to the extent of publishing knowledge and beyond that it was the job of the State Departments of Agriculture to see the research results applied to the industry [Rohan Rivett, 1972:177]. [see also Ronayne, 1978:372]. In this respect, as early as in 1927 David Rivett engineered an agreement with the State Agriculture Departments that resulted in the following conclusion:

"Investigations....which are of a more or less fundamental character and which are national in scope should be conducted by the Commonwealth, whilst problems of more or less local in character and which involve the application of existing knowledge should be undertaken by the State Departments of Agriculture".

[Currie and Graham, 1974:236]

Consequently, whilst the pre-occupation with primary industry was meant to emphasise basic or fundamental research, this pre-occupation also was meant to emphasise the publication of results. However, it may be pointed out that the emphasis on basic or fundamental research together with publication of scientific results did not emerge from the pre-occupation of CSIR's involvement with the primary agriculture industry but they directly came from the 'culture' set by David Rivett at the time of CSIRO's (as CSIR) establishment in 1926. As pointed out earlier, it was fortuitous that the primary agriculture industry in Australia from the 1920's to 1950's required basic scientific knowledge that was commensurate with the research 'culture' of CSIR. It is for this reason that David Rivett embraced the primary agriculture industry to the extent that CSIR's involvement with it would not in any way diffuse the principles set by him. This is clearly evident from the agreement
David Rivett sought with the State Departments. On the other hand, the secondary industry's requirements being antithetical to the CSIR 'culture', David Rivett's abhorrence to it clearly comes out from the public statements made by him. Even on the issue of publishing scientific results, David Rivett regarded the primary duty of scientists to be to explore nature and publish the findings. This was so important, that David Rivett regarded the restrictions imposed on making public the defence related information of CSIR's research involvement during the war as a "betrayal of principle" and more than that a "disruption of the purpose for which CSIR was founded".

In summary, then the important features of CSIR 'culture' that was set by David Rivett include: an independent relationship with the political system (structural relation as a base to the 'culture'); a deliberate effort by seeking throughout the world "the best man for the job" (norms and expectations), and offering him considerable autonomy (definition for living as a scientist - individual); a deliberate attempt to create appropriate organisational arrangements to fit the needs of researchers rather than the otherway (providing a social climate for living); the promotion of scientific research towards the advancement of knowledge; and publication of scientific results as the primary goal of researchers and as well as the function of CSIR. (meaning of research and its expectations).

Whilst the backbone of CSIR 'culture' was its autonomy, the essence of its function was certainly the building of scientific excellence in research. The manner in which this 'culture' has a long historical tradition on the basis of which scientific research is both administered and evaluated, also exhibits an important institutional function as a principle governing the conduct of scientific research.

Although autonomy was acquired by the scientific leadership of CSIR in 1926 with the willing co-operation of the political leadership, its continuity rested on the continuous struggle waged by David Rivett. As described in an earlier section,
after the war, a series of conflicts between David Rivett and the political system eventually led to the passing of the Science and Industry Act, 1949 that transformed CSIR into CSIRO. This Act in principle placed several management functions such as employment of scientists, under the subjection of the Public Service Board (PSB) regulations. The 1949 Act was a serious blow to the efforts expended by David Rivett in preserving the autonomy of CSIR until the late 1940's, on the basis of which, rested the 'culture' of CSIR. Even before the 1949 Act was passed by the parliament, David Rivett resigned from the Chairmanship of CSIR along with his Chief Executive Officer, Dr. A.E.V. Richardson. Dr. E.G. Bowen, the Chief of the Post-war Division of Radiophysics, CSIRO, had this to say on the retirement of David Rivett:

"In the 20 years I have been with CSIRO no one at the top level has since established such good contacts with ordinary members of staffs......The system in Australia which owes all its qualities to what (David) Rivett insisted upon from the outset is the best and most encouraging under which a scientist can work.....the system which now replaces it has obvious shortcomings. CSIR, as David Rivett established it and as I found it in the thirties, gave the best climate for research......." [Rohan Rivett, 1972:212]. (sic).

Contrary to David Rivett and Bowen's apprehension about the infringement of CSIR's autonomy when CSIR became CSIRO in 1949, CSIRO in fact did not undergo a major transformation as far as its 'culture' was concerned. As Fredrick White [1976:636], Chairman of CSIRO from 1959 to 1970 observes, "the 'powers and functions' of CSIR were transferred unchanged to CSIRO and the scientific programme continue as before". Commenting on the 1949 event, Ronayne [1978:371] points out that "CSIRO went from strength to strength, losing none of its real autonomy and is continuing to dominate the scientific research scene in Australia".
(my emphasis). [see also Peres, 1980; who shares similar view as Ronayne on CSIRO's autonomy].

Further, as dealt with in the previous section, the overall approach adopted by the Liberal government rested on the "policy for science", and the government, both in principle and practice remained hostile to any sort of interventionist policies for science. It was this political philosophy of the Liberal government and the ideological underpinning of the CSIRO 'culture' of maintaining an independent relationship with the political processes that were in alignment to each other. This political ideological alignment in many ways helped CSIRO maintain and preserve its research policy autonomy.

Throughout the post-1949 period up to the early 1980's the 'culture' of CSIR as set by David Rivett in 1926 received continuing emphasis by CSIRO's management. As a part of this continuing tradition, the 'culture' of CSIR was widely invoked as a principle to administer and as well as evaluate scientific research. If any changes that are evident, as we shall see, in the post-1949 period in the 'culture' of CSIR, these have come only to further reinforce it. A clear exposition of this continuing tradition is given by Gellespie [1964] who was commissioned as a member of a committee to report on the organisaton and management of CSIRO in the 1960's. The nature of the emphasis given to scientific research; the mode of selection adopted in the selection of research staff; the mode in promoting scientists or their advancement procedures followed; the importance of publications; and the policies towards industry (secondary) followed by CSIRO is systematically furnished by Gellespie which are as follows:

"In CSIRO scientific research is taken to mean the use of systematic study and of creative, intuitive, or original though and experiment to extend the available store of knowledge and understanding. It is a pioneering activity working at the frontier of knowledge and is always
concerned with the unknown".13

"The initial process of selection for a research career is...rigorous and extends over several years of advanced university training. This selection pressure is maintained both on appointment and in subsequent employment in CSIRO..... Every appointment is considered by the Executive in relation to the predetermined standard of excellence and it makes no appointment if an applicant of this standard does not appear.....All research positions are advertised, usually on a world-wide basis, and the terms of an advertisement are kept flexible both as to the level of appointment and the work to be undertaken".14

"Within the available salary structure the advancement and promotion of the research staff in CSIRO is based entirely upon personal scientific merit and achievement.....Merit advancement in CSIRO is aimed at securing for each individual research worker the rate of salary advancement and promotion which is appropriate to his scientific calibre and achievement, thus freeing him from any obligation to watch alternative avenues for advancement so that he may devote his whole attention to his own work......The research scientist is working in an intrinsically competitive world wherein each is striving to be the first to uncover new knowledge in his field. Any other form of competition as a basis for advancement is unnecessary and may be destructive if it diverts him from his main purpose".15

"The research scientist's professional standing depends upon the publication of the results of his research. To most research workers, therefore, freedom to publish their work in scientific journals of international standing is of paramount importance".16
"It is the policy of the Organisation to encourage industry and other appropriate organisations to undertake their own development work and consequently the proportion of this activity in CSIRO is comparatively small".¹⁷

Although these views expressed by Gellespie go back to the situation in the 1960's, they remain relevant up to the early 1980's. Fredrick White [1968, 1976]; Price [1976]; Philip [1978]; Philip's Report [1975]; Birch Report [1977] to a large extent; Ronayne [1978, 1979]; Peres [1980]; Macdonald [1983]; Johnston [1981], among others in their own ways reinforced Gellespie's version of the administration of scientific research in CSIRO. For example, J.R. Philip who was the Chairman of the Philip's Report and later who became Director of CSIRO's Institute of Physical Sciences, observes, "CSIR was reconstituted as the (CSIRO). This involved some institutional changes but there was a continuity of persons and of the 'culture' of the CSIR" [Philip, 1978:400].

