

The Ethnography of a Computer Music Research Institute:
Modernism, Post Modernism, and New Technology
in Contemporary Music Culture

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by

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Abstract

The thesis is a socio-cultural study of IRCAM, a large, state-funded computer music research institute in Paris directed by the avant garde composer Pierre Boulez. The approach is primarily ethnographic, supported by broader historical analysis. The aim is to provide a critical portrait of musical modernism and post modernism as expressed by IRCAM and its milieu; and to place this in historical perspective by combining anthropology with cultural history. Theoretically, the thesis examines the contradictory position of the contemporary musical avant garde: established in official cultural spheres, yet lacking wider public appeal and cultural influence. In this context, the central problem is how IRCAM continues to legitimise itself.

The thesis opens with a discussion of literature on the critical socio-cultural study of music, on the sociology of culture (especially the work of Bourdieu and Williams), and on the avant garde and modernism. Chapters 2 to 4 provide the basic account of the institution, including status distinctions, stratification, and power structures. Three local historical influences on IRCAM are outlined: the American computer music network, the French national context, and Boulez's history and ideas.

Chapters 5 to 8 analyse IRCAM's musical, scientific and technological work, examining the gaps between aims and actuality, ideology and practice. The character of IRCAM's dominant, 'dissident' and 'vanguard' projects are explored. The classification systems that structure the institute's internal conflicts and ideological differences are drawn out (Ch.6). Chapters 7 and 8 focus in on computer music production, and describe the mediations and phenomenology of this and related software research. One composer's visit is detailed, and the social and technological problems inherent in this work are analysed.

Chapter 9 provides an analysis of the main historical aesthetic traditions which inform IRCAM culture - modernism and post modernism - and develops an hypothesis of their discursive character and interrelation. This is related back to IRCAM culture, and throws light on the inter- and intra-subjective differentiation of IRCAM intellectuals, which in turn allows an analysis of mechanisms in the social construction of aesthetics and technology at IRCAM. The preceding analyses generate insight into the representation of modernism and post modernism within IRCAM.

The Conclusions describe major developments at IRCAM after fieldwork. The legitimation of IRCAM is linked to its institutional and ideological forms: particularly its processes of self-legitimation, resting on the discursive authority of its own internal vanguard, and the universalising character of advanced computer music discourse. Finally, there is consideration of IRCAM's place in long term cultural processes, and of the implications for theorising cultural reproduction and change.

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Chapter 1 Introduction

1.1 The problem and aims of the thesis

This thesis centres on an ethnographic study of IRCAM (*Institut de Recherche et Co-ordination Acoustique / Musique*). IRCAM is a state-funded computer music research and production institute in Paris, which opened in 1977. It was founded, and is directed, by the renowned conductor and avant garde composer Pierre Boulez. IRCAM embodies Boulez's ambitious vision for advancing the future of music, which can be sketched in quotes by him used in IRCAM publicity (Fig.1.1). The quotes indicate the basic aims of IRCAM: to bring music, science and technology into a new kind of collaborative dialogue, in order to produce research and technologies that will aid the progress of musical composition. The institute also houses a full concert season and educational programme; so that it incorporates both cultural production and reproduction. Boulez's vaulted rhetoric - with mention of utopia, global solutions, infinite possibilities - reveals his sense of IRCAM's historic mission. And indeed, IRCAM has a strong international reputation and a leading position in the fields of serious contemporary and computer music. It is the largest such dedicated music centre in the world, and a new departure in the institutionalisation of music.

The thesis employs the ethnography of IRCAM to make a detailed and critical investigation of the social and cultural character of the contemporary musical avant garde. It also examines the historical developments that lie behind this, at several levels. First, the national context of cultural politics within which IRCAM is situated; and then, the personal history and beliefs of Boulez, whose influence on IRCAM is profound. During the thesis, more local historical developments

Figure 1.1 Quotes by Boulez used in IRCAM publicity

"The creator's intuition alone is powerless to provide a comprehensive translation of musical invention. It is thus necessary for him to collaborate with the scientific research worker in order to envision the distant future, to imagine less personal, and thus broader, solutions."

"The musician must assimilate a certain scientific knowledge, making it an integral part of his creative imagination. As to the scientist, we are not of course asking him to compose, but to conceive with precision what the composer, or instrumentalist, expects of him, to understand the direction contemporary music has taken, and to orient his imagination along these lines. At educational meetings scientists and musicians will become familiar with one another's point of view and approach. In this way, we hope to forge a kind of common language that scarcely exists at present."

"Technology and the composer: collaboration between scientists and musicians.. is therefore a necessity which, seen from the outside, does not appear to be inevitable. An immediate reaction might be that musical invention can have no need of a corresponding technology; many representatives of the scientific world see nothing wrong with this and justify their apprehensions by the fact that artistic creation is specifically the domain of intuition, of the irrational. They doubt whether this utopian marriage of fire and water would be likely to produce anything valid..."

"Thus a virtual understanding of contemporary technology ought to form part of the musician's invention... Our grand design today, therefore, is to prepare the way for their integration and, through an increasingly pertinent dialogue, to reach a common language... Research / Invention, individual / collective, the multiple resources of this double dialectic are capable of engendering infinite possibilities. That invention is marked more particularly by the imprint of an individual goes without saying; we must still prevent this from involving us in humdrum, particular solutions which somehow remain the composer's personal property. What is absolutely necessary is that we should move towards global, generalisable solutions".

Note: All quotes by Pierre Boulez:

1 and 2 from IRCAM publicity document Jan. 1976,
3 and 4 from 'Technology and the Composer' (Boulez 1977), quoted in
publicity document c.1981.

within computer music are sketched as background to IRCAM's specific projects. Finally, late in the thesis, I characterise the cultural historical traditions of modernism and post modernism which in a deeper sense underlie IRCAM's ideology, its technological and aesthetic concerns. Although the intellectual culture of IRCAM appears predominantly modernist, it is not monolithic, and understanding it involves tracing conflicts and differences within the institute - differences that illuminate the character of post modernism at IRCAM. The historical analysis therefore feeds back into the ethnography, enabling an assessment of the institute's place in processes of cultural reproduction and change. In turn, the ethnography generates an analysis of modernism and post modernism in music as manifested by IRCAM culture.

The artistic avant garde is an historical concept that arose at around the same time as the transition in the mid-late 19th century from late romanticism to modernism in the arts. The early avant gardes were characterised by marginality, by harsh criticism and rejection of both the official art academies and the commercial art markets. They embraced uncompromising aesthetic innovation, based often on negation of the previous forms, and were oriented to the future, seeking to be ahead of their time. Their critical stance, and specifically their aesthetic critique, sometimes became associated with social and political radicalism, with utopian aspirations (1). However during the 20th century, and especially following World War Two, the position of the avant garde was transformed. Increasingly, the art of the early avant gardes became accepted by the academy, their shocking aesthetics established as dominant styles (2). From the late 1950's, there has also been a growing commercial market for the visual art of the modernist avant garde; while modernist visual techniques have become influential

in some areas of commercial design and popular culture (3).

But although modernist music, like the visual arts, became legitimised by the academy and established in subsidised spheres from the 1950's, it has, by contrast, failed to also find a larger public. The contemporary musical avant garde remains an elite form of high culture that must continuously legitimise itself in the absence of a large audience or commercial market. The musical avant garde thus appears to inhabit a contradiction. On the one hand, being no longer marginal and critical of the dominant order but itself established, it must justify and reproduce its present position of privileged subsidy, despite the lack of wider public acclaim or cultural influence. Yet on the other, it continues to promote the avant garde view of history in which the present state of things is denigrated in promise of greater things to come, of advancing the future of music.

The central problem of the thesis is how this contradiction is expressed in IRCAM culture; and the aim is, through the ethnography and history, to gain insight into the processes by which it is negotiated. The case study of IRCAM illuminates this problem well since IRCAM represents an extreme of legitimacy and subsidy in the contemporary musical world: it is a uniquely well subsidised, powerful and authoritative institution. Yet the thesis argues that, rather than an aberrant development, IRCAM is the logical outcome of certain converging historical processes and can be seen to epitomise contemporary musical modernism. The investigation of how IRCAM continually legitimises itself in order to reproduce its current dominant position, in the absence of great public or industrial success, and whilst at the same time enunciating avant garde ideology, is thus at the heart of the thesis.

A basic tenet of the thesis, applied in both the ethnography and

the history, is that IRCAM culture should be understood in relation to the broader musical and cultural field (4), including electronic music but also commercial and popular music and culture. The boundaries of IRCAM culture are thus outlined through tracing not only what is present, but also what is opposed, ignored, left undone, or what is implicitly absent (5). In addition, while the ethnographic material provides a detailed synchronic view of IRCAM's character and its forms of legitimation, the historical analysis attempts to show the importance of discursive continuity, of IRCAM's relation to the long term modernist tradition, for its legitimation. In this sense, I suggest that the character of IRCAM can be seen as overdetermined by modernist discourse (6); so that IRCAM's power and authority are intimately linked to those of this now highly legitimate cultural historical system.

1.2 Literature related to the research and theoretical framework

There is no one area of literature to which the thesis relates, and it integrates, and addresses gaps in, several related literatures. The framework is necessarily interdisciplinary. In providing an anthropological analysis of high cultural production and reproduction in an institution at the centre of the musical avant garde, the thesis is a departure in both anthropology and sociology.

The methodology and analytical approach of the thesis are anthropological. But the object is very unusual for anthropology, which has been little concerned with the study of complex society, and particularly with its powerful and intellectual groups and specialised cultural institutions (7). In general, there is little empirical social research on contemporary high culture and cultural institutions (8), nor on professional cultural production (9); nor, specifically, on these in

regard to serious music (10).

The dominant critical approach to the social analysis of art and culture has focused on the question of how an artistic text or cultural product can be shown to be ideological or to convey an ideological message. Such a text-centred approach has also occurred in relation to music (11). But there have been recent criticisms of this approach in the sociology of culture (12) and similar ones can be raised in relation to music (13). In short, the art-as-ideology perspective neither examines the practices, social and institutional character of cultural production, nor pays much attention to the aesthetic dimension. This has led to a call for increased critical examination of the institutions, social relations, practices and ideologies, and from this, of stratification, hierarchy and power, in specific areas of cultural production. In a basic sense, the approach in the thesis is informed by this critique and attempts to move beyond the limits of the text-centred, art-as-ideology perspective.

The literature review has three parts. The first, on social studies of music, provides the background for the approach taken in the ethnography. The second, on sociology of culture, provides a framework for analysing the character of subsidised high culture. The third addresses the question of the aesthetic, and more substantive literature on the avant garde and on contemporary composers.

1.2.1 Social studies of music: towards a critical ethnography of music as culture

Ethnomusicologists have long studied music as it is embedded in broader cultural processes and social relations (Merriam 1964), an approach central to the thesis. Interestingly, even from within

musicology, which has mainly produced internal, formalist and positivist studies that dissociate the musical from the socio-cultural, there are signs of increasing concern with the social and cultural context of music (14). But there are a variety of possible perspectives on this; and here I outline some recent developments in the critical socio-cultural analysis of music that influence the ethnographic body of the thesis.

Recent work by Laing (1985), Attali (1985), Durant (1984) and Leppert and McClary (1987) has broadened the scope from a narrow text-based approach. Notably, the studies by Attali, Durant and Leppert and McClary are also the first since Adorno's mid-century work (1973, 1984) to cover the total musical field by attempting sociological analysis of high music culture as well as popular music. Laing's study of punk music culture can exemplify the new broader approach. He examines the intricate mediations and associations of punk (15), employing two useful semiotic concepts: *multitextuality* - the analysis of meaning as operating through many simultaneous, juxtaposed and interrelating symbolic forms and practices; and *intertextuality* - the idea that meaning is created by signs referencing other cultural realms, through connotation and association. Laing expands the semiotic approach to music beyond text-centred approaches in three ways: by extending the semiotic frame to practices, social and institutional forms; by relating this 'internal' signification to wider, historical social and cultural forces; and by analysing the place of intertextual *bricolage* in the process of signification. He thus extends semiotics in the direction of theories of discourse, and produces a method that is applicable to ethnography.

Similarly, Attali's more speculative work on the particular forms

of power embodied in the institutions, ideologies and practices around music in different historical eras, demonstrates the fertility of the broader approach to music as culture. Both Attali, and Leppert and McClary, show the influence of Foucault in their analyses of power in relation to dominant discourses around music and their embodiment in institutional and social forms.

The approach in these studies converges with that proposed in recent ethnomusicology, such as that by Feld (1982, 1984) and Roseman (1984). Even though studying relatively 'egalitarian' non-western groups, both find it necessary to investigate the stratification and forms of power embodied in each musical culture. Feld derives from his research a methodology that he proposes as a general model for the socio-cultural analysis of music (16). His guidelines are useful, first, in emphasising the different levels of mediation around music - material environment, theories, practices, performances - thereby directing the ethnographer's attention towards the many social and cultural dimensions of music in a way similar to Laing; and second, in paying attention to stratification, power, and forms of mystification around music.

In different ways, then, the above writers focus on exploring the social relations, practices, ideologies, cultural associations, the technological and commodity forms that constitute the complex multitextual whole through which music is experienced and has meaning; and they contend that a critical social analysis should scrutinise the specific forms of stratification, power and ideology of each musical culture. This approach informs the bulk of the ethnography, especially the first half which interrogates the character of the total institutional division of labour supporting music production and

reproduction at IRCAM. This involves the analysis of the institute's status hierarchies, stratification, cultural mystification, its power structure and ideological conflicts. The second half of the thesis focuses in more closely on IRCAM's musical and scientific work, examining the gaps between rhetorical aims and actual practices, and the ideological differences between intellectuals on these key activities. The processes of computer music composition and related work are detailed, and close attention is given to the character of theoretical, textual and technological mediation in the work, in order to convey the problems and contradictions that arise.

The issue of intertextuality is central to the analysis of the rhetoric which imbues IRCAM's intellectual culture, in which constant scientific and computing analogies are the main forms of theorising and talking about music. Rather than accepting the self-evidence of these analogies, and of science as a metalanguage for music, the thesis deconstructs them. But doing so rests upon the following analysis of musical signification - an analysis similar to Feld and Roseman's views of the important role of metaphor in indigenous music theories (18).

The complex phenomenology of music-as-culture centres on musical sound and its particular form of signification. Musical sound in itself is alogogenic, completely unrelated to language, non-artefact, having no physical existence, and non-representational. That is, musical sound is a self-referential, aural abstraction. This bare core must be the start of any socio-cultural understanding of music, since only then can one build up an analysis of the social and cultural mediations around it (19). And it is this non-representational core of musical sound that makes it especially resistant to decoding as ideology, by contrast with

representational media (language, visual arts). We can clarify by extending Barthes' (1973) theory of signification to music. In Barthes' first, denotative order of signification, music contrasts with representational media since it cannot be said to denote anything other than its musical expressivity as part of a specific musical system. It calls to mind only its difference from other possible musical expressions within that aesthetic (20). This peculiar degree of self-referentiality is why musical sound may be considered a (relatively) empty sign.

It is at Barthes' second, connotative and mythic order of signification that, as Feld and Roseman agree, music becomes particularly subject to extra-musical meanings through its extraordinary evocative power. The signifieds that music connotes at this level are of many kinds: visual, sensual, emotional, intellectual - such as theories, domains of knowledge. All are metaphors that can combine into forms of discourse surrounding music. But the essential point is that the relation of these extra-musical connotations to music-as-signifier is arbitrary, cultural, historical, established by convention and in social practice; yet they are experienced as 'inherent in' or 'immanent to' the music by a process of projection of the connotations into the musical sound object. It is this process of projection that achieves what Barthes calls the 'naturalising' effect - the connotations appear to be natural and universal where they are cultural and conventional - and which therefore make this level of mediation particularly apt to be characterised as ideology. It is, then, the forms of talk, text and belief around music - the metaphors, rhetoric, the historical and philosophical theories explaining and constructing it - that can well be analysed as ideological.

Barthes sees denotation as providing an explicit, value-free, 'blameless' alibi for the deeper, implicit levels of ideological connotation. Paradoxically, in music, the lack of a denotative alibi does not have the effect of undermining naturalisation, but rather the opposite effect: connotation becomes even more transparently, 'naturally' and firmly attached to the music. This is borne out by the historical prevalence of universalising theories about music in two related but distinct domains. First, music has been particularly susceptible, in its treatment by music history and early sociology, to a kind of theoretical or ideological predetermination, as Allen (1962) demonstrates in his study of the character of music historiography (21). Second, music has throughout history been subject to two main forms of theorising: in relation to the emotions, and to mathematics and science. Both kinds of theory tend to provide universalising explanations of music, and to read these qualities as immanent to music (22). We can now understand better why, because of music's transparency as a form of signification, it offers little resistance to discursive 'invasion' and universalising ideology.

In summary, the above analysis indicates the need for attention to the character and arbitrariness of theory and metaphor in musical cultures, their role in strategies of authority, power and legitimation; and for analysis of their intertextual connections with other, non-musical realms of discourse, other areas of knowledge and practice - within IRCAM, the prevalence of scientific and technological mediating discourses around music.

The thesis, then, integrates these new approaches to the social study of music (23). Through the ethnography of IRCAM, the thesis attempts in the first place to provide a critical social and cultural

characterisation of this powerful sector of contemporary music. However social studies of music provide no substantive or general theoretical framework for analysing the broader socio-economic structures and institutional sphere within which IRCAM is located, that of subsidised high culture. For this, we must turn to the sociology of culture.

1.2.2 Sociology of culture: the character of high culture

There have recently been increasing calls from within sociology of culture and cultural studies for empirical research on the institutions and practices of cultural production (eg Wolff 1981, 1983, Bennett 1989). The writers that have touched on these issues, such as Wolff and Williams (1981), have produced abstract theoretical arguments that as yet lack engagement with the empirical complexities of contemporary culture. Equally rare in cultural and media studies are studies and theorisation of the public or subsidised sphere, since the majority of work has been on the commercial sector. But there are two exceptions: Williams (1981) and Bourdieu (1964, 1968, 1971a, 1979, 1981) provide analyses of the high cultural domain, and Bourdieu's is based on a rich body of empirical research on cultural institutions, cultural production and consumption. Both contribute a Weberian perspective to the predominantly Marxian tenor of sociology of culture. These writers can help, then, to construct a framework within which to understand the institutional character of IRCAM. The contributions are at two levels: the macro socio-economic, and the micro-social processes of 'legitimate' culture.

In terms of the macro socio-economic, Williams notes four linked, major tendencies in modern cultural production, that span the public and

market spheres: the development of privileged cultural institutions; the expansion of cultural bureaucracies; the increased scale of cultural production; and the development of international cultural flows (the prototype of which he sees as the rise of an international avant garde early in the century), and so of uneven cultural dominance and dependence. Williams thus broadens the analytic frame towards questions of centralisation, rationalisation, authority and legitimation. He also discusses the relation between market and public/subsidised sectors of culture. The public sector has tended to guard cultural legitimacy, the heritage, the classic works, the canon, but requires subsidy; it also supports and promotes avant garde work that is esoteric and lacks an immediate mass public. The market sector, on the other hand, seeks more direct economic reward and measures success in terms of large sales and audiences.

Bourdieu's sociology of culture rests upon his analysis of two general forms of power, which he also sees as underlying two key fractions of the dominant class: that based directly on economic power (economic capital), and that based on cultural authority and holding certain kinds of legitimate cultural and intellectual power (cultural capital). Bourdieu posits antagonistic yet complementary relations between these two general spheres and strategies of accumulation. This model informs his analysis of class-structured cultural consumption (1979), but also that of cultural production. The latter is exemplified by a paper on the publishing industry (1981) in which he also discusses the character of the avant garde (here within commerce). He traces an opposition within the publishing field between two industrial and institutional forms, as they map on to two literary aesthetics. The division of the field consists of the opposition whereby 'bourgeois art'

is produced by large integrated firms that seek short term commercial profits by selling both best-sellers and the dependable 'classics'; while 'avant garde art' is produced by small personal firms that accept risky, long term cultural investments with no market in the present. The short term cycle aims at rapid and sure returns, ie the accumulation of economic capital, while the long term cycle aims to accumulate cultural capital. Again, the two sectors are seen as antagonistic yet complementary (24), in that the accumulation of cultural capital is predicated on a refusal of economic success. The avant garde holds to "the ideal of intellectual negation, which demands refusal of temporal compromises and tends to establish a negative correlation between success and true artistic value" (1980: 284). Thus 'success', for the avant garde, is defined in terms of "material ascesis which guarantees spiritual consecration" (ibid). The paradox of the avant garde, then, is that it 'risks' eventually obtaining "substantial economic profit from the cultural capital originally accumulated through strategies based on the denial of the 'economy'" (ibid:286) (25).

Despite this analysis being based on fractions of the publishing industry, I suggest that it can be combined with Williams' above and re-interpreted as a general model of the relation between the two major sectors of cultural production, the commercial and the public, with the public/subsidised sphere embodying the realm of cultural capital. We will see that aspects of this analysis become useful in accounting, variously, for Boulez's ideology, the character of IRCAM, views of IRCAM's production cycle, and the mentality of some IRCAM workers.

Like Williams, Bourdieu continually stresses how, in the absence of validation through the market, legitimation becomes the prime force and

concern in the avant garde and public spheres. Both writers also observe a relation between cultural authority and a show of containing opposition and dissent (26). Bourdieu describes high culture as dominated by "a specific logic: competition for cultural legitimacy" (1971a:162-3). That competition is also functional complementarity, expressed in a system of oppositions between different positions within the field, such as differences of ideology, genre or style. Yet such oppositions of aesthetic and philosophy also delineate the unconscious boundaries of consensus. "The open conflict between tendencies and doctrines tends to mask, from the participants themselves, the underlying complicity which they presuppose and which strikes observers from outside the system. This complicity can be defined as a consensus within the dissensus which constitutes the objective unity of the intellectual field" (ibid:183). Bourdieu then distinguishes this kind of 'opposition', 'dissent-within-consensus', from the absolute differences that exist between cultural fields (27).

In terms of micro-sociology, Bourdieu outlines the following mechanisms in legitimate culture. He contrasts two kinds of cultural authority akin to Weber's distinction between the roles of priest and sorcerer/prophet. First, the legitimate, institutional authority of the teacher or curator, who is responsible for pedagogy, propaganda, devotion to tradition - essentially reproduction. Second, that of the creator with prophetic ambitions, whose authority is personal, and who must produce unique, unprecedented flashes of originality. Bourdieu links the creator role with futurism, the avant garde, and so with youth, asceticism, discontinuity, revolution. This view of the artist is almost of charismatic leadership: a theme I return to in relation to IRCAM.

Bourdieu also discusses the class structuring of cultural consumption (1968, 1979). He delineates two kinds of cultural disposition, resting upon the acquisition or absence/refusal of cultural and educational capital, and experienced as different kinds of enjoyment. For the 'cultured' classes, art competence rests on a sophisticated knowledge of the codes of representation, allowing them to savour questions of form, genre, school and so on; the pleasure is highly mediated, flowing from a mastery of the codes and readily articulated in exegeses and judgements. For the 'uncultured' classes, art perception involves naive, spontaneous, sensory and emotional gratification, baser denotative and connotative readings, and so unmediated pleasure which, Bourdieu says, is mistaken for the 'proper' decoding of the work.

We will see later how the above insights inform the ethnographic and historical analyses in the thesis. However, there are two major criticisms to make of Bourdieu's oeuvre and much extant sociology of culture (excluding Williams'). They fail to address or theorise the character of the aesthetic in particular instances of cultural production; and, relatedly, they remain synchronic and a-historical, ignoring the aesthetic and institutional antecedents and genealogy of the cultural field in question. To pursue these questions, I turn to more substantive work on the avant garde and contemporary composers.

1.2.3 Social and historical research on the avant garde, modernism and post modernism

There have been very few sociological studies of the avant garde, and far more studies in art, music and cultural history and criticism,

in aesthetics and philosophy. They range across a century of cultural phenomena, and commonly treat modernism and the avant garde as equivalent (28). In addition to the more orthodox art and music historical studies (29), they are of three kinds. Some are close to discursive analyses, in trying to distill and critically assess the main cultural characteristics of modernism or the avant garde (30); some are socio-historical, with insight into the social, economic, institutional, as well as cultural character of the movements (31); and some are more abstract aesthetic-philosophical and political discussions (32).

By contrast with studies on the visual arts, those on the musical avant garde have often ignored broader social, cultural and historical issues, and tend to remain internalist music histories centred on a genealogy of composers and their music. Thus in contributing to a broader socio-cultural reading of musical modernism and the avant garde, the thesis addresses an absence in the music literature. The aim is not only to look at musical modernism in a new way, but also to indicate the insights gained for general debates by focusing on a different medium - that is, music.

Two recent sociological studies of the avant garde give a sense of the uses and limits of sociological enquiry: one (Crane 1987) on post War American visual art, the other (Menger 1983) on the position of contemporary French serious composers. They depict contrasting scenarios for their respective avant gardes, and substantiate my earlier point that the situation of music and the visual arts is now quite different. Crane describes the 'transformation of the avant garde' in the four decades after World War Two. By the 1980's, she portrays the American art world as embracing cultural pluralism and fragmentation, a variety of co-existent world-views; and this is mirrored by a new socio-economic

diversity of patronage by government agencies and corporations. Crane concludes optimistically that the barriers between high and low culture are declining. By contrast, Menger depicts the situation of contemporary French composers as one of increasing isolation, the majority with small audiences for their serious work, no way of supporting themselves by this composition alone, and little chance of devoting their time to it. Most, he finds, are dependent on commercial work or teaching, above all on state grants, to support what they see as their serious work. In addition he charts an increasing state centralisation and control of French contemporary music, a process in which IRCAM is implicated, which leaves many composers without state support unless they subscribe to the musical ideology dominant in funding spheres at the time.

There are several comments on these studies, which provide new empirical material on, primarily, the socio-economic positions of the avant garde. They are highlighted by comparing the two. Although Menger gives a sympathetic reading of musicians' dilemmas, his study lacks distance from their concerns and fails to question the self-evidence of musicians' perceptions. He cannot ask why there is still such a very powerful subjective as well as institutional division between composers' serious and commercial work, while this is declining in the visual arts; nor why composers choose an aesthetic for their serious work which is unpopular, consigning them inevitably to a small audience and the need for subsidy. Nor can he trace the processes involved in a composer adopting the dominant musical ideology in order to become acceptable to state funding or institutions (such as IRCAM), and why some composers may do this while others fail or rebel. These questions require a more internal understanding of the culture of the musical avant garde. More

simply, due to their method both studies lack an internal view of the practices and ideologies, and so the lived character of the avant garde. Thus, they can neither trace the subtle differences between rhetoric and practice, aims and actuality, necessary for a critical appraisal; nor adequately address the central theoretical question raised by the earlier theoretical discussion of subsidised high culture - that is, how it continually legitimises itself. The thesis, by providing an internal view of the institutional culture of the musical avant garde, attempts to provide insight into these questions.

Finally, there is another absence in these studies shared with much sociology of culture: adequate theorisation of the aesthetic as a major component of artistic discourse. Although both studies give some attention to the aesthetic and discursive character of the contemporary avant garde, they do not analyse how these relate to the antecedent aesthetic traditions and longer term discursive developments which inform the present. They also, symptomatically, ignore much of the work and debate from art and cultural history cited earlier. The thesis suggests that it is only by a combined exploration of the contemporary character, and long term historical development, of the aesthetic and discourse of musical modernism that we gain insight into the dilemmas in which contemporary composers find themselves. The thesis thus attempts such an analysis, as follows. First, by examining IRCAM's aesthetic and philosophy through the ethnography. Then, in Ch.9, by relating this to longer term cultural processes through an analysis (based on secondary sources) of the main discursive and aesthetic characteristics of modernism and post modernism, in general and in music, as they develop from the early century. The history, then, has several aims. It traces the genealogy of IRCAM's aesthetic and philosophy, and so illuminates

whether IRCAM is basically continuous with or transformative of those traditions. It gives insight into the historical process of legitimation of the modernist aesthetic. Finally, it allows us to address major debates from the cultural historical literature mentioned earlier.

Finally, I will sketch two such recent areas of debate that pertain to the thesis. One concerns the supposedly critical or political character of the avant garde. There are three positions taken. First, the view that the politics of the modernist avant garde were always largely rhetorical and metaphorical, and limited to anarchic and libertarian gestures against the structures of official and bourgeois art (33). Second, the view that the avant garde was gradually depoliticised and has now become culturally dominant, so that any critical potential that it once had has now been irrevocably compromised (34). And third the view, articulated by Burger (1984), that modernism has become hegemonic, but that some historical avant garde movements were politicised and effectively critical of the social functions of art. (He cites futurism, constructivism, dada and surrealism). Burger thus distinguishes between aesthetic modernism and the avant garde, reserving the latter term exclusively for art that engages in critique of the social and institutional forms of art. From this, he is able to propose that a critical avant garde art is still a viable concept. With other writers, he proposes that this is the direction for post modern art: a renewal of the avant garde's critical potential (35).

The other debate arises from recent work by a few writers (36) on a question for long ignored by orthodox art and cultural history: that of the historical and contemporary interrelations between high and popular culture. Two writers, focusing more specifically on the relationship

between modernism and mass or popular culture (Crow 1983, Huyssen 1986), argue that the latter should be analysed as the 'other' of modernism. In this view, modernism can be characterised by its assertion of absolute difference from mass culture, expressed variously by ignoring that culture, hostility, but also in the occasional surfacing of fascination, envy and borrowing from the 'other' (37). This issue is also central to current debates about post modernism since the second common definition of post modernism is that it should involve an overcoming of the historical division between high and popular culture, a new cultural pluralism and heterogeneity in which those distinctions become obsolete (as Crane argued above). Indeed some writers assert that this has already happened, and see avant garde music as playing a key role in the process (Jameson 1984a) (38); while others (Frith and Horne 1987, Walker 1987) trace, from the other side, how some popular music has been greatly influenced by the historical avant garde. Interestingly, a version of this view of post modernism is also propounded in the editorial of the first issue of a new contemporary music journal - an issue devoted to 'musical thought at IRCAM' - by a British composer who has himself composed at IRCAM (Osborne 1984). The implication of his argument is to link IRCAM with such a form of post modernism. We will assess how accurate this is later in the thesis (see Ch.9).

I return to these debates, as they relate to IRCAM, modernism and post modernism, late in the thesis in Ch.9 and the Conclusions. But for now they raise substantive issues for the ethnography and history. First, the need to explore the presence or absence of a critical or political dimension towards the social and institutional forms of art; and second, the need to examine the relationship between high culture and mass or popular culture (an issue touched upon earlier in terms of

the importance of a broad comparative frame). Analysing these aspects of IRCAM culture will help us to place it in terms of current debates on the character of post modernism and its relation to modernism, and the continuing relevance of the concept of the avant garde.

To conclude, the thesis attempts to integrate the various levels of analysis outlined progressively in this literature review. To the synchronic analysis of IRCAM society and culture it brings the recent developments in a critical approach to music as culture, which are well served by ethnographic method. To gain a finer understanding of IRCAM's particular character as a privileged, western, high cultural institution, and so of its macro-sociological, institutional and internal cultural forms, the thesis draws upon the sociology of culture of Bourdieu and Williams. And to relate the analysis of IRCAM culture to more substantive issues and recent debates concerning the avant garde, modernism and post modernism, as well as to add a historical and discursive dimension of analysis, the thesis refers to studies from art, music and cultural history and criticism.

1.3 The methodology of the thesis

I first discuss the method of the ethnography and then, briefly, the historical research.