One of the most important ways by which the principle of scientific excellence continues in CSIRO is the manner in which the promotion and advancement of researchers takes place. And it is in this area of research management that CSIRO has always given high importance to scientific merit based on publications in internationally reputed scientific journals. CSIRO in its submission to the Birch Committee clearly reinforces Gellespie's version on the way in which advancement and promotion of researchers in CSIRO takes place:

"Advancement and promotion of research scientists is based upon personal scientific merit and achievement. Salary level is personal to the individual and not related to the post. It is an important, if not most important, factor in the success of CSIRO as a national research organisation, and influences the motivation of CSIRO's research staff"

[CSIRO, 1976:11]
While the promotion of research scientists is based upon scientific merit, scientific merit as such to a very large extent depends on the professional standing, that is publication of results in reputable scientific journals. As Gellespie suggests, any other form of output would mean unnecessary for the basis of advancement or promotion. In this respect, Johnston's [1981] study advances further support. This study is based upon the publication and professional records of 141 CSIRO scientists whose cases for advancement or promotion were considered by the CSIRO executive in the mid-1970's. Johnston demonstrates that over 80% of the salary differentials - (salary level being related to personal scientific merit) - derives from the number of years of post-doctoral experience, highest qualification achieved, number of scientific papers and books published, and the number of internal reports and conference papers produced. Further, Johnston suggests that "crude proxies for social value of research, for example, number of patents had no significant differential effect on salaries". The fact that Johnston could not find the data to explain the relationship between salary differentials and practical usefulness of research also implies the lack of emphasis or the importance given to such activity by researchers. CSIRO places a heavy premium on publications and Johnston estimates that a scientist is rewarded by $125 increase in annual salary for each scientific publication. Perhaps, it is this high emphasis given by CSIRO on publications that has prompted Johnston to name his study as "Publish or Perish - The Financial Rewards of Publication for CSIRO Scientists". This major implication of such a "publish or perish" situation might also explain the orientation of CSIRO's scientists to concentrate on academic publications rather than communicating results with the potential users [see Jessop Report, 1979:181,182]. Somewhat similar conclusions were also reached by the Birch Committee [1977:130], that on the relevance of CSIRO's work for secondary industry observes, "the organisation's service has fallen short of what is needed and the links between many CSIRO Divisions and industry continue to be tenuous".
By the mid-Seventies, CSIRO was faced with increasing criticism coming both from government and public sources and was expected to provide justification for the relevance of its research to the proliferation of enquiries from the community and industry. For example, the Birch Committee Report of 1977, while holding the ongoing research activities of CSIRO in high esteem, made a number of crucial recommendations within CSIRO. These recommendations were expected to redirect a considerable proportion of CSIRO's research activity so as to make it relevant to the needs of industry and the community at large. In this respect as Macdonald [1983:292] points out, "the acceptance by the government of the bulk of recommendations made in the Birch Report has made little difference to the research activities of CSIRO". I shall advance further support on this score later in Chapter 8 in the case of FRL. In response to the Birch Report, Prime Minister Fraser in 1978 said:

"the committee of inquiry recognised that much of the success of CSIRO in the past can be attributed to the policy of leaving scientific decisions in the hands of scientists. The Government agrees with the inquiry that this policy should remain unchanged...."

In other words, both the Government and to a lesser extent the Birch Report provided an important legitimation to the continuing tradition of CSIRO 'culture'. Thus, even in the prevailing circumstances of mounting criticism over the 'elitist' image of CSIRO's research activities [see Macdonald, 1983; Australian Scientific Industry Association, 1983; and the views expressed by science policy analysts at a Public Affairs Conference (PAC) convened at the Australian National University, which was covered in the Australian, 29 June, 1983], Paul Wild, Chairman of CSIRO in 1983 said:
"Research is a product of the mind and CSIRO takes the view that creative science can only flourish in a suitable intellectual environment. In this regard, the organisation has been greatly assisted by the practice of successive governments on minimising bureaucratic influence on its activities".19

Thus, in all its ramifications CSIR 'culture' has a long historical tradition in CSIRO. Philip [1978:401] points out that this 'culture' of CSIR "persisted as ideals right through till 1975". However, in the light of Johnston's study and the discourse on CSIRO's criticism generated by science policy or social studies of science researchers (referred to earlier) who have been closely observing the developments in CSIRO, it may be said that the 'culture' was not disturbed until 1983. For example, the mode of promotion and advancement procedures followed by CSIRO did not undergo changes until 1983. In 1983 the CSIRO's Annual Report, reporting on the fresh guidelines promulgated by the Executive states:

"..a particular feature is the emphasis on the equivalence of fundamental research and technological research for industry for the purposes of promotion. Irrespective of the objectives of their programs of research, all research scientists in CSIRO have equal opportunities for advancement. Throughout the guidelines, the emphasis is on the scientist's achievement...The evidence of these qualities is not restricted to publications...

[CSIRO Annual Report, 1983:69]

Further evidence for the long standing 'culture' of CSIR may be found in the linear model of innovation. The tradition of CSIR 'culture' always implicitly assumed the acceptance of the validity of the linear model of innovation in scientific development [see Gibbons and Johnston, 1974; and Bell and Hill, 1977] - that basic
or fundamental research leads to applied and development research in a systematic fashion (with the consequence to produce change in the development of firms, industry and ultimately the economy). This was reinforced in 1983 by Paul Wild. Under the assumption of this model, because invention springs from fundamental research there is no obligation to proceed downward from the applied end of the spectrum. Paul Wild speaking at Public Affairs Conference in Canberra in 1983 stated, "CSIRO's research spans the spectrum of fundamental, strategic and tactical, with the greatest emphasis being placed on strategic research". (Strategic research is generally understood as oriented basic research in CSIRO). Paul Wild "strongly maintained that it was not the CSIRO's job to take innovations from initial development through to a commercial stage. [See Jane Ford, Australian, 29 June 1983]. In other words, technology transfer to secondary industry was indicated not as the business of CSIRO. CSIRO was indeed traditionally involved in this business for the primary agriculture industry, albeit, through the State Departments of Agriculture. Again on this score (transfer of technology to secondary industry), there was no change in the traditional conservative attitude from CSIRO until September, 1983 when it announced the establishment of SIROTECH Ltd. (henceforth identified as SIROTECH). (SIROTECH is somewhat an equivalent body to Britain's NRDC and India's NRDC established in 1950's to fill the gap between scientific research in national laboratories and industry). As the CSIRO Annual Report [1983/84:38] states, the main functions of SIROTECH are: "arranging for the development of CSIRO's research results to the stage where decisions on commercialisation can be made; facilitating the transfer of CSIRO research results to industry; assisting Divisions in identifying and undertaking research work of more immediate relevance to particular firms; and providing CSIRO with a patents and licensing service".

So far, we have been discussing the historical tradition of CSIRO 'culture' at a broader context of CSIRO. But we have not yet related this aspect to the case of
FRL - the focus of our case study. Given the integral position of FRL within the CSIRO system, the CSIRO 'culture' in many expected ways is reflected in the case of FRL.

7.3.1 The Case of FRL

Dr. Vickery the foundation Chief of FRL who guided the laboratory for 36 years was among the few CSIRO chiefs of Divisions selected by David Rivett. The extent to which Vickery derived inspiration from his Chairman, David Rivett in organising research at FRL is 'typified' from the description of Vickery as "Rivett's white haired boy: he never asked for more" [see McG. McBean et al., 1979:198]. The other person who greatly influenced Vickery is William Hardy [Director, Food Investigation Board (FIB) and Superintendent, Low Temperature Research Station, Cambridge (LTRS)] under whom Vickery underwent research training. Like David Rivett, Hardy "believed in scientific work in the spirit of pure inquiry and argued that the paradox of science is that the short cut to utility is to forget it". It was this motive on the basis of which Vickery set out to organise scientific research on food in the 1930's. Vickery's training under Hardy made him resort to the mode of expectations held by David Rivett. This was so, because there was no 'value' clash (in terms of the paths adopted to scientific development and the organisation of scientific research) between Hardy and David Rivett. As Bastian [1976:17] puts it, "Vickery always remained close to his research training under Hardy....in analysing his practical scientific problems in their most fundamental terms to that none of these early investigations were mere 'fence-mending exercises' of the sort that (David) Rivett deplored", (my emphasis) (sic).