The bulk of the ethnography was conducted at IRCAM in Paris from January to November 1984, with a return visit for a month in April 1986. I also made several shorter visits: in May and September 1983, March 1985, and November 1987. After the fieldwork I interviewed certain key informants who had left IRCAM, and have continued to attend conferences and concerts related to IRCAM and its composers.

The fieldwork consisted of participant observation, recorded by note taking and tape recording. Informal conversation and long, semi-structured individual taped interviews were major sources of information. With a few responsive key informants serial interviews were possible, giving a running commentary on present events and filling in past events through oral history. Access to many meetings was possible, although the highest managerial meetings (of the IRCAM Artistic Committee) were closed to me. Meetings were exceptionally useful since they gave insight into rivalries, controversies and antagonisms within the institute. I attended concerts, public educational events such as seminars, and professional conferences hosted by IRCAM, and in this way partook in its broader public self and social events.

I began fieldwork by attending the six week educational course (the 'stage') on computer music run by IRCAM twice yearly for selected visiting composers and musicians. This provided an introduction to the field and its preoccupations, and gave insight into newcomers' reactions to IRCAM and to computer music.

As fieldwork progressed, I tried gradually to ally myself one after the other with different sections and subcultures within the institute. However, due to sympathies created by some relationships and the antipathy this may have engendered in others, and to the limited response of certain groups (especially the Administration and technicians), I was unable to become fully involved with all sections. I was then dependent on interviews, which seemed mainly open and frank, for insight into those groups.

My range of taped interviews did not aspire to scientific sampling, but nor did I abandon all attempts at representation. I interviewed a couple of people from each significant group within the institute: from

the postman, clerics and technicians, through the engineers and composers, to the managers and directors. For certain categories that I was particularly interested in (composers, tutors, software engineers), I interviewed as many members as I could. There are also a few tapes of meetings, discussions, pedagogic sessions, and of work in process; and about 15 hours of IRCAM related music. All in all, this provides some 130 tapes, or around 200 hours, of interview and other tape material. Appendix 1 gives a list of interview and other tapes, and information on their character and contents.

Regarding confidentiality, I have taken the following precautions in the thesis. For a few well known figures whose identities could not be protected, and for composers, writers and researchers whose identities should be acknowledged, I have given their real names in full at appropriate points in the thesis, including the tape list. But at other points, and throughout for the majority of informants, I have used substitute acronyms for their names to protect their identities (as for example in Appendix 4, the IRCAM Population). In Illustrations, I have tried to protect identities whenever possible by slightly masking the text.

My participation at IRCAM involved mainly 'hanging out' with groups and individuals at the institute, observing and being alongside their work, activities and exchanges, and attending meetings where I was welcome to. For some periods I was present for the normal office day; for others, given IRCAM's twenty-four hour operation, I stayed in the evenings, at night and weekends to accompany workers using these 'off' hours since they formed a rather different culture. Some informants became friends and companions for social activities outside the

institute. I became particularly friendly with some of IRCAM's young music intellectuals and visiting composers, but also with the computer Systems team. Thus fieldwork was not limited to the confines of the formal work setting, but involved some informal activities. This gave a view of contrasts and contradictions between subjects' formal and informal selves, especially their cultural allegiances beyond IRCAM.

I was known at IRCAM primarily as a graduate anthropologist come to study IRCAM's 'primitive tribe'. This conceit seemed to amuse intellectual informants, although it became clear that even they had difficulty in conceiving of what I might be doing. Some people also knew me as a musician, although of dubious lineage, since the music that I play professionally (experimental jazz, rock and pop, improvised music) does not command great respect in the dominant musical ideology of IRCAM. However, for some staff my musicianship was a positive asset and aided trust. Informants' different reactions to my musicianship, and their projections as to my musical identity, were therefore useful indicators of their musical tastes and ideologies. As a musician, I was sometimes invited to participate in musical research, in events and discussions. Thus during fieldwork I took part in two concerts and their rehearsals, and assisted superficially in three computer music and composition projects.

A major limit to the fieldwork was my lack of computer programming skills. When I first arrived at IRCAM I had never touched a computer. During the *stage* I began to use the computer music programs being taught, which involved following the dictates of their syntactic and conceptual processes. But I was far from adept at using them. This limited ability to use the already developed programs, with some difficulty, was as far as I got. It meant that rather than myself taking

part, I was only able to watch and, with some insight, question programmers on the processes of software research and development that are a major area of IRCAM's work.

As well as my observation and involvement, I had access to a great deal of IRCAM intellectual and administrative documentation: from scientific papers, to computer printouts of programs, daily memos and minutes of meetings (including those of the Artistic Committee from which I was excluded). These documents (even those supposedly for restricted view), and books and papers concerning IRCAM's field and related disciplines, were to be found lying around offices for all to read: a sign of IRCAM's culture of 'openness' and information sharing, as well as of office chaos. Other papers, including personal ones, were shown to me by friendly informants keen to aid the study or to prove a point. I received co-operation and openness from most areas of IRCAM.

Additional secondary sources on IRCAM and its culture that I draw upon include Menger (1983), works on Boulez (eg Heyworth 1973a, 1973b) and Boulez's own writings.

I have already, in previous sections, touched upon the aims and method of the historical research in the thesis. It is based on secondary sources from various relevant disciplines (cited in the previous section); and through it I attempt to build up several levels of historical background and context (the French national context, Boulez's personal history, the history of computer music and of IRCAM's dominant music research concerns, and finally the development of modernism) through which to understand the culture and character of IRCAM. In turn, the ethnography feeds back into an analysis of long term historical processes.

1.4 Outline of the thesis

The thesis contains ten chapters. The next, Chapter 2, provides an introduction to IRCAM as an institution: its physical character, administration, economics, organisation and population. It also outlines three key historical influences on the character of IRCAM: first, its American computer music network; second, the French national context of cultural politics, contemporary music and music policy; and third, Boulez's personal history and ideology. (The last two are covered more fully in Appendices 5 and 6). We see that IRCAM represents an unprecedented centralisation and rationalisation of resources for contemporary music, and that Boulez's cultural political career has played a great part in this outcome. We also gain a view of Boulez's founding vision of IRCAM.

The following four chapters, 3 to 6, give the basic account of IRCAM society and culture. Chapters 3 and 4 examine IRCAM's institutional division of labour, its stratification, its hierarchical status differences and their relation to variable degrees of cultural mystification (all Ch.3), its power structure, employment conflicts, and the character of workers' politics (Ch.4). We find a division between two spheres of unequal status, centred on production and reproduction, that parallels the institute's sexual division of labour; and also accords with workers' different cultural dispositions, and specifically their attitudes towards contemporary music. Status differences also parallel the stratification of workers, with one exception: a group of young music intellectuals with high status who gain little economic reward. The institute has dual power structures: a bureaucratic one for lower workers, while higher workers inhabit a charismatic economy

centred on Boulez in which they vie for advancement. The institutional politics of lower and higher status workers follow from their involvement in these different forms of power. IRCAM intellectuals exhibit two notable absences of political concern: of the politics of organised labour, and those of high technology.

Chapters 5 and 6 outline the ideologies behind the main activities and projects, musical, technological and scientific. We begin to scrutinise the gaps between aims and actuality, ideology and practice, and to see the character of 'dissident' and 'vanguard' projects within IRCAM. All of this creates an initial portrait of the total institution supporting cultural production, and of the classification systems that structure its internal conflicts and ideological differences (Ch.6).

The next chapters, 7 and 8, which focus around one composer's production visit to IRCAM, explore in greater detail the complex character of IRCAM's musical, scientific and technological work through detailed examination of the work process of computer music composition and related software research and development. This is amplified by consideration of the many levels of mediation in this work process: rhetorical and theoretical, textual, mechanical, temporal and social. This conveys the particular socio-cultural and phenomenological experience of composition and related work at IRCAM. The chapters end by drawing out an analysis of the social and technological problems inherent in this work.

The previous chapters provide a portrait of IRCAM as an institution, and of its intellectual culture. However, a fuller understanding of IRCAM's intellectual culture requires an historical analysis of the main aesthetic traditions by which it is informed. The first half of Chapter 9 provides such an analysis. It centres on a

discursive characterisation of modernism and post modernism, in general and in music, thus sketching salient features of those traditions which are then - in the second half of the chapter - related back to key aspects of IRCAM culture. The second half focuses especially on the differentiation of IRCAM culture in relation to its two main areas of work: the musical-aesthetic, and the technological. There is an analysis of the inter-subjective and intra-subjective differentiation of IRCAM intellectuals on both, from which I draw out mechanisms in the social construction of aesthetics and technology at IRCAM. Finally, the preceding analyses in turn generate insight into the representation of modernism and post modernism within IRCAM.

Chapter 10, the Conclusions, describes some key developments at IRCAM in the period after fieldwork that pertain to the prior analyses. The arguments made in the thesis are brought to bear on the central problem raised earlier this chapter, ie how IRCAM legitimises itself; and there is closer discussion of advanced computer music discourse, within IRCAM and more generally, and its ideological forms. Finally, there is a consideration of IRCAM's place in long term cultural processes; and a discussion of the implications of the analysis for theorising cultural reproduction and change.

Chapter 2 Introduction to IRCAM: its institutional character, national and international context, and history

This chapter provides a basic introduction to IRCAM, its history and its national and international milieu. The first part of the chapter outlines the institute's location and physical character, the phases of its history, the key events of 1984 (the ethnographic present), its administration, economics, organisation, population and employment. The second part examines three dimensions of IRCAM's conditions of existence: first, its main international links, to the American computer music scene; second, the national context and background - aspects of French culture, cultural policy and contemporary music; and third, Boulez's personal history and intellectual vision.

2.1 Introduction to IRCAM

2.1.1 IRCAM's location and physical character

IRCAM is physically unusual: the main building lies underground on four descending levels below the Place Stravinsky, next to the Centre Georges Pompidou (CGP), the new National Museum of Modern Art. Thus compared to the CGP's large, modern, coloured steel and glass building which stands out on the landscape, IRCAM's existence is extremely discreet. Both are located on the Plateau Beaubourg, midway between the old Jewish quarter of Paris, the Marais, to the east, and the recently redeveloped commercial area of Les Halles to the west. To the south, bordering the River Seine, lies the Place Chatelet with its two major national theatres: Theatre Chatelet and Theatre de la Ville. This is heart of cultural and commercial Paris.

In 1984 IRCAM had two buildings, one old and one new. The old

building is a red brick ex-schoolhouse overlooking the Tinguely sculptures in the Place Stravinsky (Photo 2.1). Photos 2.1-4 convey the process of approaching IRCAM from the Place, ending in the entrance: a long, almost anonymous descending flight of stairs. The new underground building, designed by Richard Rogers (1) - the same architect as the CGP - is architecturally modernist. It is built of concrete, steel and glass, the interior functional and bare with muted, drab colours and few concessions to decoration and comfort. The entrance stairs end in a glass wall containing an automatic sliding door. Inside, the reception area is flanked by an electronic security system (Photos 2.5-6). The old and new buildings are linked by an underground walkway. Like all high technology centres, because of the need to keep its computers continually on and make the most of resources, IRCAM operates twenty-four hours a day. Although the public can wander in during the day, they are not encouraged to move around freely; and outside office hours IRCAM is closed to all except staff and those with security permits. At these times, security is rigorously enforced by uniformed guards. IRCAM thus has more the look of a scientific research institute than that of a music or performance centre.

The old building contains the IRCAM Administration, some small studios for visiting composers, teaching and meeting rooms used for the stage, an electronic studio used mainly for analog tape work, the IRCAM library, and stores. The majority of technological, scientific and musical work, and performances, take place on the four levels of the new building. The lowest floor, level -4, contains IRCAM's unique and flexible performance space, the *Espace de Projection* ('Esp Pro', discussed in Ch.5). Photo 2.8 shows the stairs down to the Esp Pro from

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the next floor up. Level -3 contains mainly the Esp Pro technicians areas, including the recording studio from which Esp Pro performances are recorded; and the mechanic's workshop. Level -2, the floor on which one enters IRCAM, is the busiest. It contains the reception area, a room with a coffee machine (the main place for informal congregation), a long row of glass-walled offices (Photos 2.5-7) for secretaries, technicians and researchers, and the main seminar room. Hidden behind the offices are open-plan technicians areas and the host computer room (Photos 2.9-10); and hidden behind these are a row of soundproofed computer, electronic and recording studios. In addition, the acoustics research area and a special anechoic chamber are found here. Finally, Level -1 consists of another row of glass-walled offices, right above those on Level -2 and joined to them by spiral staircases (Photos 2.11-12); but these are for higher status staff. Boulez and other executives and their assistants, project directors and some researchers have their offices here. Higher executives have offices to themselves, while most researchers and secretaries share two or three to a room. Photos 2.13-15 give inside views of researchers' offices, most of which contain computer terminals and perhaps other electronic equipment, shelves of books, wipeboards with scribbled calculations, and desks strewn chaotically with papers.

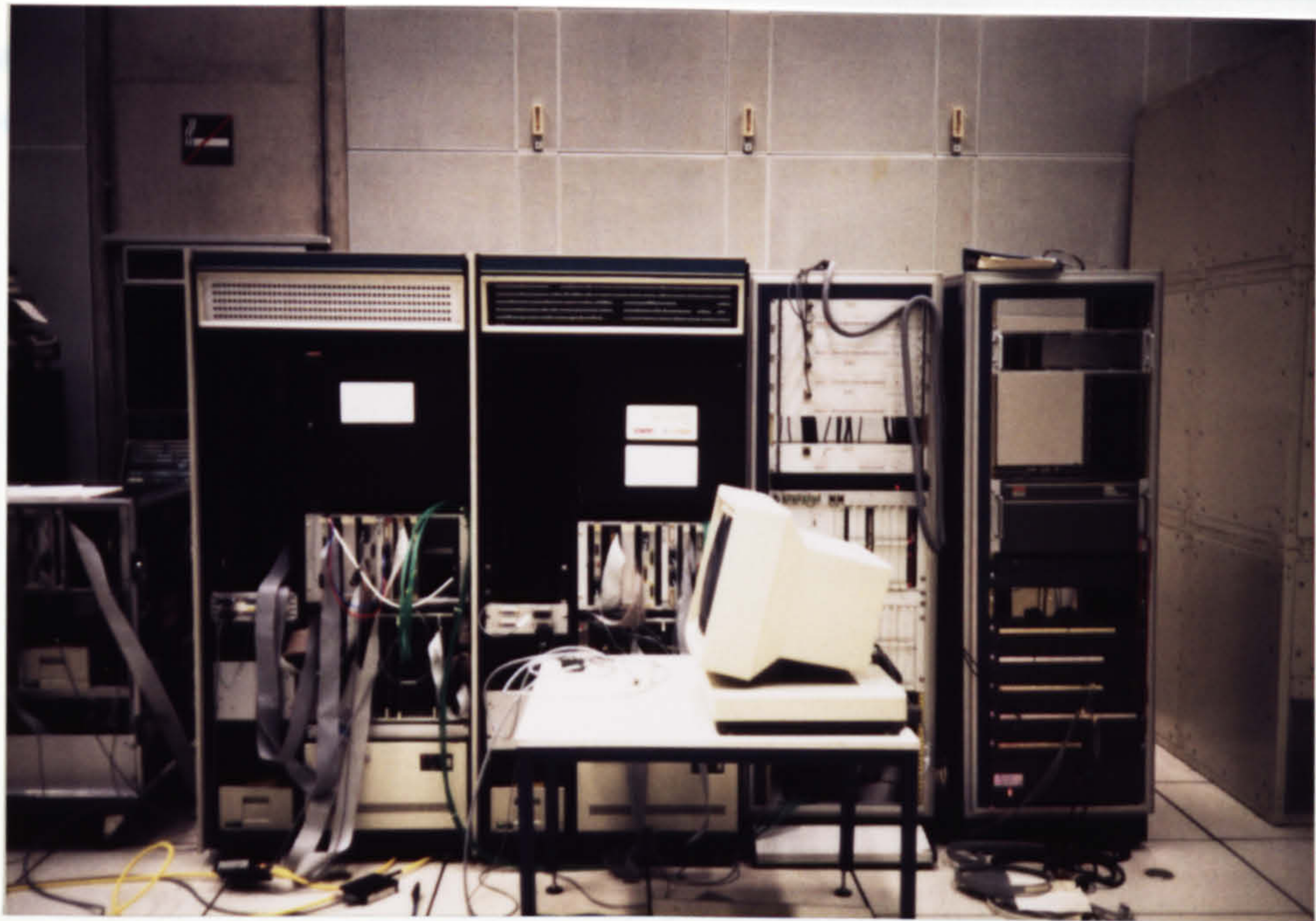
2.1.2 Four phases of IRCAM history

IRCAM's history can be divided into four phases. The first, from 1970 to 1977, involved planning and development. Boulez gained the go-ahead for IRCAM in 1970 from the highest levels of state, and put WV, later Artistic Director, in charge of setting up the institute. By 1975, some research had begun in the old IRCAM building; and in 1976 the EIC

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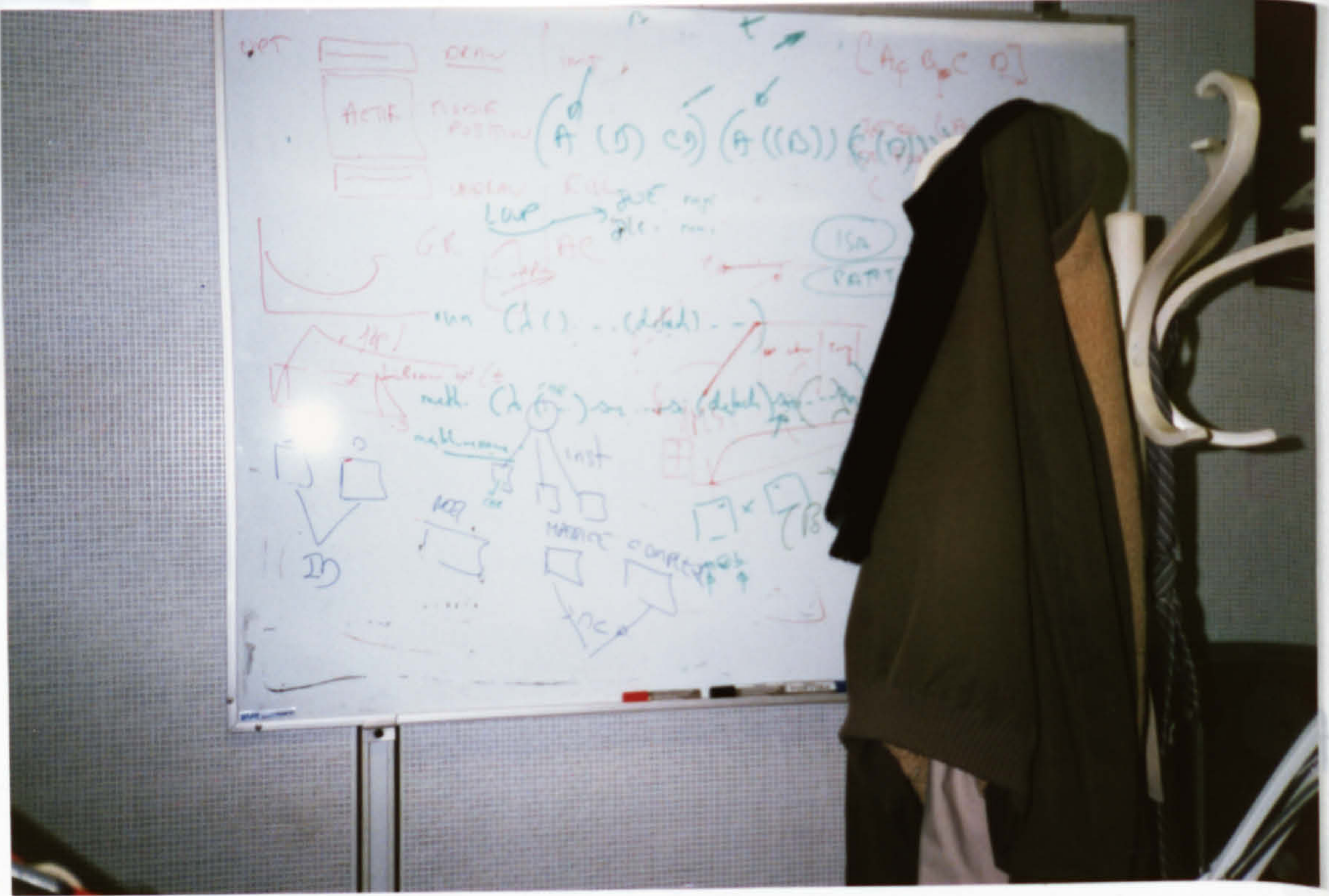
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(IRCAM's own ensemble) was founded. 1977 saw the opening of the CGP (January), and later the new IRCAM building (August). These events were celebrated by a massive series of 70 concerts throughout the year in venues all over Paris, called *Passage du Vingtieme Siecle*: a canonical statement of Boulez's vision of modern music.

The second phase, 1977 to 1980, was IRCAM's first period of full operation. The initial structure was broad in orientation: it was based on five departments, each directed by a composer-director under Boulez's overall direction. The departments were: Electro-Acoustics, Computer, Pedagogy, Instruments and Voice, and Diagonal (co-ordinating between the others). Electro-Acoustics was headed by the Italian composer Berio, who has equal stature to Boulez, so that his 'subordination' was largely formal. In reality, departments were substantially autonomous and followed their own interests: Berio, for example, invited his compatriot BU to design him a realtime digital sound processor - which became the 4X project.

The third phase was initiated by Boulez's sudden re-organisation of IRCAM in 1980, following a period of internal instability during which most of the co-directors left. The reasons were several. First, IRCAM was moving inexorably towards computer music and away from its original broader concerns embodied in the five departments. Second, a major concert of IRCAM premieres at the Metz International Festival was considered a musical disaster by Boulez, and he determined to overhaul things. Third, it was rumoured that relations between Boulez and the departing co-directors had deteriorated. Their departures, and the whole re-organisation, were accompanied by press speculation and polemical debate typical of IRCAM's high public profile (16). Boulez described the

move as rational stream-lining, making IRCAM into what it had essentially become: a computer music studio. Critics, external and internal, saw it as Boulez consolidating his monopoly of power over IRCAM; and the autocratic manner in which he accomplished the change lent itself to such an interpretation (17).

After the re-organisation, for the third phase of 1980 to 1984, IRCAM's structure became that described below for 1984: with two main sectors, their executives and various constituent projects. The change to IRCAM's fourth phase, 1985 on, was marked both by the departure of many senior figures (such as the Artistic Director WV, at IRCAM from the start); but also by one major change of technology policy - which I describe in Ch.10, the Conclusions. The ethnographic present of the thesis thus concerns the period just before transition to this fourth phase.

2.1.3 Setting the scene: the main events of 1984 at IRCAM

1984 was in some ways an atypical year for IRCAM, and is represented as particularly unproductive and difficult by IRCAM management. The dynamic of the institute was dominated by the lead up to two major, interrelated autumn events. First, the International Computer Music Conference (ICMC) in early October, which IRCAM was hosting for the first time. The ICMC is an annual event lasting about a week, a combined academic and music conference bringing together some four hundred members of the computer music world. The second event was the Parisian premiere of Boulez's masterwork 'Repons', the first night of which was also the opening concert of the ICMC. 'Repons' ran for six packed nights in a specially prepared space in the CGP, and was designed to show off IRCAM's best music and technology not only to the elite of

French culture, but also to the international computer music community. Much of the institute's work, its scientific and technical manpower, were therefore directed towards preparing 'Repons' and its technology for the premiere.

IRCAM had many uncertainties during 1984 to do with its technology. One of the main tasks for technology directors was negotiating with a commercial company called Sogitec for them to industrialise and manufacture the main piece of computer hardware developed at IRCAM, the 4X machine. The delivery by Sogitec of 4X's and related peripherals was crucial for the 'Repons' premiere, and for the programme of projected composers' commissions. But negotiations were fraught with difficulties (see Ch.2.1.5 below), and the hardware was delivered extremely late.

1984 was also an unstable period for the basic computing infrastructure at IRCAM. The year before had seen a transition from the previous system, based on a DEC PDP10 minicomputer which had served for several years, to the new generation of machines: a DEC VAX 780 with its associated software operating system called UNIX. This VAX / UNIX combination was the up-and-coming system of the moment, increasingly widespread in the international research community. But for that reason the technology was also rapidly 'evolving' and so unstable, which caused many problems to researchers and composers trying to work (see Ch.8).

Thus, partly due to technological instabilities, 1984 was a poor year for music production. Four commissioned visits were planned, but only three took place, at least one of which did not result in a piece. This was considered exceptionally unproductive; and the aim from 1985 was to have twelve visiting composers a year. One composer's visit proved particularly problematic and ended abortively. This caused an

internal crisis, involving meetings in which causes and blame were tossed around and some of the deepest problems of the institute's functioning were brought to light (see Chs.7 and 8).

1984 was also unusual in seeing the departure through the year of several of the most powerful, senior and long-staying IRCAM directors: the Administrator, Scientific Director, the Directors of Music Research, of 4X Industrialisation, and of the Systems team. In spring 1985 the Artistic Director also left. 1984 can be seen, then, as concluding the third phase of IRCAM's existence; and some major policy changes in 1985-86 indicate that 1984 was a period of transition. But for that very reason it was a period in which it was possible to witness key ideological and political conflicts, and practical problems, being worked through within the institute.

2.1.4 IRCAM's administration: bureaucracy and privilege

I give here a summary of the main features of IRCAM's administration; a full account is provided in Appendix 2.

IRCAM began as a public institution, the music department of the CGP. It has an elaborate and weighty bureaucratic structure that reflects this origin. However in 1977 it became a semi-autonomous private association with its own written statutes (see App.2), retaining some important links with the CGP. This autonomy reflects IRCAM's exceptional status and privilege, as a body involved in cultural production or origination, compared even with the rest of the CGP, which is confined to cultural reproduction. In this classificatory opposition of cultural production to reproduction, and also within IRCAM culture (as I later show), production carries higher status.

As a private association, IRCAM is able to employ foreigners, has

administrative and financial flexibility, and is able to receive private patronage. Nonetheless, IRCAM's main external executive - the Administration Council - resembles that of state institutions: it contains the CGP President (who remains IRCAM's president), many representatives from the Ministry of Culture, the Ministry of Research, the CNRS and so on.

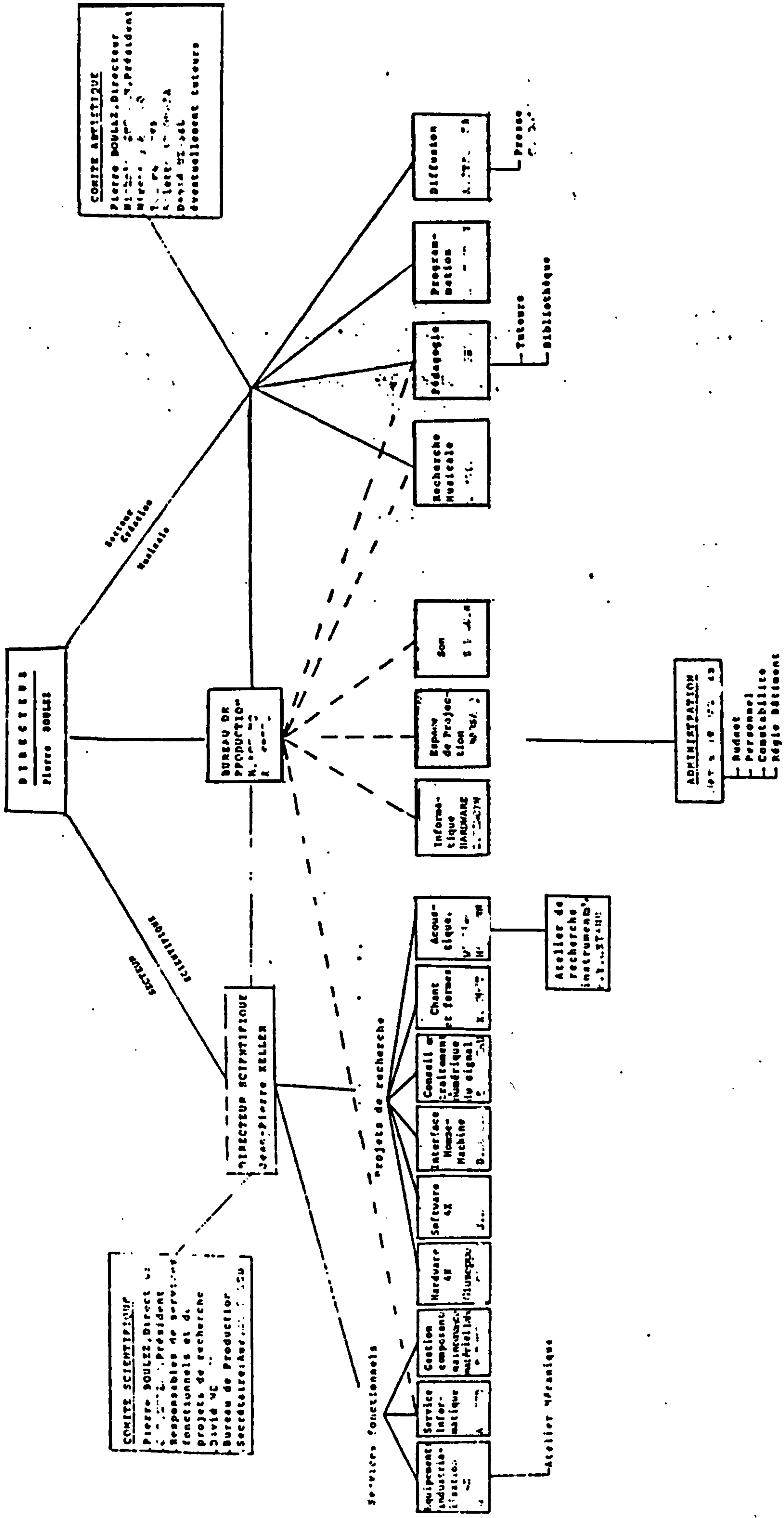
Internally Boulez, as IRCAM's Director, has overall management responsibility. He is aided by an Administration department headed by the Administrator; but the precise division of labour between them is unclear. The original Administrator, BD, who set up IRCAM with Boulez, was a very high state official and a friend of Boulez's. It was during BD's reign that IRCAM consolidated many of its privileges, no doubt linked to the exalted circles in which BD moved (2). He left IRCAM in 1982 to become a judge at the European Court of Human Rights. The next Administrator TY, incumbent in 1984, rather than being a member of the *haute bourgeoisie*, was a professional state administrator.

The Administration department does all preparation for liaison with the external executives; and it manages internal affairs such as personnel, finance and accounting, and running the buildings. There are sub-divisions of the department responsible for each of these functions. The Administration is supposed to negotiate appointments, promotions, salaries, contracts and conditions of work. It also organises the *Comite d'Entreprise*, the in-house workers' consultation body. The department supervises the security pass system, shared with the CGP, and liaises with the Centre over other shared facilities - the air conditioning system, and the cleaners.

In proper bureaucratic fashion, the Administrator issues diagrams

of IRCAM's formal organisation and power structure, called 'organigrammes'. Three, from 1982, mid 1983 and 1985, are shown in Ills. 2.1, 2.2 and 2.3. Boulez's consent is often signalled by his signature (see Ill.2.3). The 1983 diagram indicates 'functional' and 'hierarchical' relations between parts of the institute, and shows the members of each department, committee and position. It shows the division of IRCAM into two spheres: a music production sector and scientific sector, and also IRCAM's two internal executive bodies: the Artistic Committee and Scientific Committee. According to the *organigrammes*, each supervises the relevant sector of IRCAM, and each is composed of Boulez plus the directors of departments within that sector. The two committees appear to carry equal authority. However, in reality the Artistic Committee is the more powerful decision-making body; its meetings are regular and closed (3). The real politics of IRCAM take place here: invitations to composers and researchers, commissions, musical and conference events, long term planning, public relations, and even some technology policy.

By contrast, the Scientific Committee is more of a discussion forum for reviewing developments, and has little power. It meets less regularly, and all those working on the scientific side as well as administrative staff, music directors and anyone interested can attend. A researcher called them cynically "just a therapy session". In line with this, the role of Scientific Director, apparently the formal executive of IRCAM's scientific sector equal in stature to the Artistic Director and subordinate only to Boulez, is also relatively anomalous and powerless. IRCAM Scientific Directors have come and gone, usually lasting barely a year, and their authority and remit are unclear and contested by other long-staying directors. The Artistic Director, on the



----- liaisons hiérarchiques
 - - - - - liaisons fonctionnelles

other hand, is considered Boulez's next-in-command. All of this indicates how the scientific side of IRCAM has relatively less power than the artistic side. And in fact, IRCAM's statutes sanction this inequality by implying that its scientific and technological work are ultimately there to serve musical ends (see App.2).

2.1.5 The economics of IRCAM, and the circulation of products: the 4X deal

IRCAM receives both public and private financing, but the overwhelming majority comes from a state grant given by the Ministry of Culture via the intermediary of the CGP. This accounts for 70-80% of annual funds (4). Other income comes from small grants from the Ministry of Research, and interest on IRCAM's own bank reserves. Between 1982 and '85, IRCAM's total yearly income was in the region of 28-30 million francs (c.£2.5-2.7 million) per year. In return for state grants, IRCAM's statutes define it as a non-profit-making research centre obliged to do work of public benefit; and with this goes a ceiling on the amount of commercial development that IRCAM can engage in. Commercial income must not exceed 15% of annual income, so that IRCAM is legally discouraged from developing products - musical or technological - that would bring in large profits.

Another significant source of income is private donations, which come from two main sources: first, from the Swiss millionaire, music patron and conductor Paul Sacher, a friend of Boulez's; and second, from a group of wealthy Parisian matrons led by Mme Pompidou, the late President's widow, and including Mme Tezenas, an early patron of Boulez known to have run "the last salon in Paris". The latter like especially to provide commissions. In fact, private patronage contributes only a

tiny part of IRCAM's income; yet it was a key reason for IRCAM seeking autonomy as a private association. The patronage is therefore primarily of symbolic value, providing direct links to the bourgeois patronage and avant garde salons that supported Boulez and others from the 1950's on.

Appendix 3 gives a fuller account of IRCAM's precise income, expenditure and infrastructural outlay, including mechanisms of negotiation for technological purchases.

The circulation and sale of IRCAM's output may appear constrained by the legal limit on commercial income. But in fact there is little need for this external limit since none of the various potential sources of earnings reap much profit. The income from sales of IRCAM products (papers, concert and conference tickets, cassettes, videos and so on) and from IRCAM concert tours is minimal. Audiences for IRCAM concerts, although large for concerts with Boulez and similar well-known figures and for special 'youthful' events (see Ch.5), are not consistently so (for example, the mean for 1983 was 55% attendance); and concerts are far from self-financing (5). IRCAM research, as with all academic and publically funded research, is supposed to circulate freely among the research community. IRCAM technological developments may be thought to have the greatest earning potential. However IRCAM's own software is not an earner since, developed under educational licences and so with the aid of a software environment provided without commercial charges, IRCAM is also obliged to circulate this freely to other research groups. It is IRCAM's hardware that appears best suited to commercialisation. Yet the story of setting up an industrialisation deal for IRCAM's 4X machine with the company Sogitec is instructive in showing how, eventually, this also managed to avoid bringing profits back to IRCAM.

From the beginning, the 4X industrialisation caused conflicts between Boulez, who argued that the machine should remain within IRCAM's circuit and that IRCAM should not concern itself with wider markets and commercial deals, and two 4X team directors, VO (4X Industrialisation director) and the designer BU (4X Hardware director), who both wanted to see the 4X reach a larger musicians' market beyond IRCAM. VO wanted to set up a commercial offshoot, 'IRCAM Enterprises', to commercially exploit IRCAM's R and D. He was convinced of the benefits of the American and Japanese models in which, in his view, progressive research and enlightened venture capital work hand in hand. But in the face of opposition from Boulez and the Administration, and some ambiguity as to whether IRCAM could legally set up such a company, VO also decided to seek deals with industrial firms. Sogitec expressed interest, and drawn out negotiations took place in late 1983 and early 1984. Significantly, Sogitec were not interested in the 4X's musical capacities. They manufactured aeroplane parts and were closely linked to the defence industry; so that when Sogitec were suddenly taken-over in July '84 by the giant defence company Dassault - makers of planes and high tech weapons - it was entirely logical. VO sold the deal to Sogitec by finding an ingenious way to simulate aircraft noise using the 4X, and Sogitec bought it to be the basis of a flight noise simulator. Boulez now became persuaded, perhaps because several 4X's were needed for the 'Repons' premiere. He preferred Sogitec to the idea of VO's venture company. In this way, the 4X would be produced by a major French company and valorised as industrially useful; yet since Sogitec had no interest in a music market, the 4X was not likely to be produced as a commercial synthesiser, so its symbolic musical value would not be debased by entering a large market.

The eventual agreement between IRCAM and Sogitec/Dassault is redolent of this rationalisation: IRCAM was to receive just four 4X units back for free from Sogitec, and a small royalty, but no other payment. Perhaps to appease VO and BU, Sogitec loosely undertook to develop a small commercial synthesiser version of the 4X. But after the Dassault takeover this rapidly dropped off the agenda; so the 4X has reached no wider music market, nor has it even been produced to circulate among IRCAM's network of computer music centres. VO and BU were incensed by this, and BU was also upset by the militarist implications of the deal. The saga was kept quite confidential while in process, and was not spoken of freely within IRCAM in 1984.

IRCAM thus inhabits a contradiction. By statute and by encouragement from the Ministry to which it is related (see Ch.2.3.2 below), IRCAM aims to develop innovative research and technologies of the sort that the private sector will or can not produce. Yet, paradoxically, the technologies may then be of little interest to the commercial sector. They therefore reach a tiny market, have little influence and little economic value. Given the dominant ideological as well as legal frame surrounding IRCAM, then, the likelihood of it earning from its prototype hardware is small; and certainly, it made little income from the 4X. But this is less contradictory once the ideological logic is grasped whereby the technology's lack of commercial validation is compensated by its retaining maximum symbolic value on the cultural scene because of its very uniqueness. By avoiding commercialisation, the 4X remains an exclusive and prestigious 'tool' that can only be used at IRCAM and a few similar places. It therefore adds maximum prestige to the few pieces like 'Repons' which, made at

IRCAM, have virtual monopolies on its use. Without such exclusivity, IRCAM would have few unique facilities to offer to composers and their musical works.

In summary, IRCAM's legal-financial constraints and the character of its internal cultural production converge so as to effectively avoid 'undue' commercial profit. IRCAM's economic basis is thus defined both by heavy dependence on public subsidy, but equally by willed negation of economic gain. This recalls Bourdieu's analysis (Ch.1) of the sphere of cultural capital which rests upon belief in a necessary inverse relation between cultural production oriented to the future and for the public good, and commercial profit. In this sense IRCAM embodies the sphere of cultural capital; and we will see below that this also resonates with aspects of Boulez's ideology.

2.1.6 IRCAM's organisation, projects and activities

The 1983 *organigramme*, a formal guide to IRCAM's organisation, shows that IRCAM's two sectors each contain several departments or teams, each headed by a director or *responsable*. 'Departments' may consist of between one and four or five workers, some of them temporary. The diagrams appear to give equal status to many of the departments, and their directors. It thus conveys IRCAM as consisting of a series of small, autonomous, functionally interrelated units: an organic 'ecology', as one informant called it.

IRCAM's actual projects and activities in 1984 are, however, a little different to those presented by the *organigramme*. In the scientific sector, there are applied technology and pure research projects. The main applied projects are five effectively related to the 4X (Hardware, Software, Signal Processing, Industrialisation and Man-

Machine Interface), and one team working on advanced, artificial intelligence (A.I.) inspired music software, called the Chant and Formes group (the programs they have developed are called 'Chant' and 'Formes'). There are also two small, temporary applied projects not on the *organigramme*, both led by visiting American composer-researchers (QG and PL), and both concerned with live interaction between computers and performers: one (QG's) also focused on the 4X, the other (PL's) using small Apple computers. Finally, there is a software project to design a musical expert system. Again inspired by A.I., the aim is to provide an interactive software environment with built-in 'musical knowledge' related to computer synthesis of inharmonic sounds, as an aid to composition. The only pure research department is Acoustics, with its offshoot the Instrumental Research Workshop (*Atelier de Recherche Instrumentale*). It is notable that psychoacoustics, a pure research discipline central to computer music and so to IRCAM's work (see Ch.6), has no department at all and is fitted in by some workers around their other work. Two service teams are attached to the sector: the Computer Systems team (known simply as the Systems team), responsible for computer maintenance, and Lab Maintenance.

The music production sector is involved in both production (composition) and reproduction (performance, education). It contains four departments, Programming, Diffusion, Pedagogy and Music Research, each consisting of only a director and an assistant or two. Programming, the domain of Artistic Director WV, manages invitations to composer, the yearly score reading panel, and WV himself programmes most of the main concert series. Diffusion looks after publicity and press. Pedagogy is responsible for miscellaneous research, public courses, the stage for

visiting composers, and graduate researchers attached to IRCAM. Music Research has a less clear role: the director HY contributes to many of the above, and also engages in his own composition when he can. In fact these four directors, who with Boulez make up the core of the Artistic Committee, discuss together many of the decisions on concert seasons, the educational program and the commissioning structure of IRCAM.

Boulez and the three male directors (all except the director of Diffusion) have contacts in different areas of the contemporary music world which they draw upon to people IRCAM. Boulez and WV between them deal with the highest elite of the European music scene especially, and court them when necessary - for example taking Stockhausen and Ligeti out to dine to encourage them to visit IRCAM (6). By contrast, the directors of Pedagogy (RIG) and Music Research (HY), both Americans, together fill out contacts on the American scene. This is particularly useful to IRCAM since Boulez has in the past alienated key people on the American contemporary music scene (see Ch.2.3.3 below), while WV's network is limited to Europe. HY's network is mainly among the American East Coast serious music elite (7); while the maverick RIG is well-known in American computer music and so has contacts with composers, scientists and technologists from that scene, as well as some from the more 'way-out' areas of West Coast experimental music, jazz and even mainstream pop. The musical tastes and policies of these four are therefore quite different, so that Artistic Committee discussions can be antagonistic and fraught with conflicts of aesthetic and philosophy. However this 'dissensus' is also functional complementarity since between them the four cover the powerful areas of contemporary and computer music. Furthermore, rather than perceiving IRCAM's artistic policy as diverse and eclectic, we will see that some external

commentators see it as closed, monopolistic and promoting a single aesthetic (see Ch.2.3.2).

The official commissioning process involves selected composers coming normally for two visits of three months each, the first a 'research' visit to learn about IRCAM's computer 'tools', the second a 'production' visit to actually make the piece. The new works are then premiered in a concert season. They are assisted by staff known as 'tutors', attached to the Pedagogy department. The tutor role is carried out not only by the four official tutors but also by young intellectual staff, usually on temporary contracts and keen to be promoted, whom I shall call 'junior tutors' (although they have no such official title or collective identity). Tutors mediate between the scientific, technological and musical sides of IRCAM, and are therefore supposed to be skilled in music, acoustics and computer science. They teach composers about the technologies and research, and help them to find ways of realising their musical ideas with IRCAM's tools. Tutors do much of the 'hands-on' work with the machines, developing and tailoring extant software to composers' specific needs. Thus the tutor-composer relation, and indeed the role of tutor itself, aspire to embody Boulez's ideal of a fruitful and egalitarian collaboration between the musical and scientific.

However, there is also a great deal of unofficial music production, involving IRCAM workers and 'squatters' working in their own time. Although no staff are officially employed as composers (even Boulez), five of the permanent staff (Boulez, HY and three tutors), many junior tutors and even some technicians consider themselves composers, and some find ways to use the equipment out of normal hours to produce pieces.

This creates anomalies, and embarrassment for management, since IRCAM should be seen to rationally control access to its facilities and so the quality of work being produced. Yet the implicit acceptance of unofficial production, and the blind eye turned towards squatters, betrays two realities.

First, it is commonly accepted amongst IRCAM intellectuals that the best musical results come from those working more-or-less permanently within IRCAM, who get to know the environment well. (In meetings, a figure of six years was cited as the time necessary to become really adept with the technologies: clearly impossible for composers with six months). Second, although most unofficial pieces are ignored, when one is judged good, the official process takes notice, the piece is acknowledged and the rewards can be high. This is because ultimately, Boulez uses musical judgements to assess both workers and technologies; so that when a junior produces good music, sudden promotion can ensue. To illustrate in regard to a squatter: a young woman composer NP, girlfriend of a junior worker and so able to gain unofficial entry, produced a piece with IRCAM technologies which won a prize at the prestigious Darmstadt festival. Word came out that she had made it unofficially at IRCAM, and the IRCAM artistic management were made to look foolish for not being aware of the piece; yet they were pleased that she had won this important prize. Within a short time, NP was working officially within IRCAM.

Two other service teams are important to music production and performance: the Sound team, who run the recording studios and do all analog sound processing (live amplification, recording, mixing); and the 'Esp Pro' team, who run the Esp Pro and stage manage IRCAM performances. A Production Office co-ordinates all sides of the institute in relation

to music production and performance with the aim of fostering efficiency.

Finally, separate to IRCAM but very closely related is the institute's contemporary music orchestra, the *Ensemble Inter-Contemporain* (EIC). The EIC has an autonomous existence as an international ensemble. But Boulez often conducts, it takes part in many IRCAM concert seasons, and some of the players become involved in IRCAM research. So the links between Boulez, the EIC and IRCAM are strong.

2.2 IRCAM's population and employment policy

2.2.1 Permanent and temporary workers

The IRCAM population contains people with very different kinds of employment status. Appendix 4 is a list of the 1984 population by department or other relation to IRCAM, role, and employment status. It centres on the salaried, permanent employees on posts. Posts are strictly limited and number between about 54 and 59. They are controlled by the Administration, and cover the full spectrum of jobs, from Boulez to the postman. Posts are unequally distributed among the institute's parts (8), and comprise mainly administrative, clerical and technical staff, the directors of the various departments, and a core of research staff. The latter centre upon 4X projects, with 10 posts, while pure research and non-4X technology projects lack staff: Acoustics and Chant/Formes have just 1 post each. Staff on the music side are few and are not employed as composers. Musicians are in fact the workers who most often have temporary and insecure positions at IRCAM, whether as junior staff or commissioned composers. This is surprising given Boulez's original vision of IRCAM which stressed permanent collaboration between musicians, scientists and technologists (see Ch.2.3.4).

Thus the distribution of posts is markedly unequal and favours 4X-related projects over pure research and music.

In addition to the posts, IRCAM has a large number of workers on temporary and short contracts, people working unofficially and unpaid known as 'squatters', and visitors. In all during 1984, this floating population numbered about 64 people, of which some 44 stayed for a substantial period as temporary workers, squatters, students or visitors, while the rest passed through on very short visits.

There are two forms of temporary contract for IRCAM workers, known as 'vacations' and 'honoraires'. *Vacations* or fixed term contracts last for between three months and a year. They involve low pay, no security of employment, and (in '84) compulsory lay-offs of one third of the duration of the previous contract in between recurrent contracts (9). These are the most exploitative form of contract, and they are often used recurrently to employ more-or-less permanent junior staff. A good proportion are held by young, foreign musicians and researchers keen to get a toehold inside IRCAM, and especially by the junior tutors - those acting as tutors even though they are not employed as such (see App.4 p.3).

Honoraires are also fixed term contracts lasting from one to three months, better paid than *vacations* by a total fee, and task-specific. *Honoraires* are given to two kinds of visiting workers who are considered to have particular expertise: first, invited researchers and computer scientists; and second, commissioned composers. *Honoraires* computer scientists come to work on the computer system or specific research projects as consultants; their labour is restricted to the period when they are physically present at IRCAM. They are usually American, and have the advantage of an extremely favourable international labour

market. Commissioned composers, for their two three month visits, receive a fee and expenses for their time living in Paris. Financial terms for visiting composers vary, although IRCAM policy is to pay composers within a close range of fees according to their age and renown (see Ill.2.1) (10). Given their preparatory labour outside IRCAM, the fee is moderate compared to those for computer science *honoraires*.

IRCAM hosts a few postgraduate students each year, called *stageaires*, attached to Pedagogy or specific research teams such as Chant/Formes. They are not paid by IRCAM, but by external grants (11).

2.2.2 Squatters, visitors, subcultures

IRCAM's squatters work unofficially, yet they are known and joked about and tacitly accepted by the IRCAM authorities except for occasional purges. Squatters are let in informally through the friendship and patronage of certain directors, notably the Pedagogy director RIG and Music Research director HY. Most squatting is done in the evenings, nights and weekends because in the day, one's presence is conspicuous, there is little space to work, and the computer system is congested. But to get into IRCAM outside the office day one needs a security pass, which requires a patron-director to persuade the Administration. Squatters include both computer scientists and musicians. There is, for example, a continuing tradition of squatters from the Computer Science department of Vincennes university, where they are short on computer power. Musician squatters include young composers and musicians who may have attended an IRCAM course or stage, but have not (yet) got official backing.

A stream of international visitors comes through IRCAM each week. Many have past and continuing connections, as researchers, composers, or

people from the computer music or contemporary music worlds. Quite a few turn up by recommendation or simply out of interest, to look around and possibly to start a bid for a formal relation. Composers who have past and future commissions visit in order to discuss their requirements, or to do short bits of work on a tape or piece. Periodically, commercial computer music technology firms come through to give a demonstration or to formally make contact on research with IRCAM: for example, Synclavier and Yamaha both visited in early '84, while most companies in the field attended the ICMC.

Certain groups within IRCAM constitute themselves as subcultures, ie a group 'for itself'. All the technical teams - Systems, Sound, Esp Pro - have collective identities, as in different ways do the Administration, the Chant/Formes group, and to a lesser extent the 4X projects. I show later that these are constituted through both common antagonism to other parts of the institute, and by different kinds of positive collective labour and ideology. The one marked subculture that does not represent a formal team - and so is not represented on the *organigramme* - is that constituted by a series of voluntary, bi-weekly 'musicians meetings', which began at the start of 1984. Held under the auspices of HY, director of Music Research, the meetings involved collective reflection on the general direction and higher goals of IRCAM. They brought together those of IRCAM's music and research intellectuals from various projects who consider themselves most concerned with IRCAM's future and deeper orientation, or feel they should be seen to be. The group is IRCAM's own, self-constituted intellectual vanguard: I call it the musicians group (although some members work primarily on software) (12).

2.2.3 Nationality, gender, race, and age within IRCAM

In terms of nationality, IRCAM is mainly French, with a secondary presence of Americans, plus a scattering of West and East Europeans, and Australians (13). The dominant French-American polarity has been there from the start, due to the central influence of American computer music on IRCAM, and from that time on Americans have played a major role (see Ch.2.3.1 below). In fact, one effect of Boulez's 1980 reorganisation was to lessen the presence of European and French directors and relatively increase the American presence. Because of the strong American presence and IRCAM's history, American programmers, computer music scientists and composers are amongst the most frequent official and informal visitors.

IRCAM attempts its most rigorous international coverage in its artistic policy of invitation to composers, whether for commissions, submissions to the score reading panel (*Comite de Lecture*), or invitations to the stage (eg see Ill.2.4) (14). Yet the range of IRCAM commissions over the years centres on just six countries, with a few one-offs to other nationalities, but with France and America receiving by far the most (15). Clearly, this international policy is far from comprehensive and favors a few culturally dominant developed countries; the French-American dominance is again confirmed. The French-American polarity, then, has a strong effect both technologically and musically.

IRCAM has a classic sexual and racial division of labour. IRCAM's low paid, low status clerical staff are all women; while women are barely represented in the higher research and production sphere, either technological or musical. There are few non-whites at IRCAM. The most numerous are the North African men and women cleaners, seen only for brief periods in the early mornings and evenings. They come from a

private contractor via the CGP, and are the only unionised workers to enter IRCAM (belonging to the Communist CGT). The IRCAM accountant is also of North African origin, the only permanent non-white member of staff. There was one black American composer, PL, on temporary commission in '84. He saw himself as the "token black man" among IRCAM intellectuals, and was self-conscious and uncomfortable in this role.

The mean age of the institute is quite young, with the majority of the population aged between mid twenties and late thirties, and just a few over-40's. Boulez is the oldest person at IRCAM (he had his 60th birthday in 1985). The overall impression is of a young population, especially among the male higher research and production sphere; and of older authority figures gambling, taking risks, on what they consider to be dynamic young workers, on the make in their field.

2.3 IRCAM's conditions of existence

The remainder of the chapter analyses three dimensions of IRCAM's external conditions of existence, each of which have in different ways influenced its character. First, its main international links, to the American computer music scene. This indicates IRCAM's dependence on American skills as well as technologies, from both the university and corporate commercial sectors; and the cultural and ideological tensions, the nationalist rivalries, between IRCAM's French and American sides. Second, IRCAM's national context and background: aspects of French culture, cultural and music policy, and contemporary music that together lie behind the emergence of IRCAM in the 1970's. We see an unprecedented centralisation and rationalisation of resources within contemporary music, and a turn to bring music together with technology and science. We see also how French cultural officials now conceive of IRCAM and its

legitimation. This and the third dimension, Boulez's personal history, are linked, since Boulez's controversial and meteoric career is a major theme running through the French national material. Looking more closely at Boulez's history, we examine the strategies by which he has achieved international fame as a charismatic authority in music, and how this has been turned into power, as in the institution of IRCAM. Finally, I outline Boulez's ideology and founding vision of IRCAM, which enables us to assess both the institute's congruence with, and difference, from that vision.

2.3.1 The international context: American computer music networks and their influence

IRCAM has, from the start, been greatly influenced by and dependent on the American computer music scene. Computer music emerged in the USA in the 1960's mainly from universities with large mainframe computing facilities. To gain access to these, composers had to ally themselves with electronic engineering, computer science or cognitive psychology labs (Pennycook 1986), the latter researching perception, information processing and artificial intelligence (A.I.). It thus grew up, usually unofficially, on the back of powerful academic and commercial interests, in turn often linked to the defence sector (18) - a context that makes the Sogitec/Dassault deal for the 4X more comprehensible.

Two major American centres have had enormous influence on IRCAM from its inception. Stanford University's Centre for Computer Research into Music and Acoustics (CCRMA) was the model for IRCAM's original infrastructure in 1975-6. CCRMA itself emerged from the Stanford Artificial Intelligence Laboratory (SAIL), a leading A.I. centre

heavily involved in defence contracts. The decision to use Stanford was taken by Max Mathews, Director of Bell Laboratories' Acoustic Research Centre, who is known in the vernacular as the 'father of computer music'. Mathews became, around 1975, IRCAM's first Scientific Director. Bell Labs is the research base of the giant AT&T telecommunications multinational, known globally for its basic communications research. Mathews had a major role in the early development of computer music, which he fostered at Bell Labs as an unofficial pastime and which became an informal passion in his sector. He wrote one of the earliest computer music synthesis programs (Music V), and produced in 1969 the first definitive text (19). The link to Bell was made by the pioneering French computer music researcher J.-C. Risset, who had worked at Bell with Mathews during the 60's on digital analysis and synthesis of timbre. Risset was appointed by Boulez in 1972 as head of IRCAM's Computer department, and suggested the links with both Bell and Stanford.

Compared to IRCAM's 4X story, both Stanford, and Bell Labs' relations with AT&T, illustrate the very different, smoother relations between basic research and commercial applications in the USA. The director of Stanford's CCRMA, composer John Chowning, developed a very powerful digital synthesis technique by frequency modulation (FM) in the '60's and '70's, which was sold to the Yamaha corporation in a very profitable deal. This effectively made the CCRMA self-financing (20).

IRCAM's early computing environment was perceived by Americans as unprofessional and bureaucratic (21). But by the late '70's it had expanded until it was considered one of the best computing facilities in France, so that French and American researchers were keen to come. During IRCAM's early period, it became even more heavily dependent on American computer music expertise and on the technologies that

researchers brought with them. By 1977 the Computer and Diagonal departments were manned mainly by Americans. For example the latter, headed by young American composer WLe, contained RIG from Michigan State University, later Pedagogy director (who was recommended by Babbitt, the leading Princeton composer), and Stanford researcher HF, later head of Lucas Film Audio. Stanford graduates were also providing valuable programming assistance. The Stanford and Michigan State connections provided not only personnel; the latter brought over and installed invaluable software without which the computing environment could not have functioned properly (J.Gardner et al 1977:4). American help was also sought from Hal Alles, senior Bell engineer and leading electronic music technologist, in the development of IRCAM's hardware project (22).

Cultural tensions, aesthetic, technological and political conflicts, abounded in this period between the Americans, and Boulez and the French. Mathews had been appointed over certain French directors' heads, and conflicts of scientific policy ensued. For example, Mathews and WLe proposed that IRCAM should not develop large digital synthesis hardware, but should work on an area, that of realtime gestural control, neglected then and since by IRCAM (23). They were defeated, since the 4X prototype project (under its French directors VO and BU) continued apace. Mathews and Boulez also had antipathies, differences of aesthetic and philosophy, that are related in stories that form part of IRCAM's mythology (24). Mathews soon quit the job of Scientific Director, the first to experience its difficulties; and all Directors since have been French. Yet Mathews continues to visit and informally to consult. Stormy relations between Boulez and American researcher HF blew up over a piece of HF's music, which Boulez considered light and rudely dismissed. HF

left after a couple of years. Some at IRCAM regretted this, since HF is a leading talent in the field and became head of the computer Audio Division of another of IRCAM's US rivals, Lucas Film Corporation in San Francisco; and other ex-IRCAM researchers have since followed him there. Lucas Film is the entertainments group responsible for films such as 'Star Wars'; it sponsors advanced computer audio and graphics research for input into its films, video games etc. By '84, HF's group at Lucas Film had produced the nearest, although far more generalised and powerful, rival to IRCAM's 4X: the ASP (Audio Signal Processor) (25).

American personnel continue to be important to IRCAM. In 1984, three young Americans have significant roles. BYV, originally a flautist but self-trained in computer music over years at IRCAM, is 4X Software director, but also, informally, Boulez's personal in-house tutor. He has been progressively promoted until, by 1985, he became Technical Co-ordinator, a substitute Scientific Director. HM, junior tutor and former Stanford postgraduate, is IRCAM's most active psychoacoustician and a pivotal intellectual figure. (By 1985, HM was promoted to Pedagogy director). While NGF, another ex-Michigan State researcher and in '84 completing a PhD in Germany, is considered IRCAM's most able computer scientist - a 'wizard'.

To conclude, exchanges between IRCAM and the major American computer music centres - notably those at Stanford, Bell Labs, Lucas Film, and the UCSD's Computer Audio Research Lab (CARL) - continue to remain strong. IRCAM's computer consultants commonly come from one of these centres, and IRCAM researchers, when they leave, may go to work in them (26). The attractions of leaving, for frustrated IRCAM researchers, are that not only are they far better paid, but they are also able to contribute to technologies that may, in the American context, be

commercially developed and reach a wider public. Thus IRCAM's main external networks are, at an international level, this American circuit of computer music centres and researchers, with a few additional European centres; and at a national level, the French contemporary and electronic music fields, including a national circuit of music research centres, as I describe in the following section. I examine deeper problems arising from IRCAM's technological dependence on the USA in Ch.8.

2.3.2 The national context and background: aspects of French culture, cultural policy and contemporary music policy

I here summarise material and arguments concerning IRCAM's national context that are given more fully in Appendix 5.

The effects of the national context on IRCAM can initially be seen through a series of autonomous aspects of French national culture and cultural politics that individually resonate with, and together converge on, the character of the institute. They are as follows.

First, the state's strong commitment to high technology research and development; and its uncritical acceptance across the political spectrum with the decline of French Left critiques of technology after 1968. This general atmosphere accords with the centrality of technological R and D for IRCAM and its role in boosting IRCAM's authority; and with the absence of critical perspectives on technology among IRCAM intellectuals (see Ch.4).

Second, the state's historical fostering of centralised, bureaucratised, privileged high cultural institutions and, despite the articulation of a politics of decentralisation by the Left, the Socialists' continued support of this policy since 1981. This form of

policy was behind Pompidou's initiative for both the CGP and IRCAM, the former (at least) allied to his belief in the possibility of a centralised, yet popular, high culture.

Third, the high public and political profile taken historically by French intellectuals, often associated with the French Left. This gives a broader frame within which to understand Boulez's extremely prominent public and cultural political role (as we see in the next section).

Fourth, the fact that the nationalist intent of major cultural policy initiatives follows not only periods of internal social crisis (De Gaulle's reconstruction of French culture following World War Two, Pompidou's following 1968), but is also linked to important international rivalries, and particularly that between France and the USA. This rivalry is embodied in major shifts in international high cultural leadership over the century: the French avant garde dominant in the first decades of the century, a shift to American avant garde hegemony after World War Two, and France attempting to wrest back leadership since at least the 1960's. This reveals a tension between nationalism and internationalism that, I suggest (amending Williams), is characteristic of the avant garde, and that we see - along with the specific nationalist rivalry towards the USA outlined in the previous section - within IRCAM.

Fifth, the origins of the concept of the avant garde in French utopian socialist thought, including the notions that art should take a leading political role and transform the social, and that it should be closely allied to engineering and science. While the latter association is very characteristic of IRCAM, we will see that the former is more problematic. In general, this indicates the special role and power of avant garde ideology in French cultural life.

Turning to French music policy, we will see in the following that contemporary music has seen changes related to much of the above. From state support of individual composers, the state has increasingly centralised funds by channelling them through a new kind of contemporary music institution, and especially those bringing technology and science together with music (ie 'music research centres'), of which IRCAM is by far the largest, most centralised and privileged example. We also see, in this and the next section, the relation of Boulez's personal history to these developments, and his agency in exemplifying many of the tendencies described in the institution of IRCAM.

The 1950's saw two innovatory developments in French contemporary music, against the background of a conservative music establishment. They were: first, the rise of *musique concrete*, an important French school of electro-acoustic or tape composition with an institutional base at Radio France, that came to be known as the GRM (*Groupe de Recherches Musicales*); and second, the beginnings in 1954 of a regular Parisian concert series devoted to avant garde and modern music, founded and conducted by the young Boulez, that was known as the *Domaine Musical*.

The composer Pierre Schaeffer was the leading figure in *musique concrete*, which involves the manipulation of taped natural and industrial sounds by editing, reversal and speed changes, and so expands the range of possible sound materials for composition. Schaeffer is thus considered the pioneer of an influential aesthetic and technique, and during the '50's and '60's his group were considered the main French national avant garde. Well known composers visited Schaeffer's studio, including Boulez and Stockhausen. Both left dissatisfied and rivalrous.