For instance, the first success for Vickery's group (Vickery was the main research worker) in the mid-1930's came through the solution of a practical scientific problem that for the first time in the world made feasible the export of chilled meat.
covering a distance from Australia to Britain. It was indeed a scientific challenge that food scientists and the meat industry the world over deemed such an experiment as not feasible. However, even though the solution to the problem was based upon a simple process such as the addition of heavy concentrations of CO₂ which doubles the storage life of meat, this in fact resulted from interest in the fundamental problem of the relationship between water activity and the character and behaviour of micro-organisms in meat. It was this kind of fundamental research activity that Vickery sought to organise in building the laboratory. Despite the inauspicious impact of the Depression that inhibited the expansion of FRL in the 1930's, by the war time, Vickery had organised a small but a strong research group in fundamental research [Bastian, 1976:13].

As dealt with in Section 7.1 on the developments that took place during the war, Vickery's plans to expand basic research were foiled. The laboratory became a 'service' division to the government and the whole research process was directed to the development of products and processes for armed forces for about five years. At the conclusion of the war Vickery set out to restore and expand the research activities towards more fundamental and long-term investigations. Vickery brought out a detailed report on research policy for post-war expansion in 1947 titled "Statement on Nature and the Scope of Food Preservation Investigations in Australia". In discussing the balance between basic and applied research Vickery urged that, "if the Division is to maintain its leading position, a primary duty should be to make substantial contributions to the fund of scientific knowledge". Consequently, research was organised in terms of disciplinary oriented sections constituting physics, microbiology, plant physiology, chemistry and engineering. However, given the war time involvement with the food industry (ie, secondary industry) - when the work related to canning and drying of foods assumed considerable attention by the laboratory - it was not possible to withdraw "fingers which were put in every pie"
(food industry). Therefore, while Vickery sought to devote not less than one-half of the resources for fundamental or basic research activities, the industry related research efforts were expected to receive a substantial proportion of resources and attention. But, given the primary objective set by Vickery to promote basic studies in the laboratory as prescribed in Vickery's 1947 statement of policy, the post-war involvement of the laboratory with secondary industry meant a radical shift. This shift was from the direct involvement with food industry to more 'basic' studies on processed foods and related work [McG. McBean et.al, 1977:150]. This shift is evident from the developments that have taken place in the 1960's.

For example, the work of canning in the early 1950's entailed direct involvement in the industry such as solving problems arising from the introduction of electrolytic tinplate and epoxide can lacquers and studying the influence of variety and maturity of fruits and vegetables on canning quality. These activities were carried out in close association with the New South Wales State Department of Agriculture and the food industry. While E.G. Davis and P.W. Board were directly involved on canning work relevant to the industry, B.V. Chandler was involved in removing the bitter properties in naval orange juices. By the early 1960's in line with the move towards basic studies, Board shifted to study the electrochemistry of tinplate corrosion; Davis switched over to basic studies on flexible films related to the function that solution and diffusion play in overall permeability, and to changes in the physical structure of polymers in the presence of sulphur oxide; and Chandler moved on to basic studies on colour change in processed food. This shift in effect was however directly in line with the continuing traditions of CSIRO 'culture'. In the 1950's the CSIRO's Executive suggested that much of the research on canning should be shifted to the industry and even suggested the dissolution of the canning section to balance the financial shortages. Having built up a strong unit with persons and equipment resulting from the war period, Vickery was forced to justify the
continuation of all work related to direct contact with industry [see McG. McBean et al, 1977]. However, this justification was made within the overall ideology and philosophy of the CSIRO 'culture', that is clearly evident from the above examples of research projects. Here we can see the direct intrusion of CSIRO 'culture' on the FRL and the manner in which FRL's leadership responded by making legitimation in terms of 'culture' rather than food industry service - a reinforcement by directive of culture and disconnection from direct industrial relevance. Thus, we find that event hough some sort of balance between basic or fundamental research and applied research was maintained in the post-war period up to Vickery's retirement in 1967, the work related to applied research became increasingly transformed towards more basic studies. In all its ramifications, the policies adopted and the sort of emphasis given by Vickery to administer research at FRL up to 1967 reflects the CSIRO 'culture'. As referred to earlier at the beginning of the section, Hardy's ideas (Vickery's 'guru') were in no way different to the CSIRO's 'culture'. In an article written to a volume on Hardy's centenary tribute, Vickery [1967] himself revealed the path towards science organisation in FRL adopted by him:

"When I was given the opportunity to set up food research laboratories in Australia, Hardy's ideas were the basis of their organisation and have continued so ever since".

The character of research conducted by FRL in the post-war period is clearly summed up by the Committee of Review that was set up on Vickery's retirement. The committee was headed by V.G. Burley, Director of Cadbury Australia Pty. Ltd. and Chairman of the Tasmanian State Committee of CSIRO (henceforth identified as the Burley Committee). As the report of the Committee states:

"the present chief has set an extremely high standard for cooperative effort, and undoubtedly has laid the basis for
the continued eminence of the Division as a food science laboratory, both in Australia and internationally. Inevitably your Executive will be faced with the most difficult task in selecting a successor of satisfactory calibre to preserve the status and to advance the work of the Division....." (my emphasis).

Although the Burley Committee held the overall research conducted by the Division in high esteem for promoting scientific excellence, it was however critical of the existing balance between basic and industrially oriented research - (albeit in terms of 'basic studies') - that was set by Vickery. It was this balance that the Burley Committee sought to off-set by recommending that the Division should cease to play any important part in the immediate problems of the secondary food industry. In a personal letter to the CSIRO's Executive, Burley went on to deplore the nature of research conducted by researchers for industry as "too-problem oriented" and made several fundamental recommendations by which the Division was expected to strengthen its scientific eminence by the promotion basic or fundamental research. The gist of criticism made by Burley to CSIRO Executive is summarised by McG. McBean et al., [1977:197] as follows:

"that the DFP was a highly conservative Division and was too close to the immediate problems of the industry it served; it should move further and faster into basic scientific studies, shedding some of its ad hoc work on to industry. It should cease to be a Division of Food Preservation and should become a Division of Food Research - a development that would take it into a broader field and make it more akin to the 'subject' Division and less one of the so-called 'industry' Divisions".

In effect, the nature of the recommendations given by Burley's Committee were
directly in line with the continuing traditions of CSIRO 'culture'. On the other hand, it provided an important legitimization for the continuity of this culture. In 1970 the name of the Division was changed from The Division of Food Preservation to The Division of Food Research in accordance with Burley's recommendations. The new chief of the Division, Dr. M.V. Tracey, a Cambridge graduate who took over from Vickery expressed willingness to implement Burley's recommendations, and "determined to increase substantially the emphasis towards basic studies on long term research" [McG. McBean et al., 1977:199]. The extent to which Tracey reinforced the tradition of CSIRO 'culture' is clearly evident from his views expressed at the Council of Australian Food Technology Associations (CAFTA) conference, Canberra, in July 1978. With regard to the research effort pursued and the emphasis given to the type of research at DFR, Tracey said:

"The major effort and expenditure of the Division lies, however, in a field proper to a government research organisation and not to an industry research association. It is our prime role to uncover more and more knowledge of the properties and nature of foods from which can come the essential background expertise that is needed in the solution of short-term problems and from which can come really new advances in food science". [Tracey, 1978: 4]

Further, Tracey [1978: 1,2] considered the role of the laboratory (government supported) similar to that of a university department in that it's role was limited in research pursuits to the extent of discovering a new principle or method for its early development. Any further implications for scaling-up or even commercialising a research outcome that is worked on in the laboratory was considered by Tracey as the job of industry supported research associations. But unlike in India and Britain there are no research associations in Australia, except in those areas such as bread, wine
and sugar, which fall outside the ambit of DFR. Tracey's views both in principle and practice are clearly commensurate with the acceptance of the validity of the linear model in innovation by CSIRO as a whole, as dealt with in an earlier section. Another aspect of Tracey's views that clearly shows the operation of the principle of scientific excellence, is the way in which Tracey likened the role of the DFR with a university laboratory or department. As Tracey [1978:4] continues:

"In some aspects of ....... work we have a considerable advantage over the universities, in that we can undertake work that has no particular role to play in teaching which, because of its long term and sometimes intractable nature, is not suitable for training in research and which can continue undisturbed by changes in personnel for long periods. And second, I believe, equally important role is that of providing an everpresent standby for the solution of problems which cannot be clearly foreseen in any detail".