Stockhausen became involved in the rival studio of West German Radio in Cologne, which generated the main alternative electronic music approach of the period, known as *Elektronische Musik*. Boulez denounced Schaeffer's compositional approach as inadequate, untheorised and empiricist. *Musique concrete* was produced without a score or complex prior conceptualisation, unlike the serialist technique that he and others were championing. Further undermining Schaeffer's credibility for Boulez was the fact that Schaeffer was trained as an engineer and not as a musician. Despite Boulez's criticisms, Schaeffer was in fact a theorist and published a formidable treatise on his methods (27). His group were the French originators of the study of acoustics and psychoacoustics in relation to composition; they coined the new generic term 'music research' for their research on 'sound objects'. In particular they researched the complex new timbres used in concrete, and Schaeffer tried to develop a '*solfege*' or basic syntax of timbres as a new structuring device for composition. We will see that all of these aspects of the GRM's work in the '50's and '60's prefigure major dimensions of IRCAM culture; and they are continuities largely unacknowledged by Boulez. Until the rise of IRCAM in the 1970's, the GRM remained the largest and most important new music centre in France, so that Boulez's polemics must also be seen as attacks on his main national, institutional rivals. On the other hand, we will also see (Ch.8) that aspects of IRCAM culture represent an implicit negation of GRM aesthetics and techniques, shown, for example, in an almost irrational neglect of analog electronic and tape based techniques.

Boulez's *Domaine Musical* was concerned with reproduction: the performance of modern classics and of new works. Boulez's model was Schoenberg's Society for the Performance of New Music, set up in Vienna

in 1919 against the extreme hostility from critics and public alike towards new music. While Schoenberg's Society lasted only 2 years, Boulez's series grew over 19 years into a well attended, state funded institution. It began as an esoteric and elite meeting point of the avant garde; and it was patronised by a mix of the social and cultural haute bourgeoisie brought together by salon-giver Mme Tezenas, the wife of a wealthy industrialist. By the early '60's the state began to add funds and so to legitimise the *Domaine*; while Boulez, moving in exalted social and cultural circles, meeting patrons and future cultural officials, gained a reputation as a sectarian and charismatic figure. The *Domaine* had three dimensions. First, it became the gateway to success for composers, since a successful debut bestowed legitimation and recognition by the cultural elite. Similarly, in the post War artistic vacuum in which no modern canon yet existed, through its selection of works to be played the *Domaine* legitimised those works and constructed a canon of past classics and composers. Finally, the *Domaine* was internationalist in scope: it set out to express and influence international musical currents, and to impress an international intelligentsia. In this sense, Boulez's series formed but part of the broader nationalist desire to regain international cultural leadership for France.

1964 saw the next significant development in contemporary music. The Minister of Culture, Malraux, set up a commission to report on French music as a prelude to creating the new *Direction de la Musique* in the Ministry. A struggle for power took place between two factions: one led by the composer Landowski, the other by Boulez. Malraux rejected Boulez's plans; and Boulez bitterly denounced the Minister and went 'on

strike' against the official organisation of French music. He cut ties with the Paris Opera, the Radio, French orchestras and went into self-imposed exile in Germany, his second base. This high profile political episode divided public opinion and left Boulez an even more well-known, controversial figure. Meanwhile Landowski, as Director of Music from 1967 to '73, made two major policy initiatives in the diffusion of contemporary music. He gave state funding to a number of new contemporary music ensembles, and supported a great increase in specialised contemporary music festivals. For a period in the late '60's these festivals, such as the *Semaines Musicales Internationales de Paris*, found a new young audience for whom avant garde music became associated with radical politics; by the '70's this audience was already declining.

The 1970's witnessed a massive overall increase in state funds for contemporary music (for example a seven-fold increase between 1974 and 1978); and a new development - the rise of what were called, echoing the GRM's title, 'centres of music research'. These centres aimed to foster interrelated scientific research and technological development around music, and the production of new music itself. The main recipients of the enormous increases were, however, the EIC (IRCAM's ensemble), founded in 1976, and from 1977 IRCAM itself. This was a major change of policy from the support of diffusion to production. It also involved an unprecedented degree of centralisation and rationalisation apparent, first, in the transformation of music production from an individual activity to an institutional process. Another level of centralisation was the absolute dominance given to IRCAM over all other centres, and to the EIC over similar ensembles (see Tables Ap5.1, Ap5.2, Ap5.3 in App.5). IRCAM received on average more than thirteen times, and the EIC about eight times, the state funds of their nearest rivals. By 1978,

IRCAM's subsidy was 40%, and the EIC's 30%, of the total state budget for contemporary music. IRCAM was also privileged in its greater scale, its unusual administrative autonomy and, compared to the mainly national scope of the other centres' network, in its internationalism. However, IRCAM and the other centres shared in common the rationalisation of musical creativity and of the musical system in the new scientific and technological terms of music research.

The most recent phase of music policy began with the Socialists' coming to power in 1981 and their expansive post-election gesture of doubling the budgets for education and culture. The new Director of Music, Fleuret, doubled IRCAM's existing budget but also created a number of new regional music research centres, in an apparent attempt at decentralisation and at lessening IRCAM's monopoly. This is shown by the exponential rise in the number of centres: from two in 1973, to six in addition to IRCAM by 1977-80, to seventeen by 1982, to twenty-five by 1984. Fleuret espoused an ideology of cultural decentralisation and pluralism, the main policy thrusts of which were the new regional centres, and the first state support for popular music - a relatively minor training initiative. Yet on closer inspection, the regional centres were commonly set up around ex-members of the GRM and IRCAM. Fleuret's policy, then, was driven mainly by hostility to, and an attempt to counter, IRCAM's hegemony, and especially what Fleuret considered IRCAM's singular aesthetic, linked to Boulez's dominant personality. Fleuret's critique of IRCAM and of Boulez's monopoly had been articulated earlier by two of Boulez's rival composers, Xenakis and Eloy, in stinging articles at the time of the 1980 re-organisation. The articles spoke of IRCAM's failings and Boulez's abuses of power. The

polemic was not, however, disinterested: both composers benefited directly soon after when the Socialists came to power, Xenakis' small centre gaining a big funding increase and Eloy his own, new centre.

In 1986, officials of the (still Socialist-run) *Direction de la Musique* spoke as follows of IRCAM's role and its legitimation. Unlike all other music research centres, IRCAM is not under their control since its funds come directly from the Ministry via the CGP; so they perceive the sector as two-tiered: IRCAM, and the rest. There are three arenas in which IRCAM's legitimacy is discussed: its general cultural politics, technology, and music.

Regarding cultural politics, there is a dislike of Boulez's 'absolute power' and influence at the highest levels of the state, a sense of democratic outrage that "neither the Director of Technology nor of Music has the force to intervene at IRCAM, with a personality [Boulez] who is content to go to the highest and most powerful..." (JPO/HG int., my transl.). Officials speak cynically of IRCAM as 'official art' because of the dominance of Boulez's personality and of his aesthetic; they see IRCAM as institutionalised, smothering individuality (28). Whereas the small centres are considered more free, anarchic, open. "They have no art directors, no directing people...".

Technologically, IRCAM and the other centres are seen by officials as having different aims and needing different assessment. The small centres are required to operate a short R and D cycle, showing results - products, tools - at the end of 2 or 3 years. They are supposed to work on applied technological research, to bridge the gap between basic research and commerce. They are also enjoined to search for other funds, "to use their imagination to assure their survival". IRCAM, by contrast, is seen as doing basic research, not applied. It does not have to show

short term results or products, and should seek areas of research absolutely not covered by the private sector. It is assured a basic continuity of funds from the state, and should not be seduced by private finance.

However the following quote reveals some confusion about precisely the legitimate position for IRCAM to take:

"They've resolved around the classical areas of research not done by the market: room acoustics, psychoacoustics. This legitimation is immediate.. I think some private companies take this research. (On the other hand) the products that (IRCAM) creates are not commercialisable; public institutions don't have the economic necessity to need to develop commercial products. But research is different: basic research can be applied industrially.. But this is not the aim of the Institute, to develop things for the private sector, nor to develop products!"

We will see later how several oppositions implicit in the above - pure (or basic) to applied research, long term to short term, research to product development - recur within IRCAM culture (Ch.6). They are also reminiscent of Bourdieu's analysis of the character of the two basic sectors of cultural production.

On IRCAM music, officials were more evasive about mechanisms of external judgement by the Ministry. Pressed, they spoke of Boulez's fostering of young compositional talent, his absolute loyalty to IRCAM as a vanguard and his rejection of other high state musical jobs (29). Asked what has Boulez done musically since the premiere of his major work 'Repons' two years previously, officials laughed and answered "Repons! a new version..." Indeed, Repons appears to bear a great deal of the weight of legitimising IRCAM, and music - Boulez's music above all - remains the main arena for assessing IRCAM's results. However Fleuret's attitude as Director of Music was to suspend present aesthetic judgement and foster a pluralism of production, allowing history to judge and obviating the question of validation by audiences. In this,

Fleuret's ideology accords with Boulez's which, as we will see, involves a rejection of the 'mass public' and of legitimation by public 'enjoyment' at all. So officials implicitly condone the avoidance of assessing IRCAM's musical results in terms of present demand.

Ultimately, officials expressed the question of IRCAM's legitimation in this interesting way: "They search among themselves, ask themselves, year by year..to find their justification. 'What should we do?' they reflect.. They ask themselves for the justification of music research and computer developments: 'Is our work a little bit more sophisticated than that (software, for example,) on the market?'...". The official attitude thus centres on the belief that IRCAM is subject to a process of internal self-legitimation, self-monitoring and assessment; while the criteria of external validation seem both confused and irrelevant. We will see later that internal legitimation is in fact a continuous aspect of IRCAM culture, and takes many forms. It also becomes clear that both public and official discussion of IRCAM returns again and again to Boulez: the institute is, in France at least, very closely identified with the man. In the next section I examine why.

2.3.3 Boulez's personal history: the inflationary cycle of charismatic authority and power

I summarise here material given in greater depth in Appendix 6. I show how IRCAM's character, and its privileged position, cannot be understood apart from the influence of Boulez's personal history and ideology. I outline the strategies by which he has achieved the cultural authority that has justified the power and resources invested in him by the French state. Finally I sketch the character of his philosophy as it

informs his original vision of IRCAM.

I will show that Boulez has used two strategies to attain great cultural authority. The first, unmatched by most other major figures of the post-War avant garde, is his combination of productive and reproductive skills in three distinct but interrelated areas of his work: as a composer, as a conductor, and as a theorist, writer, polemicist and educator. In this way he controls every aspect of musical discourse: its production, but also the conditions of its production - its reproduction (performance, theorisation, diffusion through education), and so legitimation. Second, Boulez has been active as a composer, conductor, and in cultural politics both nationally (as we have seen), but also at the highest international levels. He has had a pivotal role in linking France to international music currents, and so combines national and international prestige. All of this has resulted in the widespread perception of Boulez as highly charismatic, a view constructed both by his own work, but also by mythic and heroic representations of the man.

Boulez's career can be divided into three phases. The first phase, his rise to fame, is from the mid 1940's to the early 60's. During the late '40's and early '50's in Paris, Boulez is remembered as a student leader who engaged in 'terrorist' actions and wrote polemical articles against the musical establishment. His denunciations took in many major figures, even those from whom he learned much: Schoenberg, Stravinsky, Brahms, Messian. His most notorious polemic, 'Schoenberg is dead' (1951), accused Schoenberg of failing to carry through the revolution instigated with serialism - the basis of musical modernism (30) - through his recourse to outdated romantic forms. Having purged the technique of Schoenberg's 'mistakes', Boulez announced that

serialism alone was the way forward for music. This laid the groundwork for what was to become the dominant '50's avant garde development: 'total serialism', in which (inspired by the later work of Webern) Boulez applied the principles of serialism to dimensions of music other than pitch - duration, loudness, timbre (see also Ch.9). Boulez's polemics also established a genealogy by portraying Schoenberg (and then Webern), despite their failings, as the prophets of future music. With another text, 'Eventuellement...' (1952), also advocating serialism, these writings became quasi manifestos for the young European avant garde. Boulez's early polemics, then, attracted public attention and notoriety, asserted his charisma, and drew followers around him.

Between 1954 and '67, Boulez was conducting and directing the *Domaine Musical*; while the late '40's to early '60's were his most prolific and successful as a composer. During the same period, he ventured abroad to the major European centres of the avant garde, developing especially strong links with two important West German centres. The first came from his close relations with the director of the South West German Radio in Baden Baden, Heinrich Strobel, who became his main German patron. Strobel also ran a major new music festival at Donaueschingen, which premiered many of Boulez's (and Stockhausen's) works. The other was Darmstadt, site of the annual International Summer Courses for New Music, which became famous as the rallying point of the new post War European avant garde. Adorno taught there regularly during the '50's, which may account for the echoes of his thought in Boulez's writings; but in general the traditions of German music and philosophy had a strong influence on him. Boulez became one of the main teachers at Darmstadt and, from the late '50's, the leading figure of the European

avant garde. His lectures of 1960, published as his first book (31), consolidated his theory of a new musical language based on total serialism.

The second phase of Boulez's career, from the early '60's to 1977, mainly saw a great increase in his conducting activities; and increasingly prestigious international work, culminating in Boulez being simultaneously the Chief Conductor of two of the world's leading orchestras - the BBC Symphony (in London), and the New York Philharmonic. In London, Boulez was successful as a conductor and cultural figure; but in New York he was less so, both with the public and with others in contemporary music. He outraged composers in a 1969 interview by insulting many fronts of American new music. In 1970 a group of well-known, mainly West Coast young composers accused Boulez of 'imperialistic thinking' for not including any Americans in a forthcoming festival. From this period, then, stem Boulez's unpopularity and controversial relations with American music. Boulez also achieved one of the world's most prestigious opera conducting jobs, at Bayreuth, home of Wagner; and conducted the entire 'Ring' cycle there in 1976 on the occasion of its hundredth anniversary. Boulez has since remained closely associated with Bayreuth, and is often compared to Wagner.

Finally, just a couple of years after the Malraux/Landowski conflict of 1964, and despite being 'on strike', Boulez became involved in another high profile French cultural political controversy. He agreed to help plan major reforms of the Paris Opera. But in May '68, when De Gaulle called on leading intellectuals to publically support his government, Boulez and others resigned from the Opera project, and he lent his name to a Leftist intellectual statement. Thus, in the context of his volatile relations with the French state and official music

during the '50's and '60's, Germany above all, but also the UK, became alternative musical, intellectual and political bases for Boulez.

The third phase of Boulez's career, 1977 on, is the period following his return to Paris to direct IRCAM. After the above conflicts, this had the air of the returning prodigal son. President Pompidou was apparently unhappy with the hostile relations between Boulez and French official life, and Boulez's virtual exile for a decade. Over dinner at the Elysee Palace, Pompidou offered Boulez a *carte blanche* to design the new music research centre that he had spoken of in previous years, thus inviting him to take part in Pompidou's post-'68 reconstruction of French culture, and specifically his new art museum, the CGP. IRCAM thus became planned as the music wing of the CGP. With the *Passage du Vingtieme Siecle* concert series throughout 1977 and then the opening of IRCAM, Boulez's return gained great public attention and IRCAM was launched with a major canonical statement. Boulez's conducting career continues while he directs IRCAM. Yet as several commentators have noted, his compositional output declined sharply after the mid '60's, which has led some to suggest that his conducting and IRCAM commitments represent spectacular but misguided attempts to overcome his compositional block. Since the start of IRCAM, Boulez's only major composition has been 'Repons'.

We can now summarise some of the strategies involved in Boulez's attainment of charisma; and we can add some more derived from representations of the man. First is the rhetorical strategy whereby Boulez is repeatedly compared to great composers (eg Wagner, Mahler, Strauss), or in which world class musicians (eg Messiaen, Klemperer, Stravinsky) are cited as supporters of his talent (32). Boulez has also

been the subject of hagiographic texts which promote his charismatic authority. Another common form of rhetoric around Boulez employs concepts of revolution, anarchism, vanguardism, and indeed heroism and prophecy - rhetoric imbued with charismatic associations; and Boulez himself toys constantly with this rhetoric. Two further aspects of Boulez's own work help to establish his authority. In his writings, he constantly references other realms of culture, thereby establishing for himself, intertextually, an impressive genealogy of musical and intellectual influences - composers but also poets, writers, artists, philosophers - and demonstrating his broad intellectual scope. He has also, over recent decades, expanded his media activities - broadcasting, writing newspaper articles. Boulez's increasing links to French and international social and cultural elites, and to the highest realms of power in France, themselves endow him with both charisma and power.

All of the above indicates, then, the ways in which charismatic authority has been vested in Boulez, and his active complicity in the process. We have also seen how throughout his career, his charisma has been converted into power: a self-reinforcing process, since recipients of power themselves become mythicised; and the Boulez myth now has great momentum. Hence it is apt to speak, in relation to Boulez, of an inflationary cycle of charismatic authority and power.

2.3.4 Boulez's intellectual character and vision of IRCAM

Boulez's writings are extensive and complex, and contain unresolved tensions, just as his composition exhibits an antinomy between extreme control and (limited) aleatoric procedures. It is nonetheless possible to extract key aspects of his theories that feed into his eventual vision of IRCAM.

In writings from the 1950's and early '60's, at the time he was leading the way with total serialism, Boulez stressed a new kind of rationalisation of the musical system.

"It is my belief that our generation will be.. devoted to the expanding of techniques, the generalising of methods and the rationalising of the procedures of composing or, in other words, to synthesising the great creative currents that have made their appearance since the end of the last century" (Boulez 1986 (1958):177).

Citing Adorno, he speaks of the necessity of discovering the immanent laws of musical development; and also like Adorno, he propounds the avant garde view that innovation, by definition, involves a refusal of immediate gratification of the general audience. Boulez draws analogies with the evolution of pure scientific theory, proposing that musical structures must also constantly evolve. There is a stress on the interface of music and science, by analogy with concepts from structural linguistic (syntax, morphology etc). However Boulez scorns "what is called the 'mathematical' - and is in fact the 'para-scientific' mania.. which gives the illusion of (music as) an exact, irrefutable science" (ibid (1960):73), and the 'number fanatics' who seek a form of "rational reassurance". Ultimately, then, he refers to the relationship between music and science as one of analogy. Yet, crucially, he never explains how he distinguishes musical discourse from those which he draws upon to structure it by analogy; and in fact rationalism and scientism recur constantly in his own rhetoric.

By the late '60's, Boulez's rationalism is transmuted into a concern with technology and related scientific research; and this is clear from his first speech touching on the IRCAM idea, given on May 13th 1968 at the height of the revolutionary events (Boulez 1986:445-463). He speaks of the need for a renewal of musical sound materials to

match the new post-tonal serial system and its forms: that these must evolve together. New technologies can provide new intervals, new instruments, new electronic sounds. In this and his famous article 'Technology and the Composer' (1977), often read as IRCAM manifestos, Boulez outlines broader problems that necessitate this change: the need to transcend negation as the basis of the new musical language, and to overcome the prevalent historicism of the musical world. In 1968 he depicts the total serialist period as having created a new musical language, but one based upon negation; he says that there must now be a shift to a period of synthesis drawing on the many musical, technological and scientific currents of the past decades.

Through these articles run also Boulez's more sociological analyses of the malaise of the musical scene. He criticises the conservatism embodied in the 'museum culture' of concert life, arguing that most major musical institutions - concert halls and events, the orchestra, instruments themselves - are outdated and have ceased to evolve. Concerts induce ritualistic and reified experience, they make participation impossible and alienate the audience. On the audience, Boulez stresses issues of perception, proposing that contemporary music must demand a new active listening, the intelligent participation of the audience. These ideas resonate, variously, with the influence of Adorno, Benjamin and post structuralism. On the actual small and elite audience for contemporary music Boulez is contradictory: he calls for composers to 'set out in search of an audience', not to be content with a 'clique'; yet within IRCAM, and as we saw above, he chides those who seek to satisfy the general, 'mass' public - '*la grande public*'. In Adornian fashion, Boulez equates large audiences with commerciality, with easy listening and a lax pluralism. He creates a dichotomy between

'entertainment' and 'demanding' music, asserting that simple pleasure and enjoyment are nothing to do with artistic value and progress. "There are musics which bring in money and exist for commercial profit; there are musics which cost something, whose very concept has nothing to do with profit. No liberalism will erase this distinction" (Boulez 1985:8). Thus autonomous music (and related research) involve, by definition, a negation of the interests of commercial success and of the mass audience. Boulez thus epitomises Bourdieu's analysis of avant garde ideology.

IRCAM's existence is predicated on an extension of the same perspective. Boulez argues that computer music has so far developed 'irrationally', in commercial situations (such as Bell Labs) "under the ceaseless pressure of the market" (1977:8), and ignorant of musical needs. Instead, it should develop in a specialised music institution where the search for 'radical solutions' can be independent both of 'official powers' and of commerce.

"An institute of this kind should enjoy a total autonomy and a very flexible internal structure despite its many external links... With no immediate obligations it should be able to manifest a true disinterestedness and pursue objectives unattainable by any organisation too deeply engaged in 'mundane' matters" (Boulez 1986:466).

Boulez suggests that the institute should address sociological aspects of music - audiences, concert organisation - as well as new instruments and sound materials.

Several institutional models influenced Boulez's ideas for IRCAM: above all, the Bauhaus, but also the German Max Planck scientific institutes, and the American university computer music centres, in which, Boulez says, there exists a "permanent alliance between musicians and scientists" (ibid:484). In his article 'The Bauhaus Model', Boulez

writes approvingly of the fusion of pure and applied arts, the 'laboratory' atmosphere of invention and experimentation, and the collaborations aimed at overcoming the 'arrogant class distinctions' between craftsmen/technicians and artists, all of which were central to the aims of the Bauhaus. The parallels are deeper than Boulez pursues: in its second phase, the Bauhaus became increasingly obsessed with progress, technology, American influence, as summed up in its new slogan 'Art and Technology - a new unity' (Whitford 1984, Willett 1978, Gay 1968). Boulez derives from the Bauhaus the notion of a 'general school or laboratory', and a concept to which he refers repeatedly: the necessity for teamwork or collaboration between 'researchers', musical and scientific, and technicians.

The heart of Boulez's vision of IRCAM, then, is a "utopian marriage of fire and water" (Boulez 1977:10) between music and science, art and technology, founded on interdisciplinary collaboration between musicians and scientists: a unification of opposites. Further, by this notion of collaboration inspired by the Bauhaus, Boulez implies an egalitarian sharing of skills and ideas. This is the crux of his vision of the institute's internal social relations; and around it, in his writings, he scatters utopian and politicised rhetoric reminiscent of various political rhetorics - socialist, Leninist, Trotskyist. Thus, as we saw in the quotes at the start of Ch.1, he calls for an end to private property and individual labour in creative work, for internationalism, and for IRCAM to be a vanguard of long-term, future-oriented research.

The ideas behind IRCAM, then, are intertextually complex and authoritative, and they raise contradictions and questions: how, for example, Boulez reconciles the desire to avoid official control with

IRCAM being a large state institution; and whether, or to what extent, his ideal of egalitarian collaboration between music and science is achieved in IRCAM's work relations. This suggests that we examine the relation between Boulez's utopian founding ideology and the actual functioning of IRCAM, to which I turn in the following chapters.

Chapter 3 Status and stratification

Introduction

The production of music at IRCAM, bringing together scientists, technologists and musicians, supported by administrative and clerical staff, involves an institutional division of labour more extensive than any previous historical form. The question is: how differentiated and stratified is this division of labour? We see in this chapter a disjuncture between Boulez's vision of egalitarian collaboration and the institute's actual social form.

I suggest that IRCAM's internal social relations must first be explored in terms of a division into two spheres ranged along a continuum between mainly reproduction-related and mainly production-related roles, a division representing a basic status distinction. This is marked in various ways. It accords, first, with the institute's sexual division of labour. It is also expressed through the different cultural dispositions of the two spheres. The stratification of institute workers by pay and conditions correlates with the hierarchy of status. But within the higher production sphere there is a strange suspension of this logic, so that for the institute's most ambitious and music-oriented intellectuals an inverse relation obtains.

3.1 Unequal status and the division of labour: production and reproduction

Within IRCAM, it is widely believed that the staff associated with research and production have high cultural status, since they are directly involved in the institute's main, public work. This high status extends beyond those with obvious executive and high cultural authority,

as the position of staff such as the young junior tutors makes clear. These workers, who do the same work as tutors - assisting incoming composers, writing software, doing psychoacoustic research - but who are not employed as such, have high cultural status despite their low pay and insecurity. By contrast, administrative and clerical staff concerned with the institute's basic institutional services - with its reproduction - have lower status. The Administration itself is concerned primarily with the institute's bureaucratic and physical functioning; while clerical staff are attached to different units, and within each they perform servicing tasks.

This delineates, then, a basic division of IRCAM culture into two spheres: a lower status administrative and clerical sphere associated with reproduction, and a higher status research and production sphere associated with production. This is another variant of the fundamental binary opposition of 'production' to 'reproduction' mentioned in Ch.2, which takes different meanings in different contexts. It referred there to IRCAM's greater prestige, as an institution involved in cultural production, than the rest of the CGP, associated only with cultural reproduction. Within IRCAM culture, the concept of 'production' refers at the most inclusive level not just to music production, but to intellectual origination in general - whether of music, research or technologies. While this IRCAM concept of 'production' is explicit, its opposite category of 'reproduction' is implied; it refers not to cultural reproduction in the narrow sense, but to the broader sociological meaning: ie servicing and maintenance of functioning. Again, the production sphere is perceived to have higher status and prestige than that of reproduction (1).

3.1.1 Gender and status

There are many expressions of the two status domains within IRCAM culture. The most obvious is a close correlation with IRCAM's sexual division of labour, whereby the low status sphere of reproduction is associated primarily with women, and the higher status production domain almost exclusively with men. Table 3.1 outlines the population's sexual division of labour by enumerating womens' jobs and employment status. It shows that women are overall far fewer in the IRCAM population than men; and within that all clerical staff are women, while there are very few women working in IRCAM's research and production sphere. They amount in '84 to just four (plus an unpaid postgraduate), none of them on full-time posts. On the other hand, there are also some men working in lowly administrative jobs, while a few women are able to achieve high office. However, it is interesting that when we examine the apparent exceptions to the rule, the analysis becomes more subtle, but it is supported. They include the Administrator TY, and two apparently linked to production, the director of the Production Office VR, and the director of Diffusion NF. TY's power is clearly confined to the administrative sphere, and it is significant that this central reproductive sphere is headed by a woman (and was again following her departure, by the new Administrator VN). It appears that VR and NF are production executives; yet they are both actually concerned with reproductive and administrative roles within the production sphere - VR with the management and co-ordination of resources for production, NF with publicity and external communications about production (2).

Thus women with higher office, even when ostensibly working within the sphere of production, are nonetheless confined to reproduction. This

Table 3.1 IRCAM's sexual division of labour: women's jobs and employment status in 1984

Posts: full-time permanent staff:

Total - 54 (100%)
Men - 38 (70%)
Women - 16 (30%)

Of the 16 women on posts:

Total - 16 (100%)
Clerical - 12 (75%) - secretaries, assistants, hostesses
Directors - 3 - Administrator (TY), Production Office (VR),
Diffusion (NF)
Technician - 1 - Systems team (ARY)

Regular temporary workers

Total - 44 (100%)
Men - 36 (82%)
Women - 8 (18%)

Of the women temporary workers:

Total - 8
Clerical - 3 - secretaries, assistants on vacations
Research - 2 - computer scientists, one 4X vacation (WRY), one
systems honoraire (NM)
Composers - 2 - one commission / honoraire (FG), one squatter (NP)
Postgraduate - 1

Other occasional visitors during '84:

Total - 20 (100%)
Men - 20 (100%) - composers, musicians, scientists, researchers

Within whole population:

Total population - 118 (100%)
Total women - 24 (20%)

Breakdown of all women workers:

Total - 24 (100%) including -
15 clerical (63%), 3 directors (13%), 2 computer scientists
(8%), 2 composers (8%), 1 technician (4%), 1 postgraduate (4%)

is why I spoke above of a continuum of positions between reproduction and production. It is interesting that the position of IRCAM technicians is precisely the obverse. The technicians are all men (with the exception of Systems technician ARY), and although ostensibly in servicing roles, these are services closely associated with musical and technological production. The Sound and Esp Pro teams assist all performances, and go on IRCAM tours; the Sound team oversees recordings; while the Systems team is vital to the continued functioning of the computing research environment. The technicians are, then, considered essential to the success of production.

Attitudes expressed directly and indirectly by men in meetings when women are not present, or reported by women, and behaviour towards women, all provide insight into the implicit ideology underlying IRCAM's sexual division of labour, as well as the discrimination flowing from it. The main expression of sexist ideology is in the hostility and suspicion aimed at women who defy the 'natural' sexual order of things by taking on higher or skilled roles. They experience three classic ideological forms of sexist hostility: the view that they are hysterics (levelled at a composer and a director), that they are being hired or tolerated because of their sexual attractiveness and/or because of their sexual relationship with a man at IRCAM (directed at a computer worker and a composer), or that they are lesbian, uninterested in men, or somehow aberrant (levelled at a director and a computer worker). Discrimination is clearly entwined with these beliefs. The clearest form, apart from the sexual division of labour itself, was a reluctance to promote one woman worker in a skilled technological male domain, despite her male boss's advocacy; and the woman composer who was patronised as girlfriend of a key music worker.

3.1.2 Space, time and status

The division of spheres is also expressed through symbolic temporal and physical / spatial divisions within IRCAM culture. Spatially, it is most clearly expressed in the location of the Administration department in the old building, separate from the rest of IRCAM, and in its totally independent micro computer network. Clerics are the only staff in the rest of the house not to have access to the VAX terminals, symbolising their irrelevance to research (3). Similarly, clerics never attend the various open meetings to do with research and production, while technicians and administrative directors sometimes have occasion to. These meetings are the place for debate and general information, for the dissemination of policy and ideas. They constitute IRCAM's own internal fora: the public space in which adults engage in democratic debate. Clerics' office-bound non-engagement with this space demotes them to the institute's 'private' sphere: by implication, to the status of non-adults.

Temporally, the population keeps two different working periods: the normal office weekday, and the rest - evenings, nights and weekends. The office day is kept strictly by all administrative and clerical staff. Clerics feel they are being monitored by the Personnel director, who sometimes hangs around the entrance hall, fetching a coffee, chatting amiably, and watching people's movements. Directors and research staff are also, less reliably, available. They may wander in later, and have long lunch engagements; meetings and consultations often fill their office days.

By contrast, the unofficial evening, night and weekend culture contains exclusively production-related workers. But within this, and

informally, different workers take different shifts. Technical teams, and all involved with performances, stay into the evenings whenever performances occur. The Systems team have maintenance duties to carry out each evening: they change over the computer tapes and disks upon which all the day's programming is recorded, and make copies - called 'back-ups' - as a security against loss. Also working regularly are the projects using the 4X, who follow a 24 hour timetable to gain maximum use. Less routinely, and less tied to specific tasks, are the computer researchers and composers who can be found working into the evening, and some throughout the night. This includes the more ambitious computer scientists who stay relentlessly pursuing their programming, amongst them some from the Chant/Formes group and IRCAM's two computer 'hackers' (or obsessive programmers) (4).