The views on the role of laboratory vis-a-vis the universities as reflected upon by Tracey were however in accordance with the tradition of CSIRO. From the beginning, it was the policy of CSIRO to encourage scientists to pursue research on as fundamental level as possible (see Section 7.3). As Ronayne [1978: 372] points out, it was a deliberate move on the part of CSIRO to encroach upon the traditional preserve of universities - what is generally regarded as pure or fundamental research. In this respect, it may be pointed out that Tracey was little influenced by the recommendations of the Birch Report [1979:xiii] which held that:

"Strategic mission-oriented scientific research is needed in Australia....It differs from university research...university work is directed to advancing the discipline...the role of CSIRO is to carry out scientific and technological research for the benefit of Australian industry and the Australian community".
While recommending the strategic mission-oriented research as the principle type of research to be undertaken by CSIRO laboratories, the Birch report however, did not rule out either the fundamental research or tactical problem-solving work from the references made to strategic mission-oriented research. While the Birch report did not attempt to define mission-oriented research in any considerable detail, the only distinction it offered between mission-oriented research - (as proper for CSIRO) - and uncommitted fundamental research - (as proper for universities) - is the intention with which research work is carried out. Further, while placing an emphasis on mission-oriented research, the Birch report [1977:xiii] went on to observe that "this is the type of work mainly pursued by CSIRO in the past". In effect, while the Birch report provided an important legitimation to the continuing traditions of CSIRO 'culture', its emphasis on 'mission-oriented research' became open to many interpretations. For example, the Officer-in-Charge (OIC) of FRL in 1983 observed:

"The interpretation of strategic mission orientation is different from one person to another. Even in this lab. the people in applied food science would argue that the Birch Report supported their nature of work. And people in the basic side, which is still mission oriented, would argue that it supported them". [From the interview with OIC, FRL]

Further, with regard to the nature of emphasis given to research activities in FRL in the light of the Birch Committee's notion of strategic mission-oriented research, the OIC continues to observe:

"I think work which has an aim, or goal in sight is applicable now, whether that goal can be achieved in one year, ten years or twenty years - it doesn't matter. It depends on what the proposal is and what the science
behind it is. So, for example, we have work going on in genetic engineering on tomatoes and on plant physiology. Now that might be five or ten years off. Now we're got work on the structure of membranes which might be thirty years off but still there is an aim in mind". [From the interview with OIC, FRL).

The emphasis given to fundamental research is clearly evident from the way in which the OIC of FRL makes it explicit that the time period of a research project hardly matters and what matters is the advancement of knowledge - the goal of science. The above remarks directly reinforce J.R. Philip's [1978:405] views on the way good research projects are undertaken.

"A significant, well-run, research project may require five years or more, a period often longer than the tenure of Ministers and indeed, than the duration of 'ideas in good currency' in society".

The emphasis given to basic research at FRL is however not unrelated to the premium placed on the publications in reputed scientific journals for the advancement and promotion of researchers. I shall advance further support on this subject in Chapter 8.
7.4 Summary and Conclusions

Just as in Chapter 6, this chapter has demonstrated how both the administration and the implementation of contemporary scientific research at FRL/CSIRO is structured by the laboratory's social and historical context. One of the major objectives of this thesis being a cross-cultural comparison, the selection of issues and the order in which they are presented in this chapter are influenced by the pattern followed in Chapter 6. Nevertheless the focus is laid on those factors that have had the fundamental influence in the shaping of FRL's research policies, practice and administration.

The social history of FRL presented in this chapter demonstrates a long standing bias towards basic research both in the administrative practices and in the conduct of scientific research. The increasing bias shown towards basic research is achieved despite equal emphasis prescribed to both the basic and mission-oriented types of research in the formal objective throughout the post-war period. What comes out of this case study is that the bias towards basic research is the product of a typical (typical because FRL/CSIRO being a scientific organisation totally funded by the government) 'culture' of CSIRO - of which FRL constitutes an integral part. The CSIRO 'culture' basically represents a set of principles which are specifically targetted towards the development of scientific excellence. It is evident that this 'culture' has in fact a long historical tradition in CSIRO going back to 1926 when it was set by CSIRO's (then CSIR) first Executive Officer - (and later Chairman) - David Rivett. Thus, this case study on FRL/CSIRO, and also Chapter 6 demonstrates the specific historic traditions scientific leaders set in scientific institutions and the consequences these traditions have for the subsequent growth, structure and function of scientific institutions.

While the essence of CSIRO's 'culture' lies in the meanings for research
that derive from a philosophy of developing scientific excellence, the basis on which this philosophy was implemented in CSIRO rested on the organisation's research policy autonomy. Right through its social history, CSIRO has been able to command substantial autonomy. But neither the 'culture' nor the autonomy on which it rested could have been possible without the efforts invested by David Rivett during the formative years of CSIRO. Equally important has been the social context within which FRL/CSIRO's growth has taken place over the years. That is, as this case study demonstrates there are three structural features of FRL/CSIRO's social context that have been conducive to the historic traditions of CSIRO 'culture'.

The first structural feature involves the 'uneasy alliance' between science and politics in the context of CSIRO. The notion of uneasy alliance was manifested in terms of two main phases. The first phase runs from 1926 to 1949. In this phase the leadership of CSIR, particularly, David Rivett played an important part in the fostering of an uneasy alliance between science and politics. This is evident from the way in which David Rivett made a constant struggle right from the inception of CSIR to prevent the organisation from getting tied-up with government policies and instrumentalities. For instance, during the late 1930's and early 1940's when government brought enormous pressures on CSIR to make it more oriented towards the development of manufacturing industry, David Rivett never allowed the organisation to become a 'handmaid' to industry with the exception of wartime exigency. David Rivett's uneasy orientation to accept governmental policies was so ingrained in the 'culture' that was set by him in 1926, that he even outrightly rejected complying with the post-war governmental requirements concerning the CSIR's involvement in war to be kept as classified information. The rejection of secrecy by David Rivett on the grounds that it has no part to play in science and the scientific affairs of CSIR may be related to the Mertonian 'norms' of science. David Rivett strongly held that the first duty of a scientist is to publish and any deviation from this
would mean a betrayal of principles - (of CSIRO 'culture') - for which CSIR stood. Being committed to these principles, David Rivett became involved in a series of conflicts with government departments over perceived threats to CSIR's autonomy from the mid-1940's to the late 1940's. In 1949 the government brought the 1949 Science and Industry Act into force that transformed CSIR into CSIRO. By this Act, the service conditions of CSIRO's employees were subjected to the regulations of the Public Service Board. This was a great blow to David Rivett's philosophy. Consequently, David Rivett resigned from the Chairmanship of CSIRO. On the whole the struggles waged by Davie Rivett in keeping the organisation in-tact from government encroachment resulted in the preservation of autonomy that made it possible to implement the principles underlying CSIRO's culture.'

The second phase of uneasy alliance runs from 1949 to early 1980's - a period notable for the long standing rule by the Liberal government. During the second phase the character of uneasy alliance underwent a change. For about two decades from 1949 the scientific community (represented by an elite) made recurrent demands for the establishment of some sort of science policy machinery. The dialogue between the scientific community and the government was clouded by misunderstandings. Whereas the scientists saw science policy machinery in terms of support for autonomous science, the government saw it as an interventionist policy. As a result of this contradiction and the lack of interest shown to science policy by the Liberal government, this reinforced the science autonomy of the CSIRO. But, the Liberal government consistently exhibited its unfavourable attitude to any sort of science policy machinery. The Liberal Government's approaches to science proceeded from "no policy in science" in the 1950's and 1960's to the "evolutionary science policy" in the 1970's and 1980's. To a large extent, science was regarded as an end in itself as implied by the approaches adopted by the Liberal government. Under the non-interventionist policies, science institutions were left relatively free
from government intervention. Contrary to the apprehensions about the loss of research policy autonomy as held by David Rivett in 1949, we find that CSIRO went from strength to strength in preserving its autonomy under the "evolutionary science policy" approach adopted by the Liberal government.