Composers using the evenings and night include, occasionally, directors and tutors, but more often those with commissions, junior tutors and squatters. They work at night for different reasons. All musicians on staff use the off-time to avoid meetings and interruptions, as well as to bypass their lack of official status as composers. Thus tutors, for example, do their own musical work when not engaged with a visiting composer late at night and at weekends. Commissioned composers work out of peak hours to avoid computer congestion on the VAX, and so to be able to work faster and without constant crashes of the system. One commissioned composer had an additional reason: he worked only at night because he so disliked the bureaucratic feel of the place. Squatters work at night to avoid official notice, and to gain maximum computer usage and freedom while they learn the ropes of computer music and produce their first inelegant sounds. The night and weekend culture thus has the sense of being open-ended, with no immediate goals or

bureaucratic demands. It constitutes a sort of self-styled intellectual and artistic vanguard, and includes a high percentage of juniors, squatters and bohemians: those least tolerant of bureaucracy, most ambitious and / or as yet unrecognised, and wishing to get concentrated work done uninterrupted or unseen. All-night workers are spaced throughout the house, logged on to the VAX at different terminals. A spontaneous camaraderie arises, so that every few hours on-screen messages and jokes pass between workers asking how work is going and whether anyone would like to go out, above ground, for a coffee and cognac. But there is no lasting group identity here: it is a small, fragmentary, changing and competitive collectivity.

Research and production staff give two reasons for working outside the office day: because of the endless interruptions and meetings in the day, and the problem of heavy computer congestion. The state of the VAX indicates the busiest time of the day: it is stretched to capacity between 11am and 5pm each weekday. Visitors, learners and squatters are thus barred from using the VAX during those times; and when overstretched, it crashes. However, there are two additional forces behind the two timetable system. The first concerns secrecy and privacy. IRCAM has an interconnected system of loudspeakers linking most studios and work rooms, and through them the sounds being produced by anyone using the computer network can be heard by all around the house: a kind of enforced 'democracy' of aural information. Similarly, programming on the VAX, since it links together all using it, means that others logged on to the system can attempt to gain access to one's files and 'look' at one's work. Both of these technologically potential 'democracies' of information cause ambivalence in their respective communities of

composers and programmers. By night working, then, intellectual staff try to circumvent them and so retain a greater privacy for their work-in-progress, whether from fear of embarrassment at crude early work or fear of rivals' spying.

The second force expressed by the timetables returns us to the basic distinction between productive and reproductive staff. We have seen that productive staff are given the benefit, and responsibility, of flexible hours. Some stay on late beyond the normal working day, or work long hours, with the incentive of being paid well enough to do so (directors, computer scientists). But not all are paid well (composers, technicians, junior tutors) or at all (squatters). So the motivation for many night workers is not pay, but the pursuit of art / science / knowledge; and, no doubt, the added status and charisma that accrues to all intellectual staff by precisely disdaining the limits of the ordinary office day and being seen to self-exploit through working extraordinary hours. For some, as I have indicated, there is the additional attraction of a kind of exclusive bohemian chic that attaches to the out-of-the-ordinary night culture. Cultural status thus appears to vary directly with the degree of self-exploitation in intellectual labour; at least, that is the implicit belief of IRCAM's vanguard, and certain results bear it out as I show next chapter. On the other hand, for reproductive staff there is no incentive to work beyond the office day. Theirs is an entirely different symbolic economy of time, in which the only measure of their job aptitude by those in authority appears to be keeping regular hours, and in which expression of dissent takes the form of snatching an extra half-hour for lunch. Lower status workers, then, engage in a symbolic struggle to wrest time back from that paid for by the wage. As we will see, both economies of time play important

roles in the respective politics of the two spheres.

3.2 Production and reproduction, the 'cultured' and the 'uncultured'

The status division between the two spheres is also expressed by subjects' different cultural dispositions, especially through their attitudes towards avant garde and IRCAM music. In Chapter 1, I discussed Bourdieu's analysis of two kinds of art perception. I show here that although we find within IRCAM culture examples of those two antagonistic positions, whereby the cultural attitudes in IRCAM's lower status sphere of reproduction correspond to the 'naive', 'uncultured' and 'uneducated' and those within the higher production sphere to the 'cultured' and 'knowing', yet the situation is more complex. The complexity extends Bourdieu's analysis, however, rather than refuting it.

The social structuring of cultural capital within IRCAM follows the three positions outlined above and in Fig.3.1 below: that is, workers associated with reproduction, with production, and those workers falling between the two - the technicians and two women artistic administrators. Whereas workers from the reproduction sphere consider themselves without any professional involvement in art and intellectual work, it is striking that those poised between production and reproduction - technicians and the women artistic administrators - share a background of work in the arts, or engage in external professional cultural activities. They are thus far from culturally naive, but professionally and pragmatically involved in artistic work (5); so they do not express the mystified distance from, or reverence for, all things artistic that is characteristic of reproduction workers.

Bourdieu sees education and 'culture' as the distinguishing factors

between his two kinds of art perception, with 'culture' the more obviously inherited and unconscious class trait. We know that he also considers educational achievement to be structured by class; yet with education he leaves some space for the acquisition of cultural capital or knowledge. Within IRCAM, we will see that the concept of a 'need for education into understanding' avant garde music is the main form by which lower status workers express their sense of lack of cultural mastery, of 'not knowing about' or 'not understanding' the music. But a 'need for education into understanding' the music is not expressed by them alone: IRCAM's higher status intellectuals and music workers also commonly express the view. However, unlike lower status workers, they consider themselves to have been through this education process, and so to have attained the understanding which is now, therefore, assumed.

3.2.1 Ways of 'not knowing about music' and 'not being cultured': aspiration, resistance, and 'otherness'

Lower status administrative and clerical workers are united in believing that they do not have the educated kind of 'culture' that IRCAM's music and intellectual sphere embodies. The only exceptions are the one or two with family or other background links to contemporary music (6). Beyond this unity, however, there are three different attitudes discernible towards the 'culture' of IRCAM's higher sphere, expressing varying degrees of awareness, mystification, and resistance. Most common, and most consciously self-deprecating, is the enchanted attitude of reverence expressed by workers who believe that they have no understanding of avant garde music, so that they must submit themselves to a process of gradual education or socialisation - signalled mainly by going to concerts - in order to appreciate IRCAM's musical and

intellectual *raison d'être*. These workers attribute their lack of 'culture' to family or education, or to a lack of 'gifts'. Their attitude is imbued with a sense of moral self-improvement, and undergoing a process of education becomes a mark of good faith in the institute and of commitment to their job. Indeed, in IRCAM's earliest period this attitude was institutionalised: weekly educational seminars on IRCAM's musical philosophy and technology were provided to coincide with the massive canonical concert series 'Passage du Vingtieme Siecle' for all levels of staff, who were expected to give up their lunch time for them (7).

Although many lower status workers talk of going along to IRCAM concerts in order to learn about the music, in reality only a few of them can be seen at most concerts. The sense of obligation is thus stronger than the desire. One secretary said of her cultural background and the effect of her entry to IRCAM:

"My parent's weren't rich, we had no theatre, no concerts. We were isolated. There were just records and radio: music was a bit secondary - something that came after, not of the first order of importance. We didn't learn music except through a local choir... Since I've been at IRCAM, I've gone much more often to concerts, at IRCAM and elsewhere. I've discovered Stravinsky; it sounds idiotic, but.. I listen better, I buy more modern things, whereas before I knew absolutely nothing about contemporary music. I have little judgement, because I have few (musical) gifts". [QRC int., my transl.]

Another reproductive worker, the Personnel director, despite his father being a provincial professional musician, stressed the process of education into higher culture as a pleasurable adventure. On IRCAM and avant garde music he began:

"Well, my education didn't at all predispose me to this kind of music. I am, on the other hand, very curious to discover this kind of music, as I am curious to discover no matter what! - all that exists!.. What I have lacked up until now is - whether it be other people, or the culture, or an approach - that could help me to understand or to like this music... Since coming here, I've had much advice (laughs)..about

how to try to enter into this music... Yes, I go to concerts - this evening I go to PL's.. No, in any case I want to get into it (as though countering his own scepticism)... I have a great openness of spirit for this kind of thing' [my transl.].

We can see here ambivalence beginning to peep through. Other Administration directors represent the second position among reproductive workers: a combative attitude of resistance to cultural mystification, a thinly concealed scepticism towards the self-evident value of IRCAM music, and even plain dislike. The Administrator herself, asked if she was interested in contemporary music, replied:

"The music that interests me above all is classical music: that's not to say that it interests me especially, but let's say that I received an education that was very classical for some years... When I arrived here, I knew absolutely nothing about contemporary music, nothing at all. I must say that I find that to understand contemporary music, or even to listen to it, it's necessary.. it's a question of education. And the classical education isn't sufficient. And when I first went to concerts here, I was incredibly, profoundly bored and annoyed. Whereas now, but that's four years that I've been here, I go now to concerts out of my own interest. It interests me: I understand the evolution, I understand the things: that's to say that I like the music.. so it interests me a lot more, whereas at the beginning!! (blows a raspberry).. it was completely hermetic! (with annoyance)" [my transl.].

The Administration's north african Accountant said of his relation to IRCAM music:

WS: "I go very rarely, very rarely to concerts here!"

Q: "Is it the aesthetic of avant garde music that you don't like?"

WS: "No, not really, that doesn't bother me.. there are many musics that are not easy to assimilate. No, what I don't like.. On the other hand, the other day I went to the PL Workshop [concert by the black American commissioned composer], and that I liked a lot... But thinking of works like Radulescu [commission premiered earlier].. Phew!!, it's hard. Me, I'm also upset when I see that we're giving a concert, and know how much that has cost, to see the result.. I'm really brought down!.. All the concerts cost a lot, are expensive for IRCAM. And generally, there are very few good concerts in my opinion" [my transl.].

Workers in this position also feel confident to express less personalised and emotional, and more intellectually detached views, sometimes spoken as though representing 'the general public'. These take the form of different critical assessments of the social context of

IRCAM music. The Administrator argues that IRCAM is failing in its duty to provide educational links for the general public with contemporary music, without which the public is annoyed by and cannot be interested in the music (8).

The Accountant is critical of the size and character of the IRCAM audience, and links that to a critical appraisal of the patronage surrounding IRCAM's composing elite:

"(I am upset by) the results, and the people affected by them: there are very few people going to the concerts. I find that strange: very big expenses and costs to touch only a very small public..(that is) strictly Parisian.. It's always the same types - 'B.C., B.G.' ('bon chic, bons gens': slang meaning very chic, very classy people).. the 'nomenclatura' we call them, I think it's what you in English call the 'establishment'! ...Me, I have the impression of IRCAM concerts that it's only a little clique that comes.. In the *Espace Libre* you find the epitome of that minority,..always the same. For example, at the level of publicity, they put a little piece in 'Liberation' - and who reads 'Liberation'?!! Exactly the same crowd! There's been a change the last year, though: they've made videos (which) explain what IRCAM is, the music made.. They're shown on TV. That's a better way to make people acquainted with IRCAM, contemporary music.. In that way, some new people come across that music. (Whereas for) the *Espace*.. well, it's little mates of a friend of [the organiser] who bring along their tapes, their little film. But it's not an unknown, anonymous guy who's made something..who can come along" [my transl.].

It is notable that this critical attitude of resistance to cultural domination is held by the more powerful workers within the sphere of reproduction. They are aware of cultural difference, and they resist it. A third position, its opposite - being unaware of the significance of cultural difference and not resisting - can be found amongst the least powerful and lowest status reproductive staff. These workers appear quite unconcerned by the issue of cultural distinction and unaware that the higher culture of IRCAM has any relevance for their own lives: the two are simply not brought into juxtaposition. IRCAM's espousal of absolute cultural values does not concern them; they are unaware both of the implicit denigration of their own culture, and of the meritocratic

option of cultural 'self improvement'. This position of 'otherness' does not preclude a reverence for IRCAM intellectuals and particularly for Boulez, the patron (boss) (9). Thus a very few of the lowest status workers do not even profess the desire to 'be educated into understanding' the music: they are content without, and have other kinds of relationship to other kinds of musics.

3.2.2 How music is experienced by the 'uncultured'

We will see in later chapters that workers from IRCAM's higher sphere of cultural production also have relationships with different, non-IRCAM, kinds of music. But in that sphere, the different musical tastes are ideologically loaded: even if not intellectualised, they represent more informed and consciously chosen positions within implicit ongoing conflicts of cultural politics and taste.

By contrast, IRCAM's reproduction workers, with no special knowledge of musical or cultural production, exhibit a different kind of relationship to their musical tastes. I have shown that many lower status IRCAM workers - in the shadow of high cultural production - are quite anxiously aware of the 'understanding' that they lack, and that they hope education can improve. The ways that they relate to musical experience betray variants of the unmediated cultural pleasure that Bourdieu describes. Asked about their musical tastes, most are concerned first simply to list music that they 'like' or 'don't like', without explaining why, so that a personal consumer choice stands as sufficient justification. Crude classifications are used to aid identification of the different musics enjoyed: (for another example, see note (10)):

"I listen to a lot of classical music. The music that I love is 19th century.. The ones I prefer are Beethoven, Wagner.. mmm,

Stravinsky, mmm Debussy... Oh yes! I love jazz. I listen to a lot of music, different music. But I like some more than others: for example, I like some jazz musicians - I like best people like... er, John Coltrane.. er (pew!).. I forgot earlier, about classical music, I like Richard Strauss. But, OK, I also listen to modern music - the Beatles.. well, I don't know if they're modern (laughs) but.." [KG int., my transl.]

The worker with the most sophisticated and encyclopaedic awareness of classification, but applied only to popular music genres and as if learned by rote rather than by inner understanding, was the postman:

"Pop, jazz, reggae, 'black', disco, country: I listen only to foreign pop... I love hard rock - Judas Priest, Iron Maiden.." Q: Led Zeppelin? A: "Led Zeppelin? I don't know whether that's hard.. Black Sabbath: that's hard rock,.. Deep Purple isn't.. no, no. It's good, but not (hard rock)" [my transl.].

Asked to explain why they like something, to expound further or to exemplify a taste, these workers are insecure and can become inarticulate. When pressed to be specific about the music he last listened to, for a couple of minutes the postman went absolutely blank and could not tell; then he blurted out:

"Elvis Presley, Little Richard, the Shadows, Buddy Holly, Chuck Berry... Beatles, Rolling Stones, the Pink Floyd... Jazz: I have lots. I have Duke Ellington, Stan Getz, Django Rheinhardt, Louis Armstrong.. Fats Domino..." [my transl.].

These workers have two ways of expressing their relation with music, extending from the 'like / don't like' consumer judgement. One is emotional and sensual: about feelings, mood, the pleasure of discovery. Reference is made to the 'right music at the right time for my mood', to 'discovery', to 'the music that I love' and 'adore', to 'gay', 'amusing' and 'ravishing' musics. When asked whether she disliked strongly any IRCAM music, a secretary replied: "It's like.. candy! Some are good, some are bad, some I like, some I don't'. The other way, extending this, dwells upon the direct phenomenal forms in which musical experience is embedded: the commodity or technological forms, their costs and

quantities, the process of buying them, the physical or emotional state of the listener. Phenomenally, the postman has the most elaborate awareness of the role of music in his life. He hoardes music on cassette and is acutely aware of quantity, cost and commodity form. He is also intensely concerned with the physical state he needs in order to listen to music (11).

Such ways of talking, then, illustrate the relatively simple, sensual and unmediated nature of lower status workers' vocabulary for their musical experience - as Bourdieu argues, an absence of knowledge of the codes and categories through which the 'cultured' are supposed to experience music. By contrast, we see in later chapters that IRCAM intellectuals have problems derived from their over-mediated ways of talk, and can be quite inarticulate about music per se.

3.2.3 Status and culture within the higher production sphere: achieved and inherited culture

I mentioned above that belief in the 'need for education into understanding' contemporary music was also held by higher status workers, musical and scientific, involved in IRCAM music; and the majority feel they have themselves gone through such a process in order to achieve their affinity with the music. This achievement is often described in mythic or heroic terms: as a gradual process of revelation or enlightenment, or a trial by fire overcoming obstacles and so a mark of determination and commitment. Whatever, the relationship is achieved and now assumed. One composer repudiates his parents' culture and speaks of the obstacles they placed in his way. He puts great importance on the classical music radio stations that introduced a higher musical appreciation into his life - also spoken of by other French IRCAM

intellectuals:

"My parents were always against me doing music.. They thought that to be a musician was a career that didn't earn a living.. the mentality that musicians always screw up their lives. So they forbade me to do music! I had to wait 20 years, till I left home (and) went to Paris... There was no music in the family house. The cultural milieu of my parents was not very elevated.. My mother was from Corsica: a woman with very little education. And my father.. had a normal education; but for him, culture.. wasn't a part of his life that could be intellectually stimulating. It was something around; but he didn't understand that culture could be enriching... No records, no; but there was the radio: and that's how I came to know about music. When I was 13, I listened all the time to 'France Musique'.. I discovered a world of music that I had known nothing about! I found (it) completely extraordinary and so.. that's what I decided to do, at 13 years. Before that.. I knew nothing: I was in a milieu, basically, that was culturally very very empty" [AG int, my transl.].

The American Pedagogy director RIG also described his emergence from the cultural milieu of his family, in Belleville Illinois, a lower middle class white suburb of St Louis, and how it began to stimulate his interest in science and music; but in rather different terms:

"My dad was very scientific oriented - a manager on a local air base. I got science from my dad: I got interested in space - this was the '50's - when I was a kid. My mother brought music to me: she was a pianist, popular music mainly. She had a lot of sheet music, collections of Gershwin tunes. She didn't play too well... My first musical experience was Tex Ritter - a country'n'western singer... At 4 or 5 years old,..I liked to listen to certain licks.. (There) was a Tex Ritter lick - 'Frog he went a courtin''! (laughs a lot)... In grade school - I was science oriented then; and I wanted to be in the band. I wanted to play trumpet, but the band manager said that my lips weren't thick enough!! (laughs at the implied racism). So he told me I had to play drums! Just like that!"

It is a rare IRCAM music intellectual who professes to a 'natural' and inherited rather than primarily 'achieved' culture. Contrasting with RIG's sense of cultural 'legacy' is that of another American, the Music Research director HY: the one IRCAM intellectual to claim inherited high cultural capital both musical and in relation to computing. From a Jewish New York background, HY's father set up one of the first computer graphics businesses, and according to HY is known as

'the father of computer graphics'. While HY's mother was a concert pianist, trained at the Juilliard, who became a leading music teacher in New York. HY talked of his mother devising stimulating cognitive musical games to teach her children. In this way, he conveys a sense of special inheritance in relation to his vocation as a computer music composer.

The result of the majority experience amongst IRCAM intellectuals of achieving, often against odds, a close relationship with contemporary music is that IRCAM's higher sphere of cultural production is imbued with a strong sense of classless meritocracy and of cultural commitment, rather than inherited cultural privilege. The classlessness is also supported by the sense that since research and production workers are judged on their creative merits, so workers from humble backgrounds can prove themselves and be promoted. And in fact, workers with both humble family backgrounds and lack of relevant high educational qualifications can do well. Thus, as well as the composer and Pedagogy director discussed above, several other key music-related intellectuals come from lower class origins (WOW, HM, NR), and some lack formal education both in music (WOW) and in computer science (BYV, MC). However I show next chapter that this apparent non-bureaucratic openness to skilled workers being formally underqualified is balanced by other workers being misqualified and overqualified. Absence of nepotism is suggested by the lack of advancement of an IRCAM music worker who is the son of a famous East European composer. On the other hand, his poor treatment may also link to his officially unacceptable aesthetic and technological positions, which I discuss in Ch.9, and from his being East European, since these workers appear to be disadvantaged within IRCAM (12).

Against the meritocracy and 'humble origins' thesis, there are also IRCAM workers who do come from privileged backgrounds. Thus, as well as

the Music Research director, the Artistic Director WV enjoys both familial and educational privilege (upper class Jewish Londoners, Cambridge, Glyndebourne). WV plays the game both ways. He feels that, since he had to fight to overcome the handicap of lack of musical background, and a family prejudice against contemporary art, his relationship with contemporary music is achieved. Yet, he boasts a family involved in painting, and in art, jewellery and antique dealing to the international aristocracy and bourgeoisie, over generations, as though his aptitude for artistic mediation and judgement are in born. Despite no higher musical education, family contacts landed him a training at Glyndebourne, the elite British musical institution, and later provided him with openings to patrons for his own early music entrepreneurial activities; so that his position as Artistic Director could hardly be more overdetermined by cultural and economic privilege. Other workers have one or other kind of privilege. American workers from lower class families tend to have been through the major American universities - for example Stanford, Yale or Harvard (HM, PL, WLe).

Thus the meritocracy thesis must be modified by regard to these underlying dimensions of privilege. Nonetheless, the fact that all higher status music-oriented staff, whatever their background, sincerely believe they have meritocratically and individually attained their particular attachment to contemporary music counters the potential within the institute for a sense of cultural domination of non-intellectual workers - a sense hinted at only by the critiques of the Administrator and the Accountant.

3.3 Status differences within the spheres of production and reproduction

Finally, the analysis above also suggests the existence of hierarchies within each status domain, which generates resentment. In the reproductive domain, Administrative executives have higher status and power than lower clerical and administrative staff and cleaners. Different groups of workers express hostility towards the Administration differently. Clerics, directly subordinate, experience it as an unmediated policing about which they remain largely mute. Research and production staff, from their 'other' sphere, express hostility through a disdain for the Administration's bureaucratic philistinism.

The production sphere also contains a hierarchy of status. Formally and publically, IRCAM's music-related staff have the highest cultural status. Boulez's vision also stressed long term research, rather than short term market-driven technological development - suggesting that IRCAM subscribes to the wider ideology whereby pure research has higher status than applied technology. The key to status within the production sphere is provided by membership of the informal musicians group, those attending the voluntary musicians meetings called together by the Music Research director HY in 1984. As well as regular attenders, other workers would occasionally turn up when interested (eg Boulez, the Artistic and Scientific directors, programmers and technicians), so that membership was self-elected. Meetings were held in a central seminar room about bi-weekly over some months. The meetings delineated a group of IRCAM intellectuals who aspire to the role of IRCAM's ambitious vanguard, and consider that they are the fundamentally music-oriented workers within IRCAM: the two are linked, as in Boulez's vision. The

group has a core of HY, the Pedagogy director RIG (also a composer), director of 4X Software BYV (a musician), director of Chant/Formes MC, two junior tutors and composers (WOW and NR), a junior tutor and psychoacoustician (HM - also a musician), a composer researcher (HU), and the tutors (WR, JIG, JDK - two of them also composers). Of these 11 workers, although almost none of them are officially employed as such, 9 are composers or musicians: the group thus contains almost all the self-defined serious musicians from IRCAM's higher sphere.

It is striking that after music intellectuals, the group consists primarily of software researchers or programmers. Of the 11, 2 are the main software project directors (BYV, MC), 2 are closely associated with Chant/Formes (WOW, JDK), and in all 9 are regularly involved in programming as part of their work. In fact, tutors and junior tutors do a great deal of programming in assisting composers, to provide them with a custom built computing environment for their piece. In addition, the Chant/ Formes team consider their work closer to fundamental or pure, long term research rather than simply short term technological development. So in the musicians group, software research comes to be identified with long term research oriented towards IRCAM's musical ends (see also Ch.6). Overall, the informal coalition of interests in the group, bringing together music, fundamental research, and software research and development, embodies the institute's major bid for its highest cultural status as a vanguard.

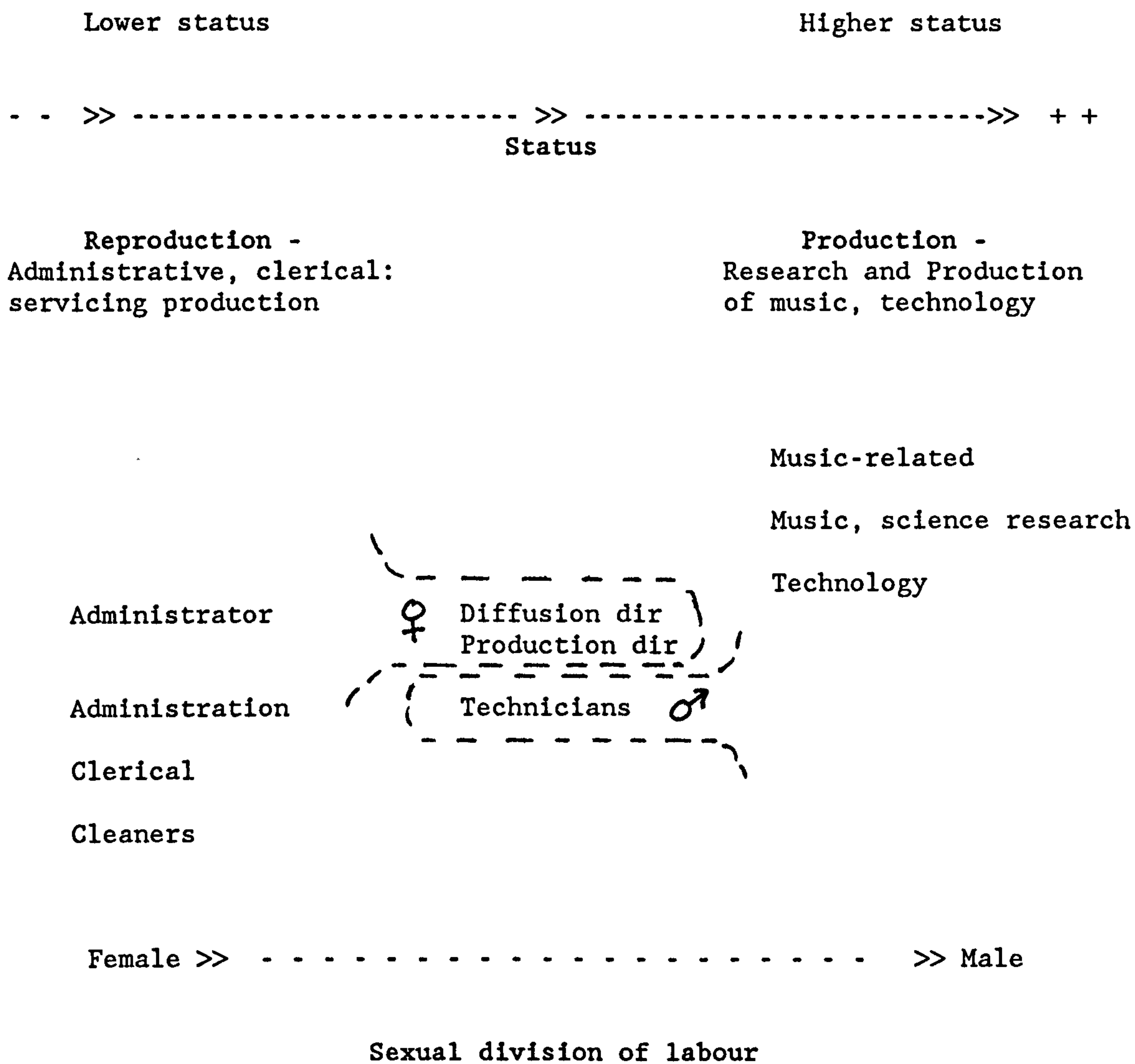
But I show in later chapters that the high cultural status and ideology of the musicians group are informally contested by others within the production sphere. Within that higher sphere, then, status is less assured, more volatile and liable to ideological struggle, than in the rigid hierarchy of the lower reproductive sphere.

Figure 3.1 illustrates the basic structure of status differentiation that I have described: the two domains of reproduction and production at either end of a status continuum; the groups of workers within each, and workers such as the women directors and technicians ranged between the two poles; and the hierarchy operating within each sphere. It also indicates how the two spheres relate to the institute's sexual division of labour. In summary, we have seen an unequal distribution of cultural capital between reproduction and production related workers; and a spectrum of attitudes from lower status workers towards their lack of high musical appreciation: from resistance, through an aspiration to attain more education and culture, to unconcern and entirely other musical interests. This spectrum accords closely with the relative power of lower status workers: the most powerful the most resistant, the least powerful the most external to, and least tempted to challenge, the dominant cultural values. Higher status workers believe they have meritocratically attained their attachment to contemporary music, which counters the potential sense of cultural domination. Within each status domain, there is a further hierarchy of status and power, with music-related research and software appearing to have higher status than the rest of the production sphere - an official view apparently also fostered by Boulez's ideology.

3.4 Stratification and status

In the last chapter I described how IRCAM's population is divided between the staff on full-time posts, those on temporary vacation or *honoraire* contracts, and those squatting or visiting and so unpaid. The population is thus differentiated not only by pay, but by contracts and

Figure 3.1 Production and reproduction: two status domains within IRCAM culture



conditions - differences in security of employment and related benefits. In relation to both, temporary workers fare poorly compared to those on posts; and *vacateurs* have compulsory lay-offs between contracts. In the following I discuss first of all the comparative pay differentials between types of contract workers; and then how differences of pay and conditions relate to the status hierarchy outlined above. I show that there is a remarkably direct correlation between the two, with one major exception within the higher production sphere.

Table 3.2 lists approximate salary levels for all IRCAM workers on posts in 1984. It is drawn from aural information given indirectly. A great deal of secrecy and mystification surrounds finances and salaries within IRCAM. So I had great difficulty in getting information on IRCAM's annual budgets, even though as a state funded institution its budgets are supposed to be available for public inspection. Salaries are generally not discussed between workers, so they remain ignorant of their relative positions. The Administration uses that to play workers off against each other (13). This may partly be due to the Administration's difficulty in dealing with the staff given Boulez's quixotic interventions, which I discuss shortly. But it is also a way of maintaining control, which adds to the distrust of the Administration.

Officially, salaries are set in line with the public sector pay scale operating at the CGP, that is, for *fonctionnaires* (public sector employees), though because of IRCAM's independent status its workers are not in fact *fonctionnaires*. According to the Personnel director, the hierarchical categories of salary reflect the degree of skill, training and responsibility and the importance of the jobs in each; and within each category a worker's age, experience and time in the job are also taken into account. Lower status workers are told by the Administration

Cat. 7 : 9,500 - 11,000 826 - 957 9,912 - 11,484
4 workers -
Technician: mechanics workshop, 4X Hard - YR (4X Hard)
Technician: audio maintenance / electrician - OF (Sound / later 4X Hard)
Technician: lighting - HI (Esp Pro)
Chief sound engineer - EF (Sound)

['Agents de Maitrise']

Cat. 8 : 9,700 - 13,000 843 - 1,130 10,116 - 13,560
5 workers -
Chief lighting technician - VOG (Esp Pro)
Computer analyst/programmer - ?? NU (Systems team / later 4X Soft)
Director 'Regie Batiment' (building maintenance) - BL (Admin)
Director Personnel - KG (Admin)
Director Finance, accountant - WS (Admin)

['Cadres']

Cat. 9 : 10,500 - 12,500 913 - 1,087 10,956 - 13,044
11 workers -
4 Tutors - WR (Pedagogy)
 - JYC (Pedagogy)
 - JIG (Pedagogy)
 - JDK (Pedagogy)
Engineer, sci researcher - XW (Acoustics)
2 Science research proj directors - AJ (Signal Processing / 4X Hard)
 - MIO (Lab maint, Man machine int, Hard maint)
Engineer, sci researcher - ??
Computer programmer - XU (Chant / Formes)
2 Software engineers, programmers - BX (4X Soft)
 - ??

Cat. 10 : 14,500 - 17,800 1,260 - 1,548 15,120 - 18,576
3 workers -
Director Production Office - VR
Director Esp Pro team - WF
Director Sound team - MI

Cat. 11 : 16,000 - 22,700 1,391 - 1,974 16,692 - 23,688
6 workers -
Director Systems team - FA
Director 4X Software - BYV
Director Diffusion - NF
Director Music Research - HY
Director Pedagogy - RIG
Administrator - TY

Cat. 12 : 22,600 - 26,000 1,965 - 2,261 23,580 - 27,132
2 workers -
Director 4X Industrialisation / Investments - VO
Director 4X Hardware - BU

'Hors grille' ie above and beyond the scale of categories:

3 workers -
Director - Pierre Boulez
Artistic Director - WV
Scientific Director - FOK

that a worker cannot rise a category without a post opening at the next level up, which they must then apply for. In practice, such rigorous controls operate for some workers and can be disregarded for others. The Table shows that workers are ranged between 12 categories, with three top executives (Boulez, the Artistic and Scientific Directors) '*hors grille*' or beyond the scale of categories. The Personnel director said that the salary structure of institutions such as IRCAM embodies at the same time an official, three-level classification of power and status: from *employes* (the lowest), to *agents de maitrise*, to *cadres* (the highest) (14).

3.4.1 Pay differentials

Table 3.2 shows how pay differentials vary across categories. Across the bottom 7 categories (clerics, technicians) wages range between c.6000 up to 11,000 fr.gr.p.m.. In the higher grades pay is absolutely, and differentials are relatively, greater. For *cadres*, wages range from c.12,500 in category 9 (tutors, researchers, programmers) to a high of 26,000 fr.gr.p.m. in category 12 (two 4X Hard related directors). I was not given access to the salaries of the top three directors, beyond the scale. However it is possible to estimate crudely, from the total pay available for them, the order of their pay (15). This suggests that top directors receive an average in the region of c.1,609,000 fr.gr.p.a. or c.134,000 fr.gr.p.m (c.#140,000 gr.p.a. or c.#11,700 gr.p.m.). (It must be remembered that this is averaged for the three directors, whereas Boulez would no doubt be paid far more than the other two). IRCAM's top wages are thus in the order of 22 times the lowest wages and 5 times the next highest wages. Clearly, from this crude estimate, workers are richly rewarded for rising up the IRCAM

hierarchy; it is a very stratified organisation.

Turning to the pay of temporary workers, an even broader range of pay differentials emerges. From the total budgets spent on all vacations and all *honoraires* contracts in 1984, it is possible to crudely estimate the mean for each kind of contract worker. Table 3.3 presents this calculation, and compares the probable mean wage of those on posts, on vacations and on *honoraires*. It estimates that the mean wage of those on posts is c.13,100 fr. and those on vacations c.7,700 fr.gr.p.m. More uncertain and complicated is the breakdown of pay for *honoraires*' (see Table 3.3 for an explanation of the calculation). From my estimate, for between 3 and 6 months' work, composers receive between 8,350 fr. and 20,000 fr.gr.p.m fee and expenses; while the estimated five computer science consultants each receive c.46,300 fr.gr.p.m. fee and expenses, assuming a 3 month visit (although at least one visited for only 1 month) (16).

Overall, we can see that *vacateurs* receive average pay around the same level as the bottom of the post salary scale. With the compulsory lay-offs, they are thus about the worst paid, and the least secure, of IRCAM's longer term workers. For commissioned composers, the average and the range of their *honoraire* pay are close to those for posts; but composers have no security or benefits, and their composing work often extends well beyond the paid period allotted at IRCAM. Computer science consultants, finally, are by far the best paid workers inside IRCAM except for the top three executives, with pay almost twice that of the nearest wages. Since their visits may be shorter than 3 months, it is possible that their pay enters the range of the three top directors'.

Table 3.3 Rough estimate of average pay for different types of contract workers in 1984

Method: Dividing budget totals for each type of contract by number of workers gives a crude average pay level for each, for comparison; does not allow for pay differentials between workers within each type.

A - Permanent posts: total budget = 13,146,000 fr
Total represents 56 workers; but calculation skewed by including three top extremely high salaries. Thus without three top salaries:
Total of wages for 53 posts = 8,320,000 fr.gr.p.a.
Average wage = 157,000 fr.gr.p.a.
= 13,100 fr.gr.p.m. per worker on posts

B - Vacations temporary contracts: total budget = 1,931,000 fr
Total represents 21 workers. Some vacateurs are part-time, some full-time, and some are on 6 months', some on a year's contract. Here I assume that these differences even each other out.
Total of pay for 21 workers = 1,931,000 fr.gr.p.a.
Average pay = 91,950 fr.gr.p.a.
= 7,700 fr.gr.p.m. per worker on vacations

C - Honoraire temporary contracts: total budget = 914,000 fr
Total represents composers and consultant computer scientists**.

1) Commissioned composers: 4 expected, and normal range of fees known to be 20,000-30,000 fr gr. Here estimated for 2 composers at 25,000 fr, 2 at 30,000 fr; and expenses equal to the same amount again. Composers' work visits are between 3 and 6 months.
Total of pay (fees and expenses) for 4 composers = 220,000 fr
Average pay = between low of 50,000 fr / 6 months = 8,350 fr.gr.p.m.
and high of 60,000 fr / 3 months = 20,000 fr.gr.p.m.
per commissioned composer on honoraire.

2) Computer science consultants: 3 known to have visited, but here estimated for 5. Consultancy contracts last between 1 and 3 months, and usually a month. Here estimated for 5 visits of 3 months each.
Total pay remaining after composers' pay...
= 914,000 - 220,000 = 694,000 fr
Average pay = 138,800 fr.gr.p.3 months
= 46,300 fr.gr.p.m. per computer scientist on honoraire.

Fr.gr.p.m.= Francs gross per month, Fr.gr.p.a.= Francs gross per annum.

** NB: It is assumed here that this budget includes composers' fees, but they may come out of a music production budget, in which case the pay of remaining computer consultants is even higher. Also, it is not known whether the budget includes expenses (for living and travel) as well as fees: I have assumed the figure does include both fees and expenses.

Source: Presentation of IRCAM's 1984 Budget: Administration Council document, Nov. 1983, and other oral and documented information.

However, this pay level is only sustained for a short visit. To complete the picture of the total population, of IRCAM's 7 most persistent squatters in 1984, 5 were musicians and composers, 4 of them foreign and none with other jobs to speak of; and 2 were computer scientists, one a university professor, the other a postgraduate on a grant. Thus the majority of unpaid squatters, with no official status whatsoever, tend to be musicians and composers hoping to find an entry into IRCAM; and their self-exploitation is total.

3.4.2 Stratification of the workforce

The above calculation begins to show the stratification of the population in relation to different kinds of worker. We can take the analysis further by examining the stratification expressed in the distribution of salaried posts by kind of work and department. The lower categories, from 2 to 6, contain exclusively Administration staff, clerics and lower technicians. Administration secretaries are paid less than all other clerics, while the three lower Administration directors (Personnel, Finance, *Regie Batiment*) are placed in category 8 below all other, including technical, directors. This all shows the low pay and low status of the administrative and clerical (reproductive) staff vis-a-vis other parts of the house, even technicians. Middle rank technicians are next in the hierarchy in category 7, the more skilled in category 8. Above category 9 workers are *cadres*; this grade contains the 4 tutors, and 7 scientific researchers or computer programmers, including the one post each for Acoustics and Chant/Formes. Above category 10 all posts are for directors, with 3 at that grade: the directors of Sound, Esp Pro and the Production Office - two technical directors, one administrative, and all closely involved in production.

Category 11 includes the director of the Systems team - the highest status technical team; and those of 4X Software, Music Research, Pedagogy and Diffusion. It also includes the Administrator TY, lower than two 4X directors (Hardware and Industrialisation) in category 12. Finally, as we have seen, Boulez, the Artistic and Scientific Directors are paid beyond the scale.

We can now see how the pay scale reflects the sexual division of labour and a devaluing both of the sphere of reproduction (administrative and clerical staff) and of women, closely associated with it (17). Predictably, skilled research and production workers, musical and scientific, come above the technicians and below the directors. The Systems manager is in the same grade as many production directors, indicating IRCAM's enormous dependence upon him for functioning. At the highest levels, three 4X related directors enjoy very high grades, two of them the highest in the institute after the top three executives. Thus the 4X teams, as well as receiving more posts, are also substantially better paid than other science and computer projects. They dominate the higher posts numerically and financially. Of the 21 *vacateurs* in 1984, 9 were for scientific research, including 5 full-time staff for 4X associated projects, 3 part time for Acoustics and 1 part time for Chant/Formes (the director MC). 8 were for junior tutors (central to music production, augmenting the tutors), one of whom is the main psychoacoustician. We see again the greater resources devoted to the 4X, and the way that musical staff are filled out by low paid contract workers.

In summary, except for top executives, the best paid workers in the institute are the visiting computer science and the 4X hardware-related

workers. In terms of regular staff, the 4X projects are privileged over both pure researchers and the other software team. By comparison, music-related workers have a less well paid and less secure profile. The 4 tutors and 3 music directors are on posts at reasonably high grades, while Boulez and the Artistic Director WV are extremely well paid. However, the musicians in the population are filled out by the 8 junior tutor vacateurs, their pay the same as lowly clerics, plus the few commissioned composers whose average pay is similar to middle range posts, and by unpaid squatter musicians. All have little or no security.

This analysis of the stratified distribution of salaries and conditions parallels closely the earlier analysis of status differentiation. It shows particularly the stratification of and between the domains of production and of reproduction, in turn associated with the institute's sexual division of labour. Thus status and stratification appear directly correlated. But within the higher production sphere, there is a striking inversion. Whereas music-related work has the highest official status within IRCAM, and scientific and technological R and D have lower status by virtue of servicing musical ends, music fares worse than technology in terms of pay and conditions.

Stratification also reverses the dominant, if contested, status hierarchy within the scientific sector. Computer science consultants are paid better than all others, although they have no security, while 4X group workers have both relatively high pay and more security. By contrast, pure research and Chant/Formes - part of IRCAM's intellectual vanguard - fare badly in terms of numbers, pay and security although their cultural status is higher. Overall, then, we have seen a very unequal distribution of resources favouring the 4X projects over Chant/Formes and Acoustics at several levels: in terms of numbers of

departments, number of workers, kind of employment, and levels of pay. Thus hardware related R and D has far better resources by all measures than both pure research and high-level software R and D.

Fig.3.2 summarises the relation between pay and security for different higher research and production groups. Fig.3.3 depicts the inverse correlation between status and stratification among workers in the higher production sphere.

3.5 Music, pure research, technology: cultural and economic 'reward'

The main question arising from this analysis is why status and stratification are inversely correlated in the higher production sphere. I suggest that this occurs partly because of the different labour markets, partly because of the different forms of evaluation operating within the spheres of music, pure research and technological development; and partly because of the ideology of vanguard workers. The 'rewards' received by different workers have the effect of achieving an uneasy peace mitigating the rivalry between them.

In terms of labour markets, IRCAM's problem is its heavy dependence on skilled computer scientists, mostly American, who inhabit a very favourable international labour market. They are thus much in demand, and can set their own terms. Pay level differences between France and the USA are great: one young programmer (FA) reported that he would treble his income by moving from IRCAM to a position at Bell Labs; while consultant NRD (told that his pay would be in the region of Boulez's) said that it was equivalent to the lowest consultancy rate that he charged in the States, at Lucas Film. Coming to IRCAM, then, often involves a drop in pay; but programmers are compensated by the chance to

Figure 3.2 Pay and security among workers

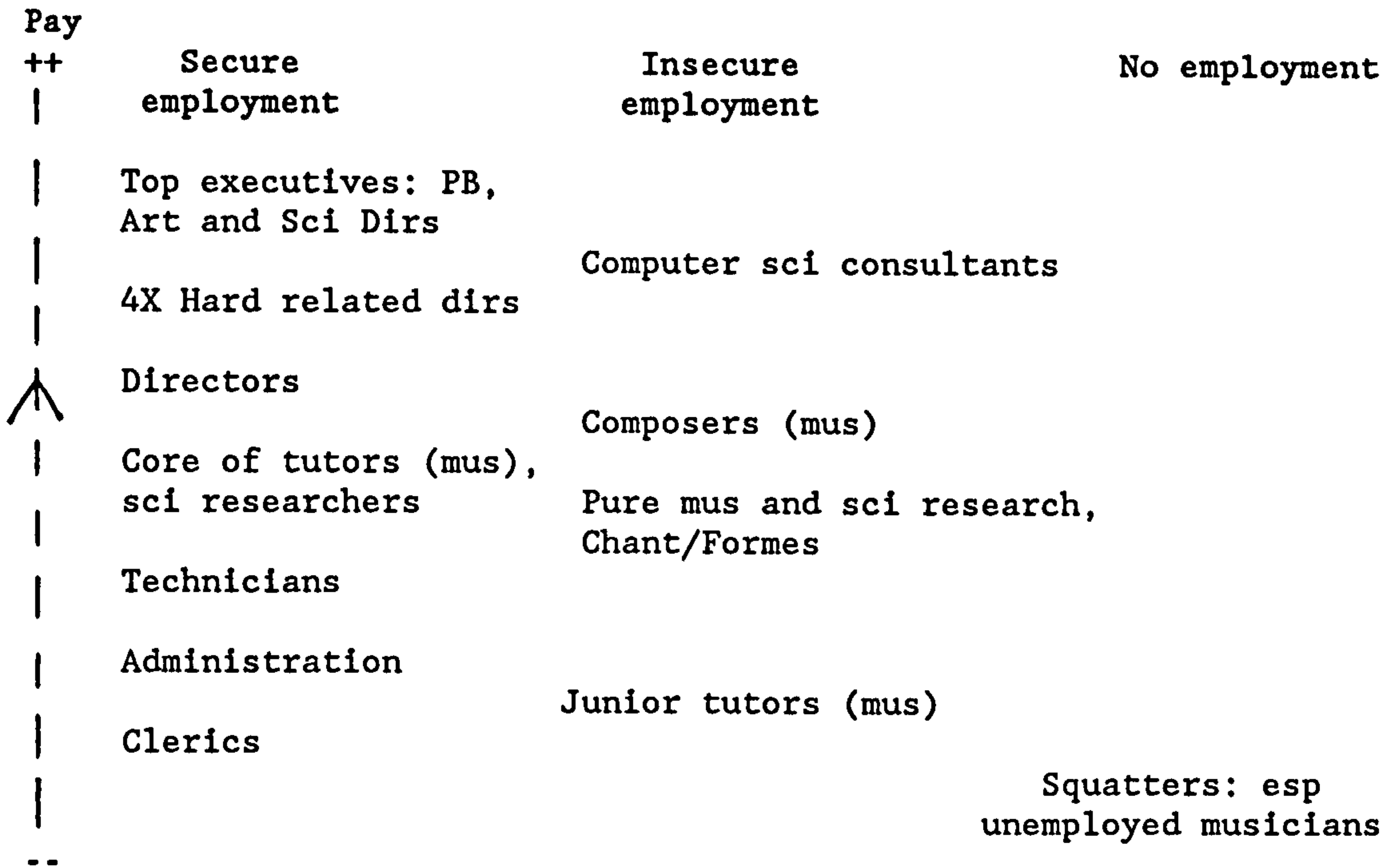
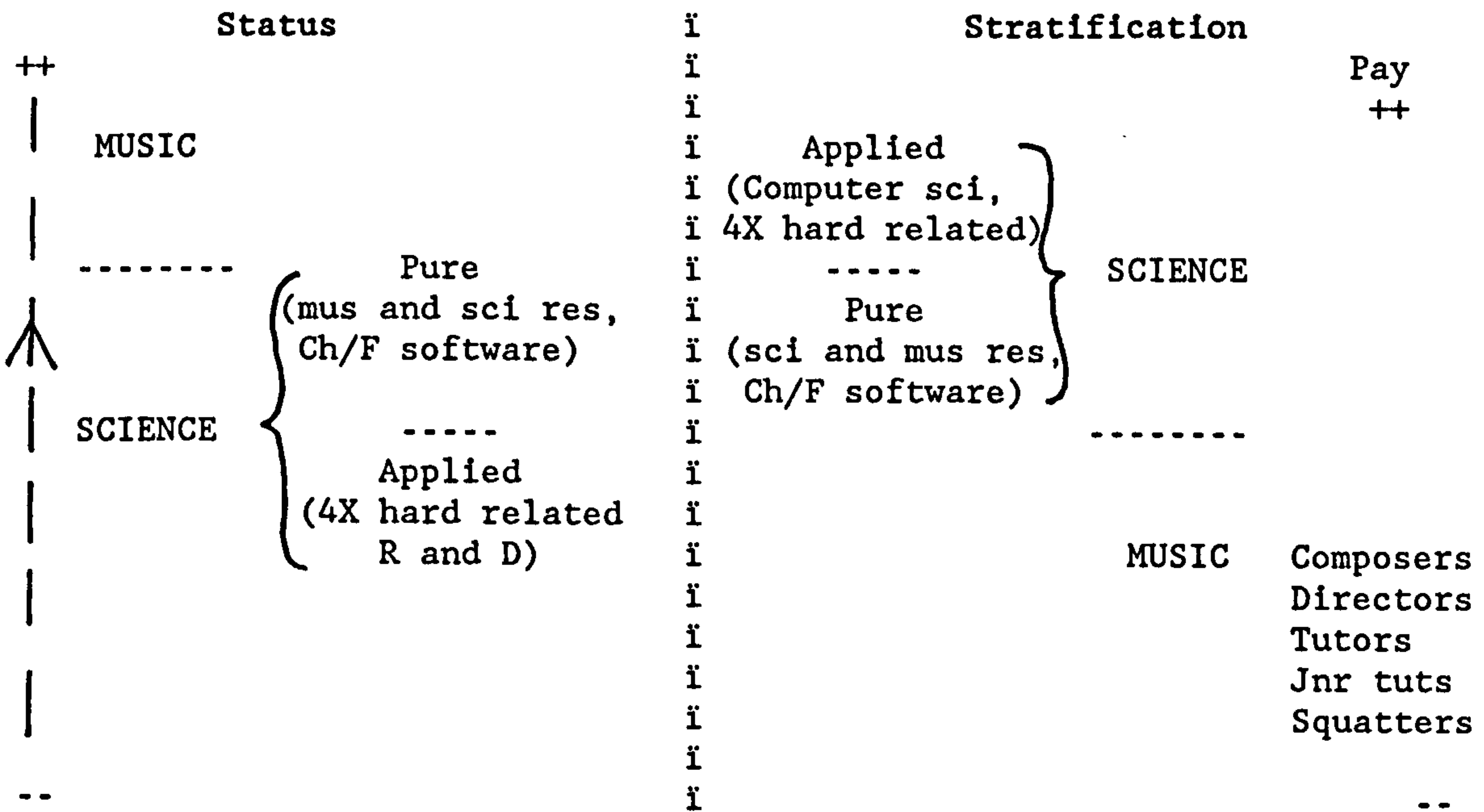


Figure 3.3 Inverse correlation between status and stratification among research and production workers



'hang out' and have fun in Paris. Despite the Administration's resistance and nationalist rancour, American computer scientists bargain their way to higher wages than those set in the official categories (18). But the French computing scene is also favourable, and disaffected French IRCAM computer scientists have little trouble obtaining jobs at other prestigious research establishments such as INRIA.

Compared to computer consultants, and except for the well-known, musicians and composers are in a weaker position since broadly speaking IRCAM does not need them: rather, they need IRCAM, for prestige and career advancement. Of course, IRCAM also appears to need a constant supply of composers to produce the musical goods that will validate its existence; and it seeks some kind of international coverage. But generally, there is an oversupply of artistic labour, and composers compete hard with one another to come to IRCAM, whether officially on commission or unofficially as a tutor, junior tutor or squatter. Hence the constant stream of visiting musicians. Composers also compete intensely, via the twice yearly *Comite de Lecture* (score reading panel), to gain an *entree* through having their pieces premiered by the EIC.

Except for the famous, then, wooed by Boulez and the Artistic Director, musicians have little bargaining power. The overwhelming attraction is the sense of prestige offered by a stay at IRCAM (19). Because of the economic strictures of commissions, and just as within the profession at large, many composers add to their income by teaching, or by commercial work - a strategy kept quiet because of IRCAM's Boulezian dominant ideology (see Ch.9.3.1). But also, for those experiencing degrees of exploitation and self-exploitation in the present, the promise is held out, by Boulez's own career as much as anything, of potentially higher rewards for their work than for any other kind of

intellectual labour within IRCAM; that is, for the very few there is the potential to achieve great economic as well as cultural success. For musicians, then, the risks and the exploitation are higher, but the potential reward appears greater, than for all other IRCAM workers.

However these labour market factors do not explain the generally higher security and pay given to technologists, and especially those in 4X projects. There are mundane reasons: the 4X is one of the oldest projects, predating Chant/Formes, and its two highest paid directors are two of the longest serving; yet it did not precede the relatively impoverished Acoustics department. Then, it is tied closely to Boulez's own 'Repons', in which so much of IRCAM's high status is invested. But these reasons are bolstered and rationalised by management ideology, spoken by the Administrator and the Artistic Director. According to them, IRCAM's posts should provide the institute's basic human infrastructure, consisting of administrators, clerics, technicians, directors, and crucial technologists. By contrast, they argue, IRCAM's musicians and higher researchers should not enjoy a permanent or secure relation with IRCAM. As creative and intellectual workers they should be kept contractual, so that they remain on their toes and need to prove themselves with results of artistic and scientific value (20).

This management view raises the problem of evaluating scientific and musical results, and so a basic contradiction between IRCAM's present functioning and Boulez's founding ideology. According to that, IRCAM's work must be future-oriented, of long-term value rather than finding immediate markets. But in fact, despite the deference of Ministry officials (Ch.2.3.2), IRCAM management must judge artistic and research results in the short term for both internal and continuing

external legitimation. As I show in the next chapter, this is resolved musically by Boulez's judgement reigning; while, strangely, the Artistic Director WV oscillates between an elitist confidence in his instinct for spotting artistic talent, and a revealing self-doubt (21).

Technological validation is, however, even more problematic since Boulez cannot judge that sphere directly; hence the apparent continuing search for a suitable Scientific Director for IRCAM. But the problem is circumvented by Boulez resting the internal legitimation of technologies, and the people responsible, on his judgement of the quality of music produced with them. Researchers are well aware of this, as articulated here by Chant/Formes director MC:

"I had asked WOW to come in order to really make a musical use of all the materials that we had already made (with Chant), like the Tibetan voices, the oboe.. We had those materials, and I had no confidence and no time to make a musical thing with them, a musical object. And it was very important because otherwise it's not possible to demonstrate the power of the (Chant) system and the interest of the materials. If it's not in a musical context, I can extrapolate but other people cannot, usually; and especially Boulez cannot. If you present something to Boulez that's not in a musical context, he's not interested, even if it's a very deep and interesting thing. You have to put it into a musical context: that was really WOW's job. Boulez is interested to have real musical output".

The 4X project has done well and has been relatively immune from this kind of judgement since, historically, it has been closely implicated in Boulez's own 'Repons'. Earlier prototypes were used notably by the director HY, on pieces that were clearly well received - as shown by HY's rapid promotion by Boulez within IRCAM. By contrast, the Chant/Formes group's credibility had been badly damaged by a piece that was made in 1979 using Chant that Boulez considered risible. The composer WLe, who had been closely involved in the group's work, originally came to IRCAM very much under Boulez's wing. However WLe left IRCAM after this fall from Boulez's pleasure; and it took the

Chant/Formes group until 1983 to recover favour. This finally occurred due to the unofficial production of a piece called 'Chreode I' by the junior tutor-composer WOW (mentioned in the quote above) which used Chant and Formes, and which Boulez greatly admired.

Thus the 4X, developed symbiotically with Boulez's own 'Repons', has been inherently favoured in terms of resources, while Chant/Formes has suffered. Yet the key 4X-related workers are not subject to the same extremely favourable labour market as international computer consultants. Nor can the higher resources and pay for 4X workers be justified by commercialisation, since the 4X has neither earned income nor been diffused (Ch.2.1.5). Thus the privileging of 4X hardware-related work is not fully explained by any of these factors. I show in Chs.6 and 7 that it is supported by a more primitive ideology in which large hardware technology is perceived by some as substantial, tangible, and so as a 'more real' and 'more productive' result than high level software or pure research. It seems that hardware results are perceived by management as both more infrastructural, and as more proven of value, than pure research and software R and D. Meanwhile, management appear to perceive Chant/Formes and similar high level music and soft research as more marginal, experimental and risky.

Finally, a deeper level of analysis is revealed by examining the ideology surrounding and perpetuated by the musicians group, IRCAM's music oriented intellectuals. Although some of the poorly paid and insecure members of the group complain of their marginality, they also chronically self-exploit by working long night and weekend hours; and in this way, through signs of devotion and the ascetic pursuit of art and knowledge, justify their role as IRCAM's intellectual vanguard with its attendant high cultural status. Indeed, some perceive these conditions

as inextricably tied. In the following, Chant/Formes director MC appears to welcome his weak contractual position as a means of greater intellectual 'freedom'. Asked: "Has it never been reasonable to expect to be given a secure and better contract?", MC replied:

"If I haven't got it, it's probably because I haven't asked for it enough... Somewhere I like the position where I could say 'well, I don't need you (IRCAM)',...at least, to live. That's not bad because it means that when I say something in IRCAM it's not for my own purposes, in the sense that if they don't pay me any more, well it's very sad, but I can live. I have a more impartial view because I'm not dependent on that (IRCAM for a living). WLe was rather conscious of that; he told me 'You should keep your position elsewhere, otherwise you will never be able to do real research at IRCAM, you will be too involved in production and the necessities of the house'".

MC links his part-time contract not only to intellectual independence and freedom, but to 'real', unmotivated (pure) research, which he opposes to baser 'production'. This is another opposition characteristic of IRCAM culture, as we see in Ch.6.

The musicians group thus combine economic marginality and willed self-exploitation with a view of themselves as IRCAM's ambitious vanguard, the bearers of pure, longer term research - as the institute's far-sighted cultural leaders. This heady mixture reveals a layer of mystification reminiscent of Bourdieu's analysis of the avant garde position within the cultural field (Ch.1). The avant garde position, here within IRCAM, rests on the belief that the highest cultural capital and the best strategy for its long term accumulation comes from disdaining immediate economic reward or a large market by adopting the marginal, prophetic role - that associated with youth, iconoclasm, asceticism. Hence self-exploitation becomes a sign of dedication to higher values, and of self belief. The gamble for all who adopt this bohemian strategy of willed marginality is that asceticism and devotion to the unrecognised now may later win recognition and 'consecration'.

For some, marginality and exploitation in the present become imbued with the hope that, eventually, accumulated cultural status will convert into economic value - that artistic success, for example, may bring very high rewards. But others clearly wish to remain marginal by deferring endlessly or disdaining altogether more profane validation (22). Thus, IRCAM musicians and vanguard researchers are tempted into self-exploitation through collusion with an ideology in which, for the present, cultural and economic capital are inversely correlated: high cultural status accrues to those who can be seen to self-exploit the most and whose economic position vis a vis the 'established order' is weakest - (hence also their collusion with the management ideology outlined earlier). In return, the vanguard are compensated by the reward of the highest cultural status.

We can thus see how the inverse relation between status and stratification within the higher production sphere rests on two ideological moments: a phenomenological privileging of hardware over software and pure research; and a belief in the inverse relation of cultural and economic capital for the musical and intellectual vanguard within IRCAM. The analysis reveals, finally, a contradiction between Boulez's original vision and the functioning of IRCAM. Those workers closest to Boulez's ideal - tutors, junior tutors, high music-oriented pure researchers, ie IRCAM's vanguard musician-scientists - rather than being the best supported core of IRCAM workers, appear to be the least secure and most moderately paid of production staff. However, they are compensated by intellectual status and, given accumulated cultural authority and charisma, a few can in fact benefit from internal patronage with ample rewards, as the next chapter will show.

Chapter 4 Power, institutional conflict and politics

4.1 The appearance of bureaucracy

I have shown that IRCAM appears a highly bureaucratized institution. With written statutes, a clear hierarchy of departments and offices, and an elaborate management structure, the institute appears both rule-bound and routinized. There are other obvious signs: an emphasis on documentation, on permanent written memos for institutional communication (1), and the formal and abstract character of administrative communication. The Administration's preoccupation with procedures for controlling entry and access (see Ill.4.1) is a further expression of bureaucratic control.

Centralized French bureaucracy penetrates the very language used at the institute. IRCAM periodically receives instructions from the Ministry of Industry and Research on the latest official French computer terms to be used in all state-related institutions (see Ill.4.3) (2).

Language use expresses in a broader way the formal dimensions of bureaucratic nationalism, in the balance struck between French and English use. French is IRCAM's official language, so that communications and meetings are supposed to be held in French, as is teaching. Informal meetings such as the musicians meetings are also by and large held in French, even when the majority of participants are American or not French. Computer mail messages, such as the daily information from the Systems manager to all who log onto the VAX, are generally in French. However, many of the constant informal exchanges on programming, research or composition, which often involve non-French speaking participants, occur in English; so that despite the rigorous attempts at translation and resistance to linguistic imperialism, English is often

the pragmatic language of choice for collaborations.

Finally, IRCAM's workforce centres, as we have seen, on a range of full-time salaried officials. The institute could be expected to run its appointments and promotions according to proper bureaucratic procedures: that is, particularly for an elite institute of high level research, for appointments and promotions to be rationally meritocratic.

4.1.1 Deconstructing IRCAM's 'rational bureacracy'

But the reality of IRCAM's functioning undermines this bureaucratic surface. It is commonplace in industrial sociology that informal associations and actual operations run counter to formal bureacracy. In the following I illustrate first of all how imperfectly bureaucratic and 'irrational' are certain key processes at IRCAM, and then show how they link to Boulez's interventions and to the system of patronage that he sustains.

Despite IRCAM's *organigrammes*, it is in fact difficult to ascertain the various departments and functions, people's roles and interrelations. The existence of squatters, for example, shows the institute's toleration of some people circumventing the security bars to unofficial entry. In fact, there is much free movement around the house between work, and many people perform several functions in addition to their official work. The *organigramme* also fails to represent the reality of executives and meetings: we have seen that the Scientific Committee is not equivalent to the Artistic Committee; while the informal but important musicians meetings, in which IRCAM's future was being talked out, had no official group identity.

Organigrammes are hard to find in the building (3). This

illustrates the practical invisibility of official guidelines to jobs and offices. Moreover, although security maintains strict boundaries to the outside world, there is a strange absence of security within the institute, so that most research labs, computer rooms, offices and cupboards are always unlocked. The only exceptions are certain technical and storage rooms, and the Administration's domain. Partly due to gradual depletion by theft, the IRCAM library is chaotic and uncomprehensive; while the books and papers lying around researchers' rooms are fair game for borrowing. Access to locks and keys is, in fact, a privilege meted out by the Administration's caretaker. But for some workers the open access has ideological meaning in accord with their utopian critique of security and disdain for property (see Ch.8).

Further undermining rational management, there is a lack of adequate documentation of IRCAM's research and production, and a lack of rational planning and co-ordination, of clearly defined goals and timetables, for IRCAM's scientific projects. (Both are discussed further in Ch.8).

The clearest expressions of non-bureaucratic-rational functioning concern employment and work, and they contradict the official ideology and *organigramme* at several levels. Most obviously, there is a mismatch between what workers are officially supposed to do, and what they actually do. For example, visiting computer scientists laugh disrespectfully at the job description on their *honoraire* contracts since they do not accord with what they are actually being hired to do. Permanent workers' job description is also often different to their actual work. Many do several jobs at once, or contribute to several areas (4). This is particularly true of musicians group members, the interdisciplinary vanguard. Examples include BYV, officially paid to be

4X Software director, who for some years has also informally been Boulez's tutor, and considers the latter his most important IRCAM work. Similarly, Chant/Formes director MC, as well as doing software research, works closely with composers using his programmes: ie acts informally as a tutor. HM, a junior tutor on vacations based in the Acoustics department, although does not work there, is in fact IRCAM's main psychoacoustician. He works in Pedagogy as a teacher and does psychoacoustical research; he also contributes to the Expert System project, and helps some composers by designing software 'instruments' - so acting as a tutor. Another junior tutor, WOW, employed on vacations as a composer in the Chant/Formes team, is also one of IRCAM's most sought after tutors and teaches on Pedagogy courses.