In its different phases, the uneasy alliance between science and politics in the context of CSIRO served an important basis for the preservation of CSIRO's research policy autonomy - which in turn reinforced the CSIRO 'culture'. From the mid-1970's although CSIRO was open to a profusion of enquiry committees set up by the government, these committees, particularly the Philip's report and the Birch report, have provided further legitimation for the continuing traditions of CSIRO 'culture'.

The second feature of FRL's structural context derives from its integral position in the CSIRO system and the broader context within which CSIRO operates. Under the CSIRO system, even though substantial autonomy is delegated to scientists working in the laboratories such as FRL, they however, remain subject to the broad goals and objectives of the laboratories constituted through a process of mutual agreement of decisions reached between the Executive of CSIRO and the laboratory leadership. That is, the implementation of autonomy by decentralisation in CSIRO is ensured by the alignment between CSIRO central and FRL's decentralised policy. Thus even when a legitimation crises arises, as we have seen in the case of canning research (see Section 7.3.1), the solution was in terms of CSIRO 'culture'. Efforts were made by the leadership of FRL (Vickery) to keep in-tact the canning research Section, but direct its research - more towards basic food sciences. Therefore, what FRL does and which type of research receives particular emphasis in the laboratory is also influenced by its larger organisation. As Section 7.2.1 demonstrates, there is a long tradition of CSIRO's main pre-occupation with the primary agriculture industry. The needs and requirements for the development of this industry depended on the
generation of new scientific knowledge and deep scientific investigations on agriculture related sciences, which commensurated with CSIRO 'culture'. Thus the pre-occupation with primary industry was not a problematic issue for the research policies enunciated by the leadership of CSIRO that placed heavy emphasis on basic research. On the other hand, the interests of manufacturing or secondary industry remained antithetical to the 'culture' of CSIRO. It is for this reason that research relevant to this industry played a very low key role in CSIRO policies right from the beginning. Thus we find that the conservative orientation shown towards the needs and demands of the secondary food industry and the increasing bias towards the basic research on food at FRL derives in part from its structural relation to its parent organisation - CSIRO. But CSIRO is not the only factor that influences the research conducted by FRL. Outside CSIRO, the very structure of private food processing industry has in many ways conditioned the activities of FRL - that draws our attention to the third structural feature.

The private foreign investment in food processing and agri-business and their control by the FMNC's has a long tradition in Australia. Section 7.2.2 demonstrates the extent to which the food processing industry in Australia is controlled by the FMNC's in the 1980's. There are a number of reasons that account for the conservative orientations of the FRL towards the food processing industry and vice-versa.

The food processing industry in Australia is to a large extent self-dependent for scientific and technological know-how. In terms of investment on food research, the industry accounts for ($16 million in 1978-79) more than twice the sum spent by the whole of the Division of Food Research ($7 million in 1978-79). Further, the food industry dominated by the FMNC's have a ready access to know-how available from overseas laboratories maintained by their parent companies. The food processing industry has a dominant marketing emphasis (context - 10,000 food products in the
market). The industry spent about 27 times the R & D expenditure of the Division of Food Research (note FRL is part of the Division) and about 12 times the R & D expenditure by the industry itself on food advertisements. The industry is not only self-dependent for the know-how needed by it, but is also reluctant to collaborate or sponsor research in local government science agencies such as FRL/CSIRO.

The way in which the food processing industry thrives in Australia is based upon the 'low' scientific and technological component in the processes and products needed by the industry. Moreover, the success of the industry is largely dependent upon factors such as: its economic ability to control the market through monopoly and oligopoly practices; advertising; the ability to safeguard the secrecy in food process and product formulations; and the extent to which the industry is able to introduce new products and processes in the market. These are the factors that make the industry quite disinterested in connection with FRL. What is also true is that the needs and demands of the food industry, particularly processes and products and the element of secrecy in food research know-how which is strategic to the industry, does not fit into the traditions of CSIRO 'culture' that have a direct bearing on the functioning of FRL. It is not surprising that the Chief of Division of Food Research J.H.B. Christian [1982:45] observed that "the food industry is notoriously conservative, largely because we, its customers are conservative". Christian's observation needs further explanation here. The food industry is conservative, but it is only conservative (in a very narrow sense in terms of sponsoring research to FRL), and not in its behaviour as such. As dealt with in Section 7.2.2, food processing is a dynamic sector of the manufacturing industry. Indeed it is the most dynamic sector because of the rapid rate at which it brings out 'new' processes and products in an effort to keep pace with the market. Thus what is also meaningful about Christian's observation is the fact that it demonstrates the legitimation of non-connectiveness of the FRL to the industry and the corresponding alignment with the traditions of CSIRO 'culture'.
These are the three structural features that have provided an important historical basis to the implementation of CSIRO 'culture' in FRL. One of the chief means by which this 'culture' was implemented in FRL was through the research policies followed by Dr. J.R. Vickery who was greatly inspired by David Rivett's philosophy of science organisation. As a head of FRL for 36 years from 1931 to 1967, Vickery followed the principles of CSIRO 'culture' set by David Rivett. After Vickery, consequent to the recommendations of the Burley committee, Tracey - the new chief of FRL, further reinforced the 'culture' of CSIRO. As the Section 7.3.1 demonstrates, the consequences of CSIRO 'culture' are clearly evident from the long standing bias shown towards basic and fundamental research both in the administration and the conduct of scientific research throughout the post-war social history of FRL up to the early 1980's.

Finally then, this chapter on the case study of FRL/CSIRO stands in direct contrast to CFTRI/CSIR that we have explored in Chapter 6. So far, in these two chapters we have been exploring the historic traditions in the research 'cultures' of scientific institutions. But we have not yet related these historic traditions either to the modes of organisational mechanisms that these have led to nor to the actual orientations of scientists and the character of research conducted by them. To establish this connection the next section will provide a broad comparative summary that will specifically focus on the ways in which the traditions of research cultures in the Indian and Australian laboratories presented so far stand in direct contrast.
7.5 Comparison between the Indian and Australian case studies

There are a number of general conclusions that can be drawn from the comparative analysis of CSIR/CFTRI and CSIRO/FRL's histories.

(i) Similarities in the origin, organisation and functions:

Both the scientific organisations - the Indian CSIR and the Australian CSIRO - have had their origins in the British model of DSIR. Both organisations have inherited the central features of DSIR's management and the organisation of scientific activities. These include:

a) the minister as political head with an understanding that the relations between science and politics will be governed by the Haldane 'Principle';

b) an advisory council and an executive council consisting of scientists, industrialists and academicians to advise the minister on various aspects of science policies that are likely to be implemented in the organisation; and finally,

c) a science organisation (such as DSIR) which whilst resting under the mediative control of state is under the direct control of a Head who is generally an eminent scientist. A key structural feature taken from the DSIR model also includes a central organisation entrusted with the responsibility to co-ordinate research undertaken by various constituent laboratories under the central organisation such as CSIR or CSIRO.

[SIR] in the title of these organisations signifies a fundamental function that these organisations are expected to perform and that is both the scientific and industrial research. CSIR (India) and CSIRO (Australia) began (and continue to function) with similar objectives and functions. These include: to undertake both basic and applied research - that is, to undertake research that is oriented towards both the advancement
of scientific knowledge and its application; and, through the research activities to aid
the development of, or the promotion of primary and secondary industries. Given the
position of CFTRI and FRL as an integral part of CSIR and CSIRO respectively, the
formal charter of objectives of these laboratories indicate the same functions as their
parent organisations.

(ii) National traditions in research 'cultures': Charismatic role of the founding
'fathers' in CSIR and CSIRO:

The two case studies on CFTRI/CSIR and FRL/CSIRO presented in
Chapters six and seven respectively, demonstrate how both scientific organisations
having originated from the same British model of DSIR, but have evolved two
different traditions in research 'cultures' over a period of time. The Indian case study
demonstrates the tradition of the utilitarian based research 'culture', where there is an
emphasis on the practical, industrial and commercial oriented values in scientific
research. The case study substantiates the long standing bias towards strong
mission-orientation (i.e., applied and development research) both in the administration
of scientific research and the conduct of research in the laboratory.

The Australian case study demonstrates the tradition of the CSIRO
'culture', where the emphasis is on the development of scientific excellence in
research. As a product of this 'culture', an increasing bias towards basic research is
evident both in the administration of scientific research and its evaluation. The way in
which the CSIRO 'culture' has governed the research activities of FRL for a long time
and the research policies espoused at CSIRO demonstrates its utility as a 'principle'.

Both these traditions in research cultures indicate two national scientific
cultures - national because the ways in which they are modified from the original
DSIR model, depicts the process of their development as a product of interaction with
their respective social and historical contexts. In that the role of leadership (both, the
scientifc as well as the political leadership), particularly, during the formative stages
in each case played a very influential part in the establishment of respective national scientific research traditions in the two organisations. Towards the development of the two traditions in research 'cultures', there are some notable parallels between the CFTRI/CSIR and FRL/CSIRO. The role of the founding 'fathers' in each case was indeed prophetic in the shaping of the research 'cultures' in the two organisations which became traditions over a period of time. However, the rationale was separate in each case. The charismatic, Nehru-based utilitarian were institutionalised in the planning of scientific research at CFTRI/CSIR which were biased towards the promotion of a strong mission-orientation in scientific research. On the other hand, the scientific charisma of David Rivett led to the institutionalisation of a reward system (in the FRL), which was based on the basic principles of CSIRO's 'culture' of scientific excellence in research.

(iii) Basis in research 'cultures':

In the Indian case the utilitarian based research 'culture' was set by Nehru, Prime Minister and (working) President of CSIR, on the basis of a close and an easy alliance initiated by him with the scientific leadership of CSIR (Bhatnagar). Nehru-based utilitarian policies and objectives of industrialisation, self-reliance, export promotion and import-substitution for CSIR were the product of Nehru's participation in India's freedom struggle (export promotion and import-substitution policies were developed after the independence). The scientific leadership of CSIR was greatly inspired by the charismatic leadership of Nehru that sustained and strengthened the close alliance between science and politics even after Nehru's death during Mrs. Gandhi's regime. But this alliance tied the CSIR closely with the political processes and from the beginning, the organisation became a vehicle of political expression for the implementation of Nehru-based policies in the CFTRI/CSIR. Thus the Haldane 'principle' was violated right from the beginning in the context of CSIR.

The CSIRO 'culture', in the Australian case, was set by David Rivett - the
first Executive Officer and later the Chairman of CSIRO (then CSIR) in 1926. In contrast to the case of the Indian CSIR, the establishment of the CSIRO 'culture' and the way it was reinforced from time to time is associated with the feature of uneasy alliance between science and politics (including scientific-political leadership). The feature of an uneasy alliance between science and politics served an important basis in drawing up an independent relationship with the political processes and the preservation of research policy autonomy in CSIRO. David Rivett-based policies in the development of scientific excellence in the CSIRO may also be related to his association with eminent scientific groups at Oxford, The Royal Society and the Nobel Institute, Stockholm, where he worked before taking the Executive Officer's position the the CSIRO. Although the "Haldane principle" in the Australian case escaped violation for a long period until the late 1970's, the way the CSIRO 'culture' governed the organisation shows the relation between science and politics as based on principles more than the prescriptions contained in the "Haldane principle". For example, David Rivett held that the organisation had no obligation in complying with the government regulations of keeping even the war related involvements of CSIRO as classified in the late 1940's. Philip's report in 1970's went on to argue that politics had no part what so ever to play in scientific organisations such as CSIRO.

Even though, David Rivett and Bhatnagar were both eminent scientists in their own right and both had academic research backgrounds, the research philosophies espoused by them were in contrast to each other. David Rivett believed in scientific research that is unfettered by 'external' controls or influences and was "a seeker after truth". Bhatnagar, on the other hand, embraced Nehru's vision and the instrumental role of science which was regarded as a key factor in social and economic development.

(iv) The issue of research policy autonomy:

In the Indian case, research policy autonomy was not a highly valuable
resource. As a part of a close alliance with political leadership, research policy autonomy was negotiated for gaining access to political power. Even though the arrangement of making the Directors/Director-Generals of all science agencies (including the CSIR) as Secretaries to the government promotes the "culture of obedience" which must necessarily yield to the "culture of critic" [see Rahman, 1975], the scientific 'elite' readily accepted it and in fact welcomed this arrangement. This is however not unrelated to the 'new caste system' of the urban white collar society. In India, the Indian Administrative Service (IAS) and the Indian Foreign Service (IFS) officers (top positions in the civil bureaucracy) will 'beat' any profession including the scientific profession, for the status, prestige, political power and the material benefits associated with the IAS and the IFS positions. Thus the arrangement of 'conferring' somewhat similar status to the 'elite' scientists (as Secretaries to government) was highly appreciated by them. It is a paradox that this does not obviate the loyalties of the 'elite' science groups to their larger international scientific community. In fact the scientific 'elite' (including the leadership of CFTRI/CSIR) have shown dual loyalties both to the world of scientific profession as well as to the world of politics. It is for this reason that there has not been a worthwhile controversy throughout the social history of CSIR on research policy autonomy.

In contrast to the Indian case, research policy autonomy was a highly valuable resource for the scientific leadership of FRL/CSIRO. Because the research policy autonomy was regarded as a valuable resource, it remained as non-negotiable entity. Throughout David Rivett's tenure, the major controversies between the government and the scientific affairs of CSIR(O) that involved David Rivett centered on the issue of research policy autonomy of the organisation, to a large extent. If anything that was negotiated between the scientific leadership of CSIRO and the political system, it was for the gaining of greater research policy autonomy for CSIRO. The extent to which the CSIRO enjoyed relatively, substantial research
policy autonomy was however not unrelated to the nature of approaches adopted by the Liberal government towards science organisation from 1949 to the 1980's. These approaches progressed from "no policy on science" to "the evolutionary science policy" of the Fraser government with non-interventionist stance on science organisations. The Australian case study clearly demonstrates the single loyalty of the scientific 'elite' to the international scientific community.

(v) **Basis of the implementation of research 'cultures':**

The main mechanism by which the Nehru based policies and objectives were implemented in CSIR was through the institutionalisation of an elaborate process of planning in science (see Section 8.2.1). At the national level, while India's planning system was developed on the basis of the Soviet model of planning, from the late 1960's the concept of planning in science at CSIR that co-opted the national goals and objectives for scientific research was worked out on the basis of Bernal's [1939] seminal work on "planning in science". The lack of interest shown by the leadership of CSIR for research policy autonomy in science may be partly related to this aspect. In many ways the concept of planning that was followed in CSIR reflects a kind of 'centralisation' in the decision making of science, because the areas of thrust for scientific research and the assignment of priorities to specific research projects in the laboratories were worked out at the top in the CSIR headquarters in conjunction with governmental bodies in planning.

In the Australian case, on the other hand, there was no such elaborate system of planning in science. Even though the individual laboratories such as FRL are subjected to the overall policies and objectives developed at the level of CSIRO's executive, substantial autonomy is delegated to the working scientists in the laboratories. Scientists are given substantial autonomy in the selection of research projects. The only principle that governed the researchers in the selection of research projects and the type of research products they were expected to bring out was the
principle of scientific excellence. Consequently, the reward system adopted by the FRL was based on this principle (see Section 8.3.2). In many ways, the 'model' on which scientific research is administered in the Australian case, closely resembles Polyani's model of the "Republic of Science".

(vi) Research directions:

As a product of the implementation of the utilitarian policies through the aid of planning in science mechanism at CFTRI/CSIR, the main preoccupations of the laboratory has been with the development of secondary industry. What this also meant was to direct scientific research by imposing demands on the working scientists to undertake those types of research projects which are likely to produce process or product oriented research results (see section 8.2). In this respect, the three major review committees that were set up by the President of CSIR have from time to time provided an important legitimation to the continuing traditions of Nehru-based utilitarian policies. Much of the scientific research at CFTRI is highly conditioned by India's social and economic problems in food together with the urban oriented secondary food industry. The private R & D in the Indian food industry accounts for a mere 16% of the total R & D in food and is therefore completely dependent on the CFTRI for industrial research on food.