The gap illustrated by the last two cases between junior tutors' official low status and pay, and the importance of the work given unofficially to them, illustrates a further anomaly: staff doing work of higher status and greater importance than their official status. Junior tutors, if hired, are hired on low paid vacations for defined tasks; yet while hired they may be asked to do a great deal of other work. They are commonly given the important tutoring role even though they are not officially recognised or paid to be tutors. Occasionally, even workers who are entirely unpaid by IRCAM are presumed upon to perform important tasks: one junior tutor, NR, in the past acted unpaid as tutor-computer assistant to a director in the composition of his piece; while one of IRCAM's key programmers, NGF, known as a 'wizard' inside the house but currently engaged on a PhD elsewhere, was periodically called in to unscramble major computer problems.

Another hidden and surprising level of 'irrationality' is the

common absence of rational educational criteria for workers' jobs, and so the ubiquity within IRCAM of people doing work that is not their main area of qualification. This ranges across the spectrum of scientific and musical jobs. The 4X Industrialisation director VO, formally trained and initially hired as an acoustician, and with no prior managerial experience, has throughout his time at IRCAM acted informally as the main managerial power of the Scientific sector (5). Equally strange is the fact that neither of the two software project directors, BYV of 4X Soft and MC of Chant/Formes, had a formal training in computer science. BYV, by training a professional flautist, gradually taught himself over his first few low paid years at IRCAM:

"I realised that the key to working with computers was programming.. When I started to work around the 4X with Pierre, I got into programming more seriously, and I started making little programmes, and then big programmes.. Then I started making programmes to make up for the programmes that weren't available".

While MC, known inside IRCAM as a high level computer scientist and a software designer involved in A.I., said:

"I've never learnt computer science... I've learnt it by experience and because I need it for this and that, and for my courses".

On the music side there are people with important musical roles who are not musically trained. A striking example is the junior tutor WOW who gained Boulez's patronage and sudden promotion through his 1983 piece 'Chreode 1'. Musically, WOW is auto-didact, and he trained in philosophy at university. In addition, people qualified only as scientists find themselves given important music-related, especially tutoring, work. One of the official tutors, JDK, trained as a computer scientist, and a junior tutor, WUA, as a mathematician: both came to IRCAM with no musical training, yet soon found themselves with music-related jobs. Similarly, the two main psychoacousticians RIG and HM, who

trained as psychologists, are involved in both scientific research and the musical-tutoring side. As Pedagogy director, RIG organises the tutors that composers work with; and he is also responsible for bringing in many junior tutors and squatters and offering them the tutoring experience. He has great sympathy with people who cross the music-science border.

The Systems team also contains interesting anomalies. The new American Systems manager from mid '84, BoW, is actually a composer rather than a computing specialist, but he knows the UNIX system well from his experience at Berkeley, hence his qualifications. At a lower level, a Rumanian on a low paid *vacation*, who trained as a composer and sees this as his vocation, secured a place inside IRCAM by teaching himself enough computing to be hired as a Systems technician [YI int]. Two other Systems technicians also have hidden artistic leanings - one as professional sculptor, the other as a graphic artist. While another East European, FLu, also a composer and son of a famous composer, is mainly given technical and junior tutoring work. Among lower status workers, the strangest mis- and over-qualification is that of the building manager, who keeps secret that he studied physics to PhD level. He explains that because of this background, he finds IRCAM a fascinating environment.

It is clear that many of these various employment realities arise from the non-standard, complex and interdisciplinary nature of IRCAM's work, the difficulty of rationally delimiting job boundaries, and the temptation for workers to cross them and extend their capacities in different directions. However, it is equally clear that they act also as a cover for the exploitation of junior workers who are keen for their

skills to be recognised; and who hope thereby to eventually be given more appropriate work, usually as a composer, through advancement and patronage.

4.1.2 Promotion and posts: the broad domain of patronage

A further dimension of appointments and promotions begins to show the importance of patronage within IRCAM and Boulez's power to override bureaucratic procedures. The redeployment of posts is a particularly 'irrational' process that undermines the notion of IRCAM having permanent fixed offices that require filling. Rather, when a worker leaves a post, it is used freely for whichever worker or function Boulez considers necessary. Crucial functions can thus remain unfilled for long periods: for example, when MIO left (on the *organigramme* the technical director alone responsible for lab maintenance, hardware servicing and man-machine interface) his job was given to OF, a sound technician who became the 4X service technician, and the other functions, including sound technician, were left for a period unfilled. OF was promoted to the 4X team on Boulez's direct orders in the lead-up to the 'Repons' premieres and tours. Another highly paid post that opened in '84, that of the departing 4X Industrialisation director who had informally been a key scientific manager, was divided into four low paid posts, while his function disappeared.

During 1984, most promotions involved Boulez's intervention, and workers, seeing that this is the crucial way to gain promotion, try to go direct to Boulez. If they cannot or are prevented, and are fobbed off with the Administration, it means that the process is far tougher, the rewards are likely to be lower, or they will be entirely unsuccessful. Thus, the two workers promoted to the 4X team as high level technicians

- NU as a programmer, and OF as hardware maintenance - both received promotion and substantial pay rises through Boulez, linked to technical needs in preparations for 'Repons'; while the junior tutor-vacateur HM attempted to gain higher pay but was constantly baffled by the Administration. By contrast, another important junior tutor, WOW, was suddenly promoted from low paid vacateur to director of Music Research when the incumbent left. Boulez decided this move in an autocratic manner that I describe below.

The Personnel director KG talked confidentially about Boulez's interventions. He said in a 1986 interview:

"When there are vacancies in posts, I consult the *Comite d'Entreprise* (the worker's consultation body), and put a poster up on the noticeboard by the coffee machine".

Thus if someone in the house thinks they have a case for advancement, they can put themselves forward. He added, indicating the possibility that this does not always happen: "OK, sometimes I forget, and the *Comite* tells me off! (laughs)". Later, KG described how HM had now become a director, of Pedagogy, and yet was still a *vacateur* - a situation unheard of in 1984 - since there were no posts available and HM had work permit problems. KG explained of the politics of compromise involved in this promotion:

"It was a promotion, but there were a few problems with the tutors who thought he wasn't competent and were jealous because we didn't ask them. In the end, it's Pierre who decides these changes!" [all my transl.].

However, the Administrator TY is not happy with Boulez's encroachment on her managerial territory through the exercise of patronage.

"He descends into the running problems, and that's wrong.. he has no idea of policy on salaries - that's not his competence! It's ridiculous.. he's not trained that way. When he gets involved on that level, it's always a catastrophe!". TY speaks of an ideal division of

labour between them as one where her role is to field all mundane aspects of running the house, and to pass up to him only important policy decisions, music-related questions and higher appointments. "What I'd like is for him to shed all the inappropriate work - for example people come to him asking for a rise, he discusses it with them - he wastes his time!... On the other hand, he has no time for basic problems: for example, the question of what should a tutor be? It's fundamental because.. they are the articulation between science and music... Pierre knows he must attend to this, yet just the other day he asked to see the scores of the tutors, to check what they're like as composers! - up until now, he hasn't looked into this at all!"

According to TY, Boulez had neglected to look at the current tutors' CV's. TY wants a more 'rational' hiring and negotiation process, and resents that people go and appeal to Boulez direct.

"It annoys me... People think they don't need to talk to me because Pierre has decided. Pierre protests 'But I just listened!' But psychologically people think they've got it in the bag, so I have to take them back a few steps... I want him to leave things alone... If people go to Boulez first, that's really an error of functioning" (all TY int., my transl.).

It is strikingly evident that access to Boulez's patronage is unequal for different status workers. Research and production staff, and technicians being brought into the 'Repons' production orbit, can call on his intervention. But with few exceptions (see below), it is not considered appropriate for lower status workers to approach Boulez over their employment problems. The form for them is to go first to their department head, and then with backing to the Administration (6). For example, the issue of promotion for the woman Systems technician, despite the backing of her boss, was deferred endlessly by the Administration. A long-standing secretary said with frustration of the situation, and of the apathy of higher status workers who lack the incentive to take part in the political channels available to them:

"(Those) people much prefer to deal directly with God! [Boulez]. They don't want to be represented because they can go straight to God!!"

Reproductive workers are thus very aware of the inequality of access to Boulez.

4.2 The institutionalisation of charisma and patronage in the higher production sphere

The respect accorded to Boulez's patronage is much strengthened by the obvious authority that he commands within IRCAM. In other words, patronage is legitimised by his position as the institute's charismatic leader.

4.2.1 Boulez: charismatic leadership and autocratic power

It would be impossible for IRCAM workers to be immune to Boulez's international reputation and his place as a national culture hero. In 1984, the only openly disenchanted voice inside IRCAM about Boulez was that of PL, the visiting but marginal black American musician. PL was disrespectful about 'Repons' and scorned the technological relevance of the 4X. We have seen above the secretary's reference to Boulez as 'God', a sardonic comment on his absolute power and his apparently benign presence. The Administrator also spoke critically of Boulez; but neither would dare to criticise him intellectually. Other than these, Boulez appears to be held in near universal respect within IRCAM, as witness the following quotations.

Q: "What keeps people at IRCAM?"

GB: (Computer science professor, squatter) "It's all Pierre!.. For me too" [my transl.]. //

Q: "So in '72, nothing of IRCAM existed. You took a big risk (changing jobs and countries to work for IRCAM)".

WV: (Artistic Director) "Not really, come on: Boulez was the King!" //

NR: (Young junior tutor, composer, on his first contact with Boulez) "In Siena.. at a very well known international seminar.. Boulez did some talks. I was totally struck by that, I mean like lightening - I felt that was my future, the things that interest me. So I dropped university, I asked Boulez what I had to do. He told me to study, then stay in touch with IRCAM". //

MC: (Chant/Formes director, on Boulez's influence on his work) "It has a

lot of positive aspects. It means that research cannot stay confined in its own rhetoric, because of this necessity, always this side of Boulez saying 'Is that musically interesting?'. //

WLe: (Former director of the Diagonal department) "I met Boulez at College (Harvard). He analysed the 'Rite of Spring' and Webern's Opus 21. I was fascinated, by his charisma.. this crazy guy. I was just bowled over by these beautiful sounds! I'd never heard anything like this: his music, it was just breathtaking". //

Two mythic incidents from 1983-84 can illustrate further the character of Boulez's authority and charisma. Both relate to Boulez's role as musical leader. An informal seminar of IRCAM's music intellectuals was called to discuss WOW's new piece 'Chreode 1'. For several hours, WOW discussed the piece at a blackboard in terms of the computer programmes - Chant and Formes - that he had helped to design which were used to compose it. He described in minute detail the transformations and manipulations of material, the encoding and notations used. After this, we adjourned to the Esp Pro to hear the piece, and then returned again to more discussion in the seminar room. Suddenly, Boulez - who had quietly come in earlier - spoke. He said that WOW had told plenty about the programming and scientific basis of the work, but had neglected to speak of its implicit musical ideas, of the 'architecture of emotion' consisting of climax, tension, dispersion, change of timbres and so on. Boulez ended by noting that the problem of composition was 'to give meaning to the structures'. This was the only intervention to break out of the programming mode of talk and raise specifically musical issues.

A major commercial computer music company came to give a demonstration of their latest big synthesiser to IRCAM. It reached the moment when the automatic music transcription facility was to be shown in action. After repeated requests for someone to volunteer to play a tune (7), a reluctant tutor sat at the keyboard and played a few bars of

sleazy cocktail muzak. The audience rushed to the front of the room to watch, with awe, as the music crystallised into a score on a small VDU in front of their eyes. Suddenly Boulez, who had unobtrusively entered the back of the room, said: "But it's got it wrong! It should be in three.. in 6/8!" At this there were cries of "He's right!". The machine had transcribed the music into a 4/4 meter rather than the 6/8 or 12/8 that was appropriate. The demonstrator was dismayed, and the synthesiser became a laughing matter among IRCAM researchers. Boulez's 'Emperor's New Clothes' intervention made him appear as the 'true seer', as the fastest and most perceptive sceptic in the room, in line, moreover, with his scepticism towards commercial technologies (8).

However, when Boulez exercises power he is less benign and more autocratic. The way that major decisions and crises were dealt with in the following three crucial meetings illustrate this manner. The first was a musicians meeting that took place several months into the discussions, and concerned the question of formalising the future direction of the Music Research department given the impending departure of the current director HY. The previous meetings, all but one without Boulez, had been open occasions for free speaking. The group had in fact been discussing a new democratic way of working in the department, without a head. In this meeting, Boulez invited each project in the group to speak, and as they did he asked difficult questions. An hour in, Boulez took over and began a monologue, interrupted only by the junior tutor HM, in which he entirely redefined the structure of the group, and elected the new department director or 'secretary', to be held in rotation: all propositions that had previously been aired rather than agreed. Boulez, to a stunned room, summed up: "We've agreed, I

think, on the idea of a rotating secretary of Music Research - for one year each, chosen from among the tutors or researchers. I propose, because of his strong ideas in all these things, WOW as the first annual secretary... We'll decide all this democratically, and work on the question of how to implement a democratic structure.. So you must go and decide for yourselves if my proposal of WOW for first secretary is OK" [MMtg 16.4.84]. Despite the final disclaimer, Boulez's suggestions were taken as '*faits accomplis*'. It was felt to be deeply ironic that in the end Boulez dictated the structure and head, so that neither the way the decision was made nor the new proposal were in the least democratic.

The second meeting, a Scientific Committee, was held in the wake of a disastrous three month commission visit by the composer AV (see Ch.7). It also became the occasion for Boulez to announce the forthcoming departures of several key staff. It was therefore a crisis meeting. Many technical problems had dogged AV's visit, and the meeting was concerned with tracing the reasons. But the problems were multiple, and blame was shifted around. Boulez's temper rose until he suddenly burst into a monologue:

"We never get things properly planned in these meetings! This discussion should have been had a year ago, ahead of AV's visit!.. Composers coming here are always put into terrible, impossible working conditions and cannot produce. So we can't meet our commitments because of that, and we might as well shut up shop!... We need a manager, to coordinate and make sure that people produce results at a precise date!! We need an autocrat! Autocrats aren't idiots!!"

Pressed further, Boulez exploded:

"We're not a laboratory here! We have absolute imperatives to fulfill, quotas of production. We can't live like in a lab, constantly muddled and changing the environment and tools. We haven't this luxury! It's like children. This is impossible and no good.."

The third meeting was partly Boulez's resolution. A rare general

meeting of both music and science staff, at the time of the successful Parisian 'Repons' premiere, Boulez used it to introduce the new Administrator VN whose arrival he had announced by memo days before (see Fig.4.2). While discussing the budget planning for the coming year Boulez suddenly elected his personal tutor BYV as the equivalent of a new Scientific Director, but in a subtle way. BYV had asked: "Who decides the divisions of the budgets and according to what criteria?" Boulez replied: "It's up to you (collectively) to decide! The Artistic Committee, headed by WV, and the Scientific Committee.. headed by, I propose, BYV". The whole room, including BYV, seemed shocked by this. Later, the future of the experimental concert series *Espace Libre* was raised, and Boulez was damning: "They're awful! Mortally boring, bad.. amateur, unprofessional. We must reflect for a year and decide what to do with our concerts!" Just one voice was raised against the diatribe: "That's ridiculous! I don't agree". But the series was gradually terminated. Boulez's handling of power is thus abrupt and autocratic, despite his awareness of, and toying with, issues of internal democracy. This may indicate why the delegation of power, for example to Scientific Directors, has always been problematic.

4.2.2 The diffusion of charisma and patronage, and the role of musical and theoretical legitimation

Patronage and the use of personal contacts have always played a role in some of IRCAM's higher level appointments (9), as could be expected in a new and complex field, and in the musical world in which, like the artistic world in general, patronage plays a major role.

But the most striking patronage phenomenon links closely to issues of charisma, and consists of a pattern whereby Boulez lights upon a

hitherto unknown young man in whom he then invests great authority and power, either by promotion or by external recruitment. The young man enjoys a period in which he becomes a kind of divinely elected heir, as though being tested as Boulez's successor: a crucial problem for Boulez, in line with Weber's classic analysis of charismatic leadership (10). The task of the 'heir designate' (consonant with Weber's analysis) seems to be to exhibit and accrue as much charisma - consisting at IRCAM of artistic-musical, and scientific, talent - as Boulez himself, in order to prove a worthy successor. More interestingly, the heir has a second task: he must also himself exhibit a 'talent' for spotting and fostering talent, by bringing in other young men (and women) of high artistic and intellectual quality. In other words, he must also develop a skill for bestowing patronage and thus create a nexus of talent. However in reality, there is nowhere for an heir to go beyond a certain point; so the pattern generally ends with the heir's fall from Boulez's grace, and the young man leaves often feeling disillusioned and bitter.

Now we can see the importance in this general 'charismatic economy' of Bourdieu's linking of charisma and artistic talent (see Ch.1); and of the strategies discussed earlier whereby IRCAM's young vanguard musicians and intellectuals attempt to bolster their talent and charisma by ascetic displays of devotion. The ideological equation they are operating with dictates that to be a 'successor' they must demonstrate their creative talent as new, prophetic, rebellious against the current order: and thus as yet marginal and unrecognised. As we saw at the end of Ch.3, some of IRCAM's vanguard seek to remain marginal, preferring this position vis a vis power within IRCAM; others seek to be plucked out of obscurity and recognised by the leader or his co-authorities, who

can validate the truth of their work - and promote them. This ideology of accumulating charisma and seeking patronage is diffused throughout the higher music-oriented intellectuals. Amongst them, several key figures have since the start of IRCAM exemplified the role of successive heirs elect. Moreover we can trace links between them since, paradoxically, in proving themselves they have 'elected' and patronised each other in turn (11).

Four young men - WLe, HY, WOW and NR - epitomise the phenomenon of the elected heir, and have had similar experiences. WLe was the director of Diagonal before 1980. Boulez brought him to IRCAM in his late 20's from his job as head of the Basle Conservatory. The main project fostered by WLe was what became Chant/Formes. He brought into IRCAM the director, MC, but also others including HY, who later replaced him as heir. The collaboration between WLe, a composer, and MC, a scientist, was described by MC as the utopian prototype of all such work, and indeed of IRCAM (see quote Ch.7 p.*). MC recalled nostalgically the fruitfulness of the collaboration, enabled by WLe's musical and scientific talents; and hinted that Boulez was envious of this dialogue and of WLe's skills:

"WLe was involved in research himself very deeply, he was programming, he was making experiments etc. So he had insight into that, and the results, somehow, that Boulez could not have.. Boulez was not able to do that at all: a question of time, courage, of involvement..."

Boulez soon after began his own long standing relationship with his personal tutor BYV, perhaps modelled on MC and WLe's dialogue.

However WLe, who had been seen as Boulez's 'golden boy', fell out very badly with Boulez around 1980, with the result that WLe left - an incident so painful in the collective memory that people were loathe to speak of it. The turning point (discussed above in Ch.3) was a piece

that WLe produced, using the new Chant software developed with MC, that Boulez greatly disliked. MC described the incident ambivalently:

"I think the results of the research were poor and disappointing. It's true that considered at that moment, our voices were, like Pierre said, 'plastic voices' and 'like spaghetti'... Pierre Boulez was certainly impatient to get some results; but really, musically, an outcome in the direction that he wants, and nothing else! (laughs)".

Soon after, when WLe left, it was apparently because of this aesthetic failure (12)..

In the 1980 re-organisation, at the time of WLe's fall, Boulez suddenly announced HY as the new director of the Music Research department. HY was widely seen as the successor to WLe in the role of Boulez's favoured heir. HY was in his mid twenties, a young American composer with no previous high position; but he had been at IRCAM for several years and had begun to develop a relationship with the 4X team. In this period, HY had worked for very little on short contracts. Suddenly, with the promotion, which was also a surprise to him, he had power and authority. He became important on the Artistic Committee, and organised major conferences and publications. He also used the job to continue to compose, bringing in and patronising other young composers to work as his assistants. Among them were WOW and NR, later successors to his position. He had American musical networks, which he drew on heavily. But HY introduces another significant development: he is very strong theoretically and rhetorically and proved himself a fine speaker, writer and publicist. He could thus command authority at international conferences. HY's eventual falling out with Boulez was signalled not so much by a piece of his own, but by the experimental concert series *Espace Libre* that he started in 1983. His power on the Artistic Committee declined; and his lack of favour was marked by Boulez instructing him to undertake a mundane documenting task: to write a data

base of composers' visits. By 1984, HY was looking for other work, and by summer had secured a high level job at a major American university.

WOW was the next heir designate. He first came to IRCAM on the stage, and was noticed by MC because of the interesting sounds that he produced during the course (13). MC and HY brought WOW in as a junior assistant and composer to work with MC on Chant/Formes. Like all junior tutors, WOW also helped others with pieces, including HY. He was on 2 and 3 month contracts, and before his sudden promotion was still on six month contracts in the 6,000-8,000 franc bracket. There is no doubt that the key element in WOW's promotion by Boulez in spring '84 was his piece 'Chreode I' (see pp.7-8 above). As mentioned in Ch.3, the piece - using Chant and Formes - also had the effect of finally legitimising the programmes and the Chant/Formes group: it is a striking example of a well-received piece legitimising a technology for Boulez. The Chant/Formes director recalls Boulez's reception of WOW's piece with excitement:

"It seems that..(Boulez) has found WOW's piece really something, and one of the first and one of the rare, rare, rare examples of music done at IRCAM that has some interest!... I asked Boulez one day: 'What of interest has been done at IRCAM?' And the only one I think he found was the Holler 'Arcus'! That's all!! since '76 or so!.. and now he talks of WOW's piece too".

By the time that WOW took over the Music Research job, patronage had become the job's more-or-less legitimate concern: seeking and bringing to IRCAM interesting young researchers and composers with projects to be done, cheaply, under the department's auspices. WOW, Parisian born and bred, was well-placed to draw in local talent, and saw this as his role. One major success was his association with his wife-to-be, the composer NP, whom he encouraged as a squatter, brought in and helped to learn programming. They could be found together late into the

night at adjacent terminals, learning new programmes and A.I. languages, preparing their pieces. From this, NP produced an unofficial piece that was highly acclaimed at Darmstadt (Ch.2), and the glory reflected back on WOW for his astute patronage. WOW's skills are wider still than HY's since in addition to being a composer and theorist / rhetorician, he is also a good programmer. However by 1986, WOW was himself becoming disillusioned; and his place as Music Research director has in recent years been taken by the latest young heir elect, NR.

NR was also invited into IRCAM by HY in the early '80's, to work as his assistant on a piece. He came to do the IRCAM stage aged barely 23, where HY noticed him and plucked him out as an assistant. Since then, and during '84, he had been a junior tutor on very low pay, working long hours; yet all the time learning and producing pieces in his own time. NR had an early Italian training in computer music. He was also known to be not only a composer, but capable theoretically, scientifically and as a programmer. In '84, like WOW and HY, he was giving substantial theoretical lectures and was being commissioned to write papers. NR had a significant musical success in '84 with a piece for piano and computer tape; and this was affirmed by his being commissioned to make a piece for the important IRCAM 10th Anniversary concert series in 1987. From IRCAM, with HY's help, NR went as a postgraduate to a prestigious American college; and then returned to accede as heir elect in the position of Music Research director.

These four examples, and their interrelations, exemplify the successive phenomenon of Boulez's heirs designate. I have shown how these young men were themselves socialised into becoming patrons; and I have also indicated how musical success is central to gaining Boulez's

support, but that it is not sufficient since within IRCAM culture it must be buttressed by strong theoretical, rhetorical and scientific skills.

The main alternative patronage system to that around Boulez described flows through the Pedagogy director RIG and those around him (14). RIG is responsible for allocating tutors, he organises the stage, and chooses graduate students and odd researchers; he also brings in many of the junior tutors and lets in many squatters. Through these functions he has ample opportunity to offer work to young people that he finds interesting, and so brings many people to IRCAM, most of them on low pay or unpaid, encouraging them to feel that this is an exciting break. RIG's committed view, like MC's, gains strength by his own example: like MC he often works late, and is rumoured almost to live at IRCAM. RIG's informal, 'laid back', friendly and anarchistic approach is the opposite of Boulez's. RIG gives the impression of being on the same level as those who work around him, while at the same time he has running battles with both Boulez and the Administration. He thus appears the leading American bohemian dissident within IRCAM. His identification with the young and marginal is partly illusory, inasmuch as he is a powerful figure; and it has an effect of encouraging them, in the main, to collude in their economic marginalisation.

We have seen how charisma and patronage go hand in hand and systematically imbue the production sphere; and that the latter is legitimised and appears natural and benevolent through being linked to the concept of talent. Around this system are interwoven the narratives of key individuals' IRCAM careers, which stand as dramatic, exemplary myths to the young musicians and intellectuals who enter IRCAM, alerting them to the high risks, and the high potential rewards, of collusion in

the system. Finally, the analysis reveals the contradiction inherent in succession to charismatic leadership, since it shows the chronic volatility and fragility of the position of the heirs elect and their apparently fated eventual downfall, ultimately because their rise threatens the leader and they cannot be allowed to usurp him (15).

4.3 Politics and institutional conflict; the dual structure of power

In the remainder of the chapter I outline the institutional conflicts and broad political character of IRCAM. I show in this section that workers from the lower sphere of reproduction are subject exclusively to the bureaucratic structure of power embodied in the Administration, so that unlike production-related staff their appeal to Boulez's patronage is reserved for crises. The two spheres of production and reproduction within IRCAM therefore express not only status divisions and stratification, but also two structures of power: one bureaucratic, official and explicit, associated primarily with the lower domain of reproduction; the other based upon charisma and patronage, implicit, associated with the higher domain of production and intellectual work, and ascendant over the bureaucratic.

I show that politics within IRCAM are divided between those of workers from the lower reproduction sphere whose primary concerns are with the politics of employment and of the institution, with conditions of work, pay, time and so on; and those of higher status intellectual and production-related workers, most of whom disdain these politics, and are far more involved with patronage, with aesthetic and scientific legitimation, and with the many internal and external ideological and discursive disputes around their work (see also Chs.5 and 6).

4.3.1 Institutional conflict for lower status workers: bureaucracy and malice

The politics of workers in the lower reproduction sphere concern the basic parameters of their jobs: pay, hours, conditions, the attitude of bosses, and the threat of sanctions and sackings by the Administration. For some, this translates into a concern with the political processes through which they can express grievances and negotiate with the Administration, while for many it does not. The main formal channels for worker representation with management at IRCAM are, first, a body called the *Comite d'Entreprise* (company committee), and second, several positions called *Delegates du Personnel* (personnel delegates). The *Comite* has the highest profile of the two. It is a workers' consultation and negotiation body only, consisting of several elected staff, the Administrator, a representative of the Direction, and the Personnel director who convenes it every month or so; and it has no actual power. It apparently exists to air workers' problems and fears, changes brought in by management, and also to dispense little 'extras' provided by the organisation (sports facilities, outings, holidays, discounts). *Comites* have become widespread in French industry, and they are seen explicitly as an attempt to provide an alternative in-house consultative body that will discourage and obviate cross-enterprise unionisation. The *Delegue* position, again elected but requiring an individual to put him/herself forward, appeared anomalous within IRCAM since only one existed in '84 and no one else had come forward. It was widely believed that this *Delegue*, a technician whom the Administration had wanted to sack and who had a poor reputation as incompetent, had become a *Delegue* because a worker holding that office cannot be sacked -

also true of ordinary members of the *Comite* (16).

Of all the staff interviewed, only two secretaries who had been active in the *Comite*, and the Personnel director, chose to speak about in-house politics. One secretary had been at IRCAM from early on and had been instrumental in starting the *Comite*. The following near monologue from an interview portrays her views on the *Comite*. The speech is an eloquent account of the dual power structure within IRCAM.

"By law, any enterprise with over 51 posts can have a *Comite*. I was interested in provoking this event, so I helped to start up the *Comite*. I gave information to everyone informally..or no one would have been elected, as the Administration did not tell any workers!.. The people involved were..all lower workers, not *responsables* (directors)... It's very informal: but that's very bad, not the way to run a *Comite*. It's not taken seriously - people in high positions don't want to be involved. Why? It's not politics: it's basic rights, humanitarian! Perhaps they think they're going to dirty their hands with stupid things, and they prefer to deal with 'interesting' things... On the *Comite* should be TY (the Administrator), plus somebody from the Direction; then somebody from the high level and the low level of workers, and those two groups of workers should belong to unions. But if not, they can be just workers - and here it was like that, no unions, so no politics involved. So it was just people talking without any politics: this was interesting. And yet still, the higher people did not want to be involved.

Two years in, the Administration said: 'Within two weeks you must offer two people from higher categories to come on the *Comite* - and no one applied! Just BL (*Regie Batiment* director) and UK (a programmer) - that was all! Those people are not interested in politics, not interested in power... You know, in IRCAM something is very clear: it's difficult to have a homogeneous group.. The reason why is people are very very independent, they always want to fight on their own, to deal on their own with one of the highest people: so, everyone wants to speak directly with Pierre Boulez, to explain directly their things! They don't want to be supported by anyone... Everyone goes directly to Pierre, or TY (Administrator). They don't like to belong to a group... So if the higher people at IRCAM don't get involved in the *Comite* it's because they can manage - they are kind of selfish.. They can do so! They have some power! And in the other group, they can't manage to do that because they have no power, so they have to be several to fight, to get some explanation. This is the way many many things work here: and it's the reason why it doesn't work. Everyone pushes their own thing, no sense of general interest. It's disappointing. Higher people go to straight to Pierre; lower people have no such chance" [LK int].

It is interesting to note the two different meanings and the ambivalence attached to the secretary's reference to 'politics'. She

seems to mean, first, organised union and left party politics, which she wants to distinguish from 'basic rights' and 'humanitarianism' and to disown, in order not to dissuade other workers from being involved. But later, she talks of 'politics' in terms of a critical attitude to and awareness of 'power', and as a constructive and necessary force. The secretary's own attitude to unions is in fact positive, and she is deeply frustrated that IRCAM workers do not see fit to get unionised. There are no union members within IRCAM, except for the CGP cleaners - North Africans seen early in the morning and late in the evening - who also clean IRCAM, and who belong to the Communist CGT. During 1984 they were engaged on a chronic dispute which led to occasional strikes, and on those days both IRCAM and the CGP buildings were thoroughly leafleted. The leaflets argued passionately the local CGT case (see Ill.4.4); yet at IRCAM, they lay around apparently unnoticed, and drew no reaction from workers.

The same secretary provides a convincing analysis of why IRCAM is difficult to unionise, and continues to illuminate the issues, as follows.

"To have a union inside IRCAM, we would have to have a leader: and no one in here wants to be a leader. Many people would like to have a union here in case of injustice - because they realise that in case of problems, injustice, the Administration and Direction - Pierre Boulez - are very powerful; and without a trade union it's very difficult to fight. Even if you ask help from the *Inspection de Travail*, it's not enough; and we saw that several times in the past".

Q: "No one will tell me the stories of injustices!"

LK: "It's difficult, phew!! (pained).. there have been lots! Because it's that high to explain for how many people! (defeatedly, very reluctant to talk)... Those bad events, I will let you know... There are more reasons why people don't join unions: first, they are not all French, and I'm not sure that foreigners can belong to unions; then, the people working here for a very short period - two or three years - don't want..to scare the Administration, they want to be well thought of for their research - to get new contracts! And third, there are many different positions (kinds of worker) in this place - fifteen different positions in such a small place! So there are fifteen little groups, that can't get together to fight with the same aim in case of a problem.