In the Australian case, the scientific leadership of FRL/CSIRO never allowed the organisation to become a 'handmaid' to secondary industry. The main preoccupation of the organisation right from the beginning has been with the development of primary, agriculture industry. The preoccupation with the primary, agriculture industry in the Australian context was to do with the generation of new scientific knowledge and to undertake deep scientific investigations - characteristic of a basic type of research. The research policies in the CSIRO which were based on the CSIRO 'culture' were in no way in conflict with the above type of scientific investigations. Consequently, the FRL/CSIRO developed a strong conservative
attitude towards secondary industry. In the specific context of FRL, FRL's conservatism towards the secondary food industry is however not unrelated to the 'conservative' attitude on the part of industry (conservative only in sponsoring research at FRL). The secondary food industry is strongly controlled by the FMNC's and makes two times the investment in R & D compared to CSIRO's food research investment. Further, the FMNC's have ready access to their overseas R & D establishments maintained by their parent organisations. The 'self-dependant' nature of food the industry in know-how that is strategic to its success, undermined the linkages between the industry and the FRL.

(vii) Neighbourhood-effects: the relation with the universities:

Whereas CFTRI/CSIR is highly influenced by its 'neighbourhood' effects - be they from the specific socio-economic problems of the people or be they from the demands made by the secondary industry - the universities remained as a notable exception to this. Right from the beginning, Nehru based utilitarian policies for CSIR have in effect weakened and often inhibited a close collaboration with the universities. While applied and development research are regarded as the role-proper for CSIR, the fundamental or basic research is regarded as the role-proper for universities. The progression of review committees from 1940's to 1970's that were constituted by the President of CSIR have from time to time reinforced the above boundary between CSIR and the university system. The recommendations of the Second Review Committee (1954) that suggested a close relationship between the two is a deviant case: the Special Committee that was constituted over the Second Review Committee rendered it ineffectual by reversing the suggestion made by it. In the specific context of CFTRI, even though the laboratory had extensive collaborations with the United National University (UNU) and FAO in the training of students, the emphasis has been on the applied side of food research. An International Food Technology Training Centre (IFFTC) has been operative on the CFTRI campus from 1966 and it
trains students for a Master's degree in Food technology.

In the Australian case if there existed any boundaries, these boundaries were between the CSIRO system and the institutions concerned with industrial research and its application. (State Departments of Agriculture and the secondary, manufacturing industry). Unlike the Indian case, CSIRO right from the beginning encroached upon the traditional preserve of the universities - that is the emphasis on basic or fundamental research. Because of this feature, even though there existed tensions between the CSIRO and universities (mainly from the university side), both have had extensive collaborations. From 1966 two committees (Report by the CSIRO Advisory Council in 1966 and the Birch Report in 1976/77) have sought to eliminate the tension between the two research systems. The 1966 committee proposed the establishment of joint CSIRO-university research units and the location of CSIRO laboratories close to universities for sharing equipment, personnel and enhancing co-operation between the two. And the Birch committee's recommendations for the creation of "centres of excellence" as joint ventures between the CSIRO and universities further reinforced the close collaboration between the two systems of research. In the specific context of FRL, the laboratory had always maintained a close collaboration with the universities by establishing a couple of research units on university campuses. Currently FRL's Plant Physiology Group is located at the Macquarie University.

(viii) Traditions in wider culture:

The establishment and the growth of CFTRI/CSIR over the years have taken place in an atmosphere of India's specific social and economic problems. These concern rampant poverty, heavy dependence on the import of food grains (up to 1970's), lack of sufficient foreign exchange reserves, the political imposition of goals on industrialisation, export promotion, self-reliance etc., coupled with the impact of India's specific culture and religion related issues on food customs and practices.
Economically speaking, India's per capita GNP stands as one of the lowest in the world. Furthermore, the financial resources available for R & D in terms of per capita also stands as the lowest in the world. The only feature on which India ranks as top in the world is her population and its mass poverty. As the case study demonstrates all these problems in one way or another have at some stage influenced and conditioned the research activities of CFTRI in its social history. At every turn of events (when ever a specific problem such as shortage of foreign exchange, war, famine etc., cropped up) CSIR became a vehicle of political expression towards the solution of a problem.

In contrast, the development of food research in CSIRO was set in a context of economic wealth rather than poverty and starvation. Historically, Australia has been a rich country with a small population and abundant resources both economical and scientific. From the per capita ownership of housing, food level consumption to the per capita GNP, Australia ranks among the few top countries in the world. This is not to say that the country has been totally free of problems (economic). Whenever it had any such acute problems its 'luck' had come to the rescue. Referring to Donald Horne, Barry Jones [1985:108] observes "when the economy appeared to falter in the nineteenth century we found gold. When Australia faced invasion in 1942, the United States come to our rescue. In the 1950's we found oil and other minerals. In each case our luck changed. Because we were never traumatised, Australians did not have to face up to rigorous planning, to look ahead to future stages". Throughout the post-war period the export of primary industry (agriculture and mineral) products played an important part in Australia's welfare economy. There were no great pressures for the Liberal government to make the secondary (manufacturing) industry as the prime mover of economic development, particularly, by the use of science and technology. Science and technology did not play an important role in Australia's political agenda until the early 1980's [Barry
Jones, 1985:103]. As demonstrated in Section 7.2 under the long standing feature of an uneasy alliance between science and politics, the Liberal government remained hostile to any sort of interventionist policies in science, particularly in the case of CSIRO. On the whole the social context within which CSIRO's growth has taken place over the years has been very conducive to continuing the traditions of a CSIRO 'culture'.

7.6 Summary of Hypotheses

In the light of the theory discussed in the three chapters (Chapters 2, 3 and 4) and the comparison made on the two case studies, we have now reached a stage in the thesis where it is possible to draw together the analysis of the social and historic context of FRL and CFTRI with the earlier (chapter 4) - theory of scientist action and constitution of meaning into a series of hypotheses conveying what actually goes on within the laboratories. My intention in formulating these hypotheses should be pointed out clearly. These hypotheses provide short testable statements of the way in which key elements of the general theory presented in Chapter 4 can be expected to appear in data derived from the comparative case studies. In this sense, the hypotheses should be regarded as like outcroppings of a more hidden load of arc. The affirmation of single hypothesis is therefore for less important than the general substantiation, across a range of disparate hypotheses, of the overall picture, for it is this overall picture which best allows us to see where the general theory (or lode, in the above metaphor) applies to complex real-world situations. As some attempt to bridge the gaps between more holistic theory and its specific application, I have presented "general" hypotheses, and sub-hypotheses that (in most cases) can be derived from the general hypotheses and their application to the specific laboratory contexts. (This relationship is presented in Table 7.7)

The hypotheses are also numbered for future reference. I should stress
however, that in keeping with an interpretive sociological paradigm, the hypotheses should be seen primarily as devices for organising evidence and directing attention towards areas where support is critical to the overall theory. The hypotheses should not be seen in the narrower 'objective' scientific sense, as logically isolatable statements (from a general holistic picture) which are formulated a-priori, and subsequently tested in isolation from their place in an overall evolving and interpretive picture of social reality. The intention of presenting hypotheses is to help organise the interpretive account presented by this thesis.

As a step towards providing this 'organisation' of evidence, Table 7.7 also aligns the areas of data that have been collected in the study against the hypotheses to which they can be directly referred. The thesis returns to the hypotheses at the end of the empirical data Chapter 8, whilst the overall picture of theory that their substantiation depicts is presented in the Chapter 9 conclusions.

A. General Hypotheses:

H.1. The concept of professionalism as a type of social control in science is only one (among other sources) source of social control that may govern the action of scientists.

H.2. The goal orientations of scientists are subject to the social control of research activity which is constituted both by professional orientational reference groups (as agency of professionalism in science) as well as social reference groups.

H.3. In mission-oriented laboratories the extent of influence emanating from professional orientational and social reference groups, is highly mediated.
by the complex of laboratory's organisational structures/research 'cultures'/strategies. (Mechanisms and expectation in research administration).

H.4. The variation in the goal orientations of scientists in the two laboratories (CFTRI and FRL) is a product of the mediated versions of the interplay between different orientational and social reference groups.

H.5. The way in which laboratories mediate the influences coming from various reference groups is set within the laboratory's historic tradition of the research 'culture'.

H.6. The extent of influence emanating from the professional orientational and social reference groups may be expressed not only at the attitudinal level of the goal orientations of the scientists, but may also be expressed in the actual practice of their research activity.

H.7. What scientists say they do (as will be expressed in the questionnaire based responses) may vary from what the scientists actually do (as will be expressed in the products of their research activity). Variation between statement and practice is likely to reflect the construction of legitimation practices within the meaning of research.

H.8. In mission oriented laboratories, the goal orientations of scientists, the values attached to scientific research, its organisation and application are organisational specific* and more likely to vary across national and social contexts.
H.9. The similarities in the pattern of goal orientations of the scientists within the FRL and within the CFTRI, are likely to outnumber the differences in goal orientations within the separate institutions.

*Here this specifically refers to laboratories such as CFTRI and FRL within their national contexts, where, these laboratories form an integral part of their larger organisational contexts of CSIR and CSIRO respectively.

B. Hypotheses specifically oriented towards the comparison of CFTRI and FRL scientist's goal orientations.

H.10. The goal orientations of CFTRI scientists are likely to be more highly directed by the "utilitarian ethic" in research rather than "scientific excellence ethic" in research.  

10a. The goal orientations of the FRL scientists are likely to be more highly directed by the "scientific excellence ethic" in research rather than the "utilitarian ethic" in research.

H.11. CFTRI scientists are more likely to give importance to acquiring membership in laboratory based and industrial committees rather than in committees of professional bodies.

11a. FRL scientists are more likely to 'bracket' the importance of acquiring membership of laboratory based and industrial committees whilst placing importance on membership of professional bodies.
H.12. CFTRI scientists are more likely to place importance on organisational responsibility and the gaining of experience in science administration rather than being indifferent to administrative responsibility. 12a. FRL scientists are more likely to 'bracket' organisational responsibility and the acquisition of experience in science administration than to assign importance to administrative experience.

H.13. Both as a product of the laboratory's mediation and by the virtue of the scientist's socio-cultural context, CFTRI scientists are more likely to be subject to strong influences of social reference groups (political and socio-culture based groups) than the professional orientational reference groups. 13a. Both as a product of the laboratory's mediation and by the virtue of the scientist's socio-cultural context, FRL scientists are more likely to be subject to strong influences of the professional orientational reference groups rather than wider social reference groups.

H.14. In the context of the predominant influence exerted by social reference groups, professional orientational reference groups are unlikely to be insulated from the immediate social context of the laboratory environment. 14a. In the context of the predominant influence exerted by professional orientational reference groups, social reference groups are likely to be relatively insulated from the immediate context of the laboratory environment.
H.15. CFTRI scientists are more likely to be influenced by the maximum neighbourhood effect both in terms of its reference to the research activity as well as social organisation within the laboratory.

15a. FRL scientists are likely to be influenced only by the minimum neighbourhood effect both in terms of the research activity as well as social organisation within the laboratory.

H.16. Under the impact of the "utilitarian ethic", the goal orientations of the research projects and the productivity of CFTRI scientists are likely to be predominantly instrumental by virtue of their being highly directed towards the industry oriented values in research rather than the specialised scientific community.

16a. Under the impact of the "scientific excellence ethic", the goal orientations of the research projects and the productivity of FRL scientists are more likely to be directed towards the specialised scientific community rather than industry oriented values in research.
### TABLE 7.7

Hypotheses explored and the research material/variables used in the respective hypothesis.

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Reference to the variables/research material</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.1. Limitation of professional control.</td>
<td>Variables: 1, 2, 4, 6, 7, 12, 24, 35, 36, 42 to 47, 52, 64 vide Table 8.4; Chapter 3.</td>
</tr>
<tr>
<td>H.2. Reference group effects on goal orientations.</td>
<td>Variables: 1, 2, 3, 6, 9, 12, 17, 18, 19, 20, 7, 8, 10, 64, 22, 16, 24, vide Table 8.4; Section 4.4.</td>
</tr>
<tr>
<td>H.14 and H.14a Professional orientational and social reference group entry and insulations in the laboratory contexts (CFTRI and FRL)</td>
<td>Variables as per H.2; Chapters 6 and 7.</td>
</tr>
<tr>
<td>H.3. Reference group influences and laboratory mediations.</td>
<td>Chapters 6 and 7; Sections 8.2 and 8.3; Variables: 35, 36, 36, 42 to 46 vide Table 8.4.</td>
</tr>
</tbody>
</table>
H.10 and H.10 a.

Effect of laboratory's 'cultures' on the goal orientations of scientists in the CFTRI and FRL.

Variables: 1, 2, 3, 6, 9, 12, 17, 18, 19, 20, 7, 8, 10, 64, 22, 16, 24; Chapters 6 and 7.

H.11 and H. 11 a.

Goal orientations of CFTRI and FRL scientists towards acquiring membership in various committees.

Variables 17 to 20 vide Table 8.4.

H.12 and H. 12 a.

Goal orientations of CFTRI and FRL scientists towards organisational responsibility and science administration.

Variables 5, 14, and 21; interview data;

H.4. Impact of laboratory mediations and variations in the goal orientations of scientists in the CFTRI and FRL.

reference as per H.3.
H.13 and H13 a.

Laboratory mediations and the influences of various types of reference groups in the context of CFTRI and FRL.

Variables: 1, 2, 3, 6, 9, 12, 17, 18, 19, 20, 7, 8, 10, 64, 22, 16, 24; Chapters 6 and 7; Sections 8.2 and 8.3.

H.5.

Nature of laboratory mediations and its relation to the research 'cultures' extant in the laboratories. Reference as per H.3.

H. 15 and H 15 a

Neighbourhood effects on the research activity and the social organisation of scientists in the CFTRI and FRL.

Chapters 6 and 7; Variables as per - Table 8.22; interview and research projects data.

H.16 and H 16 a.

Effects of research 'cultures' on the research projects and the productivity of scientists in the context of CFTRI and FRL.

Interview data; and data on the research projects and the productivity of scientists vide Appendices 5 to 15; Chapters 6 and 7.
H.6 Influence of reference groups on the goal orientation of scientists at the attitudinal level vs actual research practice level. Variables: 1, 2, 3, 6, 9, 12, 17, 18, 19, 20, 7, 8, 10, 64, 22, 16, 24, vide Table 8.4; analysis on the goal orientations orientations of scientists via questionnaire based responses (Sections 8.4; 8.5) vs analysis of the actual orientations on research projects and the productivity of scientists. (Section 8.6).

H.7 Construction of legitimation practices of scientists in the CFTRI and FRL. Section 8.6; Chapters 6 and 7; and the analysis of interview data in Sections 8.6 and 8.7.

H.8 Social contexts of scientists in the two laboratory case studies and variation in the goal orientations of scientists and their research practices. Section 7.5; Section 8.6; and Section 8.7.

H.9 Similarities and differences in the pattern of the goal orientations of scientists. Sections 8.6; 8.7 and 8.8.

Note: see Section 7.6 under A and B for full description of the hypotheses.
Footnotes to Chapter 7

1. Initially David Rivett planned to establish the Food Research Institute in collaboration with the British Food Investigation Board (FIB) with Thomas Hardy (Director FIB) as Head. Hardy, not being prepared to take up the position, recommended Dr. J.R. Vickey for the job.

2. See Rohan Rivett [1972:111]

3. Now ARD is called Aeronautical Research Laboratories.

4. See Rohan Rivett [1972:200]

5. See Ronayne [1984:156]


7. See Philip's Report [1975:22, 23]


10. From the Abstract of a paper presented by Dr. J.P. Paul Wild, Chief, CSIRO, at the Public Affairs Conference, Australian National University, Canberra, June, 1983.


13. See Gillespie [1964:13,14]

14. ibid, pp.20,21

15. ibid, p.26

16. ibid, p.25

17. ibid, p.15

18. The quote is taken from Macdonald [1983:292]

19. As 10. above.

20. These scientists are singled out because all three scientists are the core members of Applied Food Science Group at FRL. It is in this Group that the impact of the research policies are of basic or fundamental research are easily evident, which reflects the CSIRO 'culture'. See also the criteria case of the Applied Food Science Group dealt in Section 8.6.
21. See MacG. McBean et. al. [1977:197]

22. It may be pointed out that SIROTECH Ltd. an equivalent body to NRDC, India, is established in 1983-84 period outside the scope of the present thesis. However, given the recent establishment it is too early to explore the relations between SIROTECH and CSIRO laboratories.

23. I have referred to the interview period in the Methodology chapter. For confidentiality the name and dates are withheld.