I mean, secretary, technician, musician - it's different! They have not the same problems! For example JFA, KR (low administrative workers): they are alone, they have no one in similar positions.

The *Comite* could be more powerful - it is in big companies, like IBM. But we are not very professional about it here. It's meant to solve injustices, deal with social life, conditions and so on.. But it doesn't have voting power or back up externally, unlike unions. The Administration was supposed to inform the *Comite* of many things; but they didn't do so, we had to fight for it.. They just treated us like little kids, you know - 'Be nice, play!' We didn't manage to get much from the *Comite*.. We were playing our role, but they were not playing their role; and after four years, I decided to leave. When injustices have come up, the *Comite* has taken them up; but the Administration has often said: 'You should not be involved - stay in your place!'

The secretary's evident pain and cynicism and her political awareness are surprising since she generally appears far from angry or politicised and is, rather, a sunny middle class woman. Her reluctance to exemplify 'injustices' may derive from her current desire to revoke her former politicisation, but it also seems tinged with fear - a fear of the Administration expressed also by other low status workers (17).

The kinds of grievance that such workers may fear can be illustrated by two stories of past 'injustices' meted out to women clerics. The less extreme story concerns a secretary, OR, who had long been at IRCAM. She described how, after some years, her work relations with her director boss began to deteriorate for no apparent reason, which began a cumulatively punitive process against her centred on *avertissements* - official cautions.

OR: "And then things started getting bad on my level. Have you heard of these things called *avertissements*? Well, if you get three, you're fired."

Q: "Who decides what's worth an *avertissement*?"

OR: "It's usually your chief, who'll complain about you to the Administration. Then the Administration sends you an *avertissement*. I got one in March... XX (the director) had been invested with a lot of power at that time, and he used it.. In my opinion he started a campaign - he just tried to wear me out, psychologically, morally - it was extremely hard to bear... The pretext? I was 5 minutes late one morning, quarter of an hour late another morning, and half an hour late back from lunch another afternoon. He hadn't of course taken into account that I'd worked the previous years sometimes up to 8 o'clock at night here. I was working on the Holliger concert then: I was down there (in the Esp Pro)

mother)... And then (the *avertissement*) just rolled automatically through... You have to reply by recorded delivery.. I had to go and see the Administration; that's your chance to appeal. But it's very rare that an *avertissement* is taken out of your file... After that, it got worse.. I'm afraid I once lost my temper with XX. According to him, I was insulting and 'not subordinate'... The last part of the campaign: he started taking work away from me, reducing my work to filing.. He barely spoke to me. He was trying to freeze me out, you know? He used to leave me notes of what to do, and keep photocopies of them, and if I hadn't done certain things, that would go down in the file. And I got another *avertissement*!.. my work was given in slowly, I had 'ceased to operate as before' - you know, the kinds of things people can always find to accuse you of... He was collecting a file on me that I didn't even know about. He'd obviously been spying on me: he'd noted down things that I'd actually said! He was saying he didn't know what I was there for, on one occasion. And I think I said to him: 'I'm here to correct your English!!' - sarcastically - because I couldn't take it any longer. And he noted that down in a dossier, and in the second *avertissement* that phrase was there - ludicrous!! - that I had 'criticised his English', unreasonably! (laughs incredulously)".

The secretary saw a solicitor and decided to fight. She went to see both the Administrator, and finally Boulez, and a compromise solution was offered - that she move to work in the other sector, without demotion. Boulez also agreed to cancel the cautions, if things went well, and so overrode the Administration's procedures. The secretary emerged enormously grateful for Boulez's humane and enlightened intervention, and appeared charmed by his attention (18).

This secretary had been active in the *Comite d'Entreprise*, and openly admitted that, like the technician earlier, she had initially become a member in order to protect herself from being sacked. She spoke about the attempt to unionise IRCAM.

"We went to a couple of meetings at the CGP, MG (another secretary) and myself, with members of the CFDT, not the CGT - it's less violent; CGT is Communist, CFDT is more Socialist. We both got involved because of what had been happening here. We went to get some information. And they said: 'You're not protected there at all, you're sitting ducks everytime the Administration has a capricious moment'... I think we had a little meeting (at IRCAM); but people were basically against it. They seemed worried about militancy, politicising the situation.. I think they were scared. Although everybody who talked about it reasoned and said 'well, we've got the right..'. But they also thought the Administration might get a bit heavier.. (Involved in the initiative were) a number of research workers, the technicians and the secretaries

basically: not the responsables or higher level researchers, no, no" [OR int].

The second story of injustice done to lower status workers had the status amongst them of a notorious myth. The story was told by the same secretary. It concerned another secretary, GF, who had been sacked.

"GF worked for the Administrator TY. She was given a *faute grave* for some trivial mistake: she signed a document she shouldn't have, and engaged IRCAM in a sum of money - about 13,000 francs. It was to do with putting IRCAM's name into a telex directory. She was supposed not to have read the small print.. TY was the boss: she decided that. People thought it was a bit trumped up because if TY had bothered to write a letter cancelling it, ..all would have been well. But TY said it was too late... 'you don't make that sort of mistake twice'!"

Q: "When you're given a *faute grave* you're sacked?"

OR: "Yes; and while you appeal you delay your leaving date. So GF fought. Everyone thought it was unfair... If she'd made a cracking mistake.. half the budget of IRCAM to a rival organisation, well! She was pregnant at this time: that wasn't widely known, but then she let it be known.. very early, two months. That's when we tried, at the *Comite*, to use her pregnancy: you can't give a *faute grave* to a pregnant woman... Now, in GF's case it wasn't possible to use that, because she hadn't had her pregnancy declared officially by a gynaecologist.. (ironically) you have to have your 'form!' She egged us on, she thought it was very unfair; she remained very ideological. I think we tried to convince her: 'how could you stay on and work in that atmosphere?' But she was quite determined; we had lots of meetings.

Her sister works at the CGP, and she rustled up the union... And that's when we got a bit embarrassed because it was after we'd spoken to Boulez, as members of the *Comite*. He listened to our case: and he was going to see the President and Personnel. And we were very very embarrassed because instead of waiting to see what worked out, the union distributed a tract here! And we thought it was bad timing because it might have made Boulez very angry... Boulez suggested that she could become a receptionist for the Museum - he'd negotiated that. The *Comite* also went over to see the CGP President. We saw him, we had a talk with him. He received us graciously; but there wasn't much to do.. We said we thought the punishment didn't fit the crime. I remember asking: 'what constitutes a *faute grave*? Is there a list?' A bit simplistic I suppose, but I wanted to hear what he'd say. He said: 'no there's no list', so it's just a structure... We didn't want the union involved; we didn't want to provoke Boulez, he was very involved in the matter.. And it was Boulez who organised a solution: he said that the next time anything like that brewed up, he should be told immediately, so it wouldn't become a 'psycho-drama' again... But GF's move to the CGP would have involved a drop in salary: she didn't accept it. She saw it simply as an unjust thing. So she left... GF thought the *Comite* were selling her out making a deal with Boulez, she got very bitter. And she had a miscarriage of course.. she lost the baby... Women at IRCAM became antagonistic to TY (the Administrator) since then".

This second story, in which the Administrator - a woman - was

considered wilfully to have contributed to causing a miscarriage, constructs her as monstrous and inhuman, and no doubt relates to the distrust shown by workers towards her. In this secretary's eyes, the stories delineate a managerial division of labour in which a malicious Administration stands opposed to Boulez's benign and charming, humanistic leadership. Further, unionisation is perceived as a force that may provoke Boulez and so endanger the potential for asking for his patronage. For this secretary, the stories are interpreted to show that even for lower workers, rather than unionising it is better when in dire straights to appeal to Boulez's personal favour. As we have seen, not all lower status workers share that opinion; but at least they are commonly aware of and concerned with the possibility of unionising - an awareness that is notable by its absence amongst higher status workers.

4.3.2 Politics and their absence among higher status workers

In general, as we have seen, higher status production workers inhabit a world of competitive patronage and charisma and go direct to Boulez to negotiate pay. Higher workers do, however, have conflicts with the IRCAM bureaucracy. Here I show that junior tutors and tutors, for example, clash with the Administration over pay and conditions; while others engage in more purely ideological battles with them. I show further that IRCAM's research and production culture is notably nonpolitical (19).

Amongst higher status workers, the most exploited (eg junior tutors, vacateurs) may have to deal with the Administration in the period when they are proving their value to IRCAM. One battle arose out of the musicians group deliberations, after the departure of the director HY, in which they envisaged a new democratic structure for a

collective research group. For some, this included the desire to equalise the substantial pay differences within the group. When the new 'secretary' WOW was announced by Boulez, the fight seemed well primed. WOW had been a junior tutor-vacateur, and his promotion signalled a chance to try to raise other junior tutors' pay to near the same as the official tutors' - paid around twice as much on salary. The following interview with the American junior tutor and psychoacoustician HM, WOW's close friend, about his own fight with the Administration to raise his pay, conveys the atmosphere around these issues. He begins by talking, apparently, of a new openness within the group about each other's pay:

HM: "Nobody's ever had this knowledge before - so you were always operating in the dark. You didn't really know against what to make your demands; 'cos you could say 'I want this much', and she (the Administrator) would say 'Nobody makes that much!' That's what she told me. I asked for a certain salary; she said 'Oh even people who have an *equipe* of five guys don't make that much'. She lies through her teeth!"

Q: "When did you learn about each other's salaries?"

HM: "I still don't know what everybody's salaries are; I just know what WOW's salary is, and he knows mine. Nobody knows what HY's (past director) was. No, I don't know the tutors' salaries..."

Clearly the Administration are thought to operate by obfuscation, aided by the continuing secrecy between workers about their pay (20). At one point, HM and WOW, in their frustration, threatened to publically expose workers' pay levels. But in fact they did not do this; and it would be inappropriate for their intellectual charisma were they to be seen as too concerned with such issues. In effect, WOW's promotion by Boulez in '84 ended the group's plan for a united front on pay and for the ending of secrecy on salaries. His promotion was divisive and caused resentment. By 1986, HM had also been promoted to director of Pedagogy. Thus Boulez's interventions help to fragment attempts to co-ordinate the negotiation of pay and promotions among higher status workers.

Another major struggle between the Administration and higher status

staff during '84 concerned the official tutors. It was not about pay, but the use of their time and their job description. Tutors' post contracts described them as assistants to visiting composers, and had no word about their being composers themselves. However, three of the tutors consider themselves serious composers, and they decided to fight for the right to a substantial period to be set aside each year for their own composing within IRCAM (21). Rather than come to an ad hoc and personalised understanding with Boulez, the organiser, the tutor JIG, wrote a document which he was negotiating with the Administration, so that it would go officially into their contracts. At the heart of the negotiation was the issue of who is defined as a composer and who is not: a highly emotive and rivalrous issue between IRCAM musicians. The tutors, subordinate to the directors on the music production side, considered that several of those directors saw them as second class composers not worthy to be given composing time at IRCAM in their own right, as semi-technical assistants servicing the 'real' composers. For this reason, given their compositional qualifications on paper, the tutors may have considered it more likely that they would receive a productive and reasoned hearing from the Administration.

The Pedagogy director RIG is notorious for conflict with the Administration. But its character is different: he is known to be ideologically against bureaucracy, rules and 'policing'. The objections go both ways. RIG acts in many ways that the Administration experience as anarchic, and which provoke their censure (22). Other major political conflicts within the production sphere concern management: not just specific decisions, but the nature of senior scientific management in particular. In 1984 these included conflicts over the 4X industrialisation (outlined in Ch.2); and over the Scientific Director

role. Otherwise, the main political preoccupations of IRCAM's intellectual and production staff centre on their work and involve constant discursive conflicts and oppositions (see Ch.6).

There is one final characteristic of the overall political nature of IRCAM's research and production culture to be noted. It lacks a significant political dimension that it could be expected to have: that is, a concern with, or at least awareness of, the politics of high technology. Given the 4X industrialisation deal with major defence contractors, the proximity of IRCAM's technological work to militarist applications was clearly an issue in the air. Yet although I first heard of the 4X deal and its implications from a junior tutor who was uncomfortable about the defence links, of all the population only two visitors spoke of the issues at length: American computer musicians ID (of the UCSD centre CARL), and NI (23).

When I raised the militarist links of the 4X deal, ID responded at length as follows.

ID: "Oooh! (Sighs). It's a very very thin layer that separates the technological base of computer music from that used in advanced radar systems for things like cruise missiles.. Typically work like that gets done at Lawrence Livermore Laboratories and Los Alamos Laboratories in New Mexico.. They build the missiles, build and design the bombs, design the delivery systems, the works.. And, you know (upset), we're on the same (computer) network with them. And I get requests from time to time from Los Alamos and Lawrence for CARL software.."

Q: "You mean they just send you computer mail..?"

ID: "Mmm! 'Send us a (computer) tape'".

Q: "How do you feel about this?"

ID: "Well, very queasy. You know, I'm a pacifist, a Quaker! (laughs) And er.. so I had to determine my position on this.. well if I took a classical pacifist line I wouldn't have anything to do with the field. Because it's just too close. On the other hand, I made the following - I hope not too devious - argument. That really what counts the most is how these things get utilised. And if we abandon this technology to the military, then we can guarantee that it will be used without any humanist rationale whatsoever. Whereas I like to think of what I'm doing as a way of recapturing the technology for humanist considerations,.. (against) its tendency to be very anti-human in its direct presentation.. the user interface has been very unfriendly..

At the deeper moralistic level, the importance is to reclaim the

stuff in the name of humanity.. what's that wonderful saying? 'It suffices for evil to triumph that good men do nothing' (laughs)".

Q: "Could you just say 'no' to requests for software from Los Alamos?"

ID: "I could, since we just give it away - we're not under any obligation to give it to anyone on the education network.. Los Alamos are in on that network: it's the standard UNIX 'uucp' network that connects the VAX here at IRCAM to us in San Diego".

Q: "It's not just a technological link-up because it's also this network of exchange of knowledge and information..?"

ID: "Yes, and actually I have not said 'no' - I could, but I haven't. There's only a few ways to get through to those people and confrontational techniques are not going to work. I do go on marches, you know: I walk up to the front gates of General Dynamics and tell them to stop producing cruise missiles. But..when I'm dealing with people from General Dynamics who are interested in CARL software, I'm much more engaged with trying to lure them away from their activity - by proposing these alternative utilisations of the technology. There's another good reason for keeping the exchange going: (the defence industry) are very technologically astute themselves. And to an extent micro and desktop computers are there because of the armament industry".

Q: "So how much do you get back from them?"

ID: "Exactly! A lot! (laughs) Well I think you'd have to say that the whole field is there in its present state as a result of the interest the military has in it! They have such vast resources to command that it's certainly helped accelerate the technology... I do feel like a flea on the back of a monster, it's true. But I'm trying to bite as hard as I can and figure out where the jugular vein might be... It's a kind of meditation to be in this position: to be confronted with what are clearly the major driving forces of American industry and technology; and to try and peer into it and see the directions it might be taking, and to use my humanistic judgement powers to try to influence it where I possibly can.. (But) I am aiding and abetting at this point, there's no question about it, in the sense of not being able to do anything different, except turn the whole thing off!

We sent out a letter describing the CARL software, and one of the letters we had back was from Los Alamos; and we sent them a tape (of the software), and I haven't heard from them since. I suspect their use of it is related to speech research - with a view to allowing fighter bomber pilots to give verbal commands.. Perhaps underwater acoustics, sonars, for submarines... The same thing can be used equivalently without any modifications whatsoever to either help make bombs or help make music... A lot of the defence establishment runs UNIX.. the latest Berkeley UNIX release was sponsored in part by defence - one of the ARPA projects (24).. So they sponsored this UNIX development for military applications, which meant of course that it was also a more wonderful environment for making music! (laughs)".

Q: "Should these things be debated in the computer music community? Are they?"

ID: "They are not. It's utterly unconscious: this is probably the most extended discussion on the subject I've ever had.. I've thought of raising it.. If the community were to address, to even consider this relationship, essentially it would just completely distract the field - I think that's the conception people have of it, that it would just derail the entire enterprise. Because if you would just focus consciously on this as an issue.. it would just consume you! As perhaps

it should!.. I'm not sure but quite a lot of people in the computer music community don't actually support the relationship with the military-industrial complex.. They think it's a good idea that so much of the GNP of the United States is going towards military R and D, because they unconsciously see (the) fall-out for computer music!... No one in the computer music field has put forward a positive view of the links; but I've talked to half a dozen people in other areas of computer science who've thought that everything's just as it should be - mainly pure A.I. researchers. Artists do tend to have a liberal streak. But the problem is that if you're engaged in computer music, and you consider yourself a liberal, then there's this strong cognitive dissonance that must exist between your liberal leanings and the technology you're utilising - the way that technology got into your hands!"

This man's account not only of the close militarist links pervading computer science and music, but of the lack of conscious debate about this between computer music researchers, suggests that the phenomena are wider than just IRCAM. The second American visitor to volunteer a view on the subject, NI, did so in a very different style befitting his position as a marginal and non-academic computer music entrepreneur.

"I can appreciate what the 4X is: it's a tremendous accomplishment, tremendous machine!! I'd never seen such a powerful piece of hardware in my life! Never seen a machine that could even begin to do what it can do in realtime. I was absolutely amazed!.. I heard you needed a letter from the Pope to get near it (laughs sardonically)... I mean I'd love to work with the 4X, the way I worked with the Alles machine at the (Bell) Labs; but.. that doesn't seem likely. No, I don't even care what the limitations are: a machine that powerful is fabulous. And it saddens me greatly to hear how proud they are of its use, its commercialisation. A tremendous irony. They're proud!!! (incredulous). I was in a roomful of scientists and engineers and they were boasting about its use: 'we have made a commercialisation of this, it's now being manufactured for a flight simulator'! They should be ashamed. Not proud, they should be ashamed! That the world's most beautiful and powerful musical instrument is being used to train people to kill other people. And they don't even see that! I was so amazed: I was the only person in that room who saw death around! I could have cried" (25).

Within IRCAM, ID's contention that computer music researchers suppress the issue of computer music links to defence industries can be supported not only by the almost total absence of any mention of the issues (26), but also by the following qualitative example. In this interview, a key French Chant/Forme researcher discusses his lack of aptitude for computing before training in high level A.I. related

computer science at a major French state nuclear research establishment.

MC: "I had zero experience... I had to do something to learn it: so I went and asked for work and I learned it. Somebody told me: 'Well the thing to do is (go to) the Nuclear Energy Research Centre in the south of Paris.. Maybe they can take you and teach you'. I went there and they took me for a *stage* (post graduate course). I learned a little; and they asked me if I wanted to work on the subject that they were interested in, which was speech synthesis, because there was a research group on speech transmission and recognition etc..."

Q: "Why on earth was there such a research group at the Nuclear Energy Research Centre?"

MC: "Because at that time nuclear energy was not rising but falling, so all the people had to find new areas, domains of research or applications. And as they had a pretty good background in signal processing, speech was a good way to experiment with their knowledge".

Q: "More generally, has there always been such a strong tie-up between research around the nuclear industry or nuclear energy and computer science, historically?"

MC: "I have no idea..."

Q: "I just wondered when you say you went there to learn, whether..."

MC: "No, it's just a question of opportunity. I found someone, and he knew about that place where I could find a job, a place. That's all, nothing else."

In this narrative the researcher fends against his own responsibility for his decisions. His almost over-emphatic stress on the purely pragmatic and instantaneous considerations behind his entry into a nuclear research centre and then into speech synthesis serve to defend against any other possible considerations about these links.

In conclusion, we have seen that IRCAM's higher research and production sphere is imbued with institutional politics centred on rivalry for intellectual prestige and charisma, and for the patronage that flows from these. I have shown that this sphere is characterised equally by two significant absences of political consciousness or practice: of the politics of institutional and organised labour (whether the *Comite d'Entreprise* or unionisation); and of the politics of high technology. In the French context, the latter also appears congruent with the wider decline of critical perspectives on new technology among the French intelligentsia (Ch.2.3.2, App.5).

Chapter 5 Music reproduction, technology, acoustics: aims and ideologies

Introduction

The rest of the ethnography focuses in on IRCAM's intellectual domain, and in the next chapters I outline the ideologies, mediations and practices of IRCAM's musical and scientific work. I characterise the aims and ideologies of the three main areas: music production and reproduction; technological research and development, and acoustic research; and finally, psychoacoustics, music research and software development - all associated with IRCAM's vanguard.

I begin by arguing that IRCAM is characterised above all by a chronic musical and aesthetic uncertainty revealed in its everyday work and music production culture. By contrast, the institute's concert programming embodies an extremely coherent and forceful canonisation of twentieth century high musical modernism, consistent with Boulez's own ideology and genealogy of music history. In the light of profound musical insecurity in the present, we see how IRCAM's resources are channelled into three powerful and legitimising displacements: first, an unassailable interpretation of the musical past; second, the development of technology and pure science around music; and third, central to IRCAM's intellectual identity, the assertion of a realm of utopian and scientific thought and theory closely linked to composition, and concerned with IRCAM's unique role in the future of music (Ch.6).

5.1 Music production and reproduction

5.1.1 The absence of music: aesthetic doubt and uncertainty

Empirically, music is strikingly absent and 'unheard' in the

institute's daily working existence, except in its role as an occasional evening performance centre. Walking around IRCAM in the day it is rare to hear any music. Sometimes, when a *stage* is in progress, students' first, often inelegant essays at computer synthesised sounds can be overheard through the interconnected speaker system (Tape 1, eg 1) (1). Music is sometimes practised, and sounds produced, behind the closed doors of the IRCAM studios. But generally, for those expecting IRCAM to be a musical environment, there is a sense of simple musical deprivation that can breed 'rebellion', as illustrated by the following anecdotes. The composer AV was working as usual late into the night on sound synthesis files that took some hours to deliver up a sound. He tapped away at the computer keyboard and re-wrote the parameters of the files, while I sat and watched. After several hours, he called over to me with frustration: "Hey, Born! Play me some real music!", commanding me to sit at the grand piano parked in the studio and sight read a book of Bach chorales lying nearby. Elsewhere at IRCAM in a tiny attic room, the composer PL also regularly worked nights. Stumbling into his room in the small hours, I found PL playing loud music on cassettes to entertain himself as he programmed through the night. Contrasting starkly with the laborious and cerebral activity, PL played pop star Michael Jackson's 'Thriller' album, then top of the pop charts and his favourite; or music by notorious New York improviser, John Zorn, with whom PL played.

Music itself is also largely absent from the IRCAM *stage* for computer music beginners. The first lecture given with taped music examples, one of very few, came a full month in to the course. Compared with the strong emphasis given to learning the theoretical foundations of computer music, music and sound themselves clearly had a low

priority, which students found taxing.

Musical and aesthetic questions are very little discussed openly or debated in meetings. This can be illustrated by the significant meeting described in the last chapter in which WOW discussed the composition of 'Chreode I'. My diary notes about the meeting also include the following.

"..WOW discussed the piece for several hours entirely in terms of the programs (Chant and Formes) that he had helped to write that were used to compose it.. The language used both to discuss the programs, and of the programs themselves (programs being the new codes used to construct the music) was that of science and structuralism ('syntax', 'frequency', 'phase', 'quantum')... This was fascinating because I was observing the social process of constructing and negotiating a new language, notation and mode of analysis (ie the computer program) deeply implicated in the composition process, since it controls the new medium (the computer). Boulez's intervention had raised the question of the limits of this language, what it did not seem able to discuss; and the dangerously seductive determination, the autonomous rationality, of languages and notations around music. The seminar encapsulated the uneven development of media and aesthetic. The institute is primarily united around its technology, but seems uncertain about how to use this, and how to create means of communication (an analytic language, a notation) which do not take over and dictate aesthetically. I think a further uncertainty is the aesthetic itself, ie the 'musical decisions' which the young composer was so anxious to avoid discussing until Boulez made his point".

Thus Boulez's intervention was experienced as a ray of light piercing the technical and scientific discourse, as though only Boulez could risk talking directly of music.

We will see later how aesthetic discussion becomes sublimated into the issues of music research and psychoacoustics that preoccupy IRCAM's music vanguard; so that IRCAM composers, when they give introductory theoretical lectures or write articles on their music, define their aesthetic primarily in terms of these scientific conceptualisations. But more generally, the impression of how the aesthetic is raised within IRCAM's daily culture is through intellectuals' sudden infatuations with new scientific, especially biological, analogies for music: a kind of

constant, arbitrary conceptual foraging. Thus, walking along the top corridor of offices one afternoon I pass the American composer BH, a squatter who is keen to find a place within IRCAM. He talks with excitement of a new branch of genetic biology that promises to provide beautiful conceptual models for composition. Another day, I notice in a tutor's room a large glossy book on Mandelbrot's fractal geometry: a new area of mathematics concerned with formulating the 'logic' behind the apparently random shapes found in nature (for example, in geology, the shape of coastlines). The tutor is learning about this with a view to importing it into his compositional schema. I learn later that it is being referenced more widely by artists trying to bring science into their work. This same tutor is self-conscious about this phenomenon of conceptual borrowing, and speaks warily of "science envy". At a musicians meeting discussing the Formes program, a music director digresses enthusiastically:

"...Also there are very important and interesting biological models now: Lindermayer - his work on biological growth, how a leaf grows, functions of growth generation... I've been thinking of (a biologist) as a possible scientific adviser here, his work is very exciting and may have applications to musical structure. In fact much of Pierre's work reminds me of growth processes" [Mus Mtg 28.2.84].

Less elevatedly, an old composer taking the stage tells me confidentially at length about his aesthetic vision. He says that he wants to develop a way of generating the total form of a piece from the internal micro-structure of its component sounds:

"So the apple will have the same internal structure as the tree it's hanging on, and as the molecules in the apple! All the levels of the musical structure will be perfectly unified! Don't you think that'll give a marvellous result?" [St.N:56].

Other phenomena confirm the sense of chronic aesthetic uncertainty and dissatisfaction. First, there is a deep rivalry between IRCAM's internal composers expressed in constant private put-downs of each

others' work. Close colleagues would confess to me, confidentially, that they thought so-and-so was really a better philosopher, or programmer, or researcher than a composer, and so should concentrate on that. Thus, one composer says to me that so-and-so (a junior tutor aspiring to be a composer) is not really a composer. Another composer, having seen the premiere concert of a third, dismisses the new piece as a mess. A junior tutor-composer says of a visiting composer "I don't like his music, though I must admit it's clever technically". The same person says with frustration of a fellow tutor's piece: "This was very atonal, lyrical, self-conscious - not what IRCAM should be doing, nothing very new, and irrelevant to his work here". No internal composer's piece is immune from harsh private criticisms by his peers. These judgements happen so often that they become a fragmenting undercurrent of doubt beneath what appear on the surface to be close collegial relations centred on optimistic theoretical and scientific exchanges.

Privately divided amongst themselves, IRCAM music intellectuals collude in putting down outside composers: a classic form of reinforcing community by uniting against the outside. Tutors, for example, maintain a flow of sardonic comments on the progress of visitors' pieces. Sitting down to a musicians meeting, the group joke about the recent IRCAM premiere of a major composer from the rival GRM whom they say has still produced a *musique concrete*-like piece, despite having access to the advanced technology of the 4X. They laugh about the premiere, complain that it was boring and hilariously omnipotent: the composer sat high on a raised dias in the centre of the Esp Pro with a spotlight trained on his head and hands as he controlled the mixing desk (2). Visiting composers are commonly seen by IRCAM music intellectuals as willing

victims of the commission process, inexperienced with the technology and so impotent to produce good pieces and utterly dependent on their tutor as a 'nurse'. A tutor muses that the visiting composer he's working with is being very quick: "He's turning it out by the metre, and as soon as he's finished the piece he says 'OK, now can I have a job at IRCAM?'!!"; at which, again, all present fall about laughing with derision at this composer's naive audacity.

Aesthetic uncertainty both fuels, and is embodied by, the classification conflicts that express struggles between IRCAM workers over who is defined as a composer and who is not. In this classification system, to be defined as a composer confers the highest cultural status and confirms artistic talent, while not to be implies lack of these. I have already shown that almost no one at IRCAM is officially employed as a musician; and of the few who are, a further implicit hierarchy exists between those considered, or who assert the right to be defined as, a 'real composer' and those who are not. Boulez is most securely 'a composer', followed by the Music Research director HY who attracts envy for his assertion of the right to spend time on his own composing. Less securely, the junior tutors WOW, NR and HU are classified as composers: WOW, because of his successful piece which has 'proven' him; HU, because his composition has a high profile and because he defines his contribution strictly in music-theoretical and compositional terms. It is notable that the young men who gain the status of composers are also those in the running as Boulez's 'heirs elect'.

The hierarchical classification is revealed equally in the dissatisfaction of those musical staff who are not institutionally defined as composers, especially the tutors and junior tutors who consider that they are. That a hierarchy exists is illustrated in this

casually contemptuous remark by a music director:

"I wouldn't want to be a tutor here! Why don't these guys leave and take the risk of getting other work, being musicians if they want to? I wouldn't stay and be an assistant at IRCAM till I'm 40! How awful! That's my definition of academicism".

Hierarchical classification works to elevate as well as subordinate. In conversation with a director, we discuss an IRCAM visitor known to me primarily as a performer and improviser, at IRCAM to work on a music programming project. When I ask whether there are many other instrumentalists working on projects at IRCAM, the director says admiringly: "Well no, but we see AA primarily as a composer, considering what he's doing". The director's reaction betrays a further hierarchical ideology of the composer and instrumentalist, since when AA is considered to be innovating he is redefined, upwardly mobile, as a composer.

The deepest classification conflict is not even overt: it concerns the low status IRCAM workers who themselves compose, but who are defined neither as composers nor even as musicians within IRCAM. The 'double lives' of three such workers - the Sound director MI, the Systems team programmer YI, and the technician-junior tutor FLu - were publically revealed only when their music was played in one of the controversial *Espace Libres*. Hearing these workers' pieces, the air was full of surprised comments: "But I didn't know that XX made tapes!". The public airing of these workers' pieces was controversial: it alarmed one key music intellectual who might have been expected to support such an open event. He was deeply troubled, saying that the concert was dangerous in revealing an uneven diversity of musics within IRCAM which, he thought, would be fuel for IRCAM's critics. By contrast, the director in charge of the *Espace Libre*, HY, held the concert to symbolise IRCAM's lack of a

"house aesthetic": in his view, a positive strength.

Finally, musical uncertainty is most clearly expressed in the chronic dissatisfaction with most IRCAM music that we have seen is pervasive among even IRCAM music intellectuals; and which often exists back-to-back with an apparently uncritical reverence for Boulez's 'Repons', so that his music alone is exempted from the general gloom. I mentioned earlier how word has it that of all IRCAM pieces, Boulez himself values only two: WOW's 'Chreode I' and the composer Holler's 'Arcus'. The junior tutor-psychoacoustician HM told me that, of all IRCAM pieces, he valued most visiting composer AV's piece since he believed it utilised well his own psychoacoustic research. HM scorned the compositions of some other IRCAM composers who claimed to base their pieces on his research. He saw them as simply using his research for rhetorical justification, while the music itself showed no relation to his ideas (see also Ch.10.2.2). Typical of the comments on IRCAM music are the following, from an exchange with a Chant/Formes researcher when I asked him: what's your attitude to the music that's produced with your software tools?

MC: "Ah, extremely disappointed most of the time. It's very rare that I find something really interesting musically. I admire Holler's work, but musically I don't like it.. On the other hand, I think that Harvey's piece is really the best thing that has been done at IRCAM. But, I suppose that's not the thing that will stay in the future because.. it's more on the end of something than something new. It's amazing, musically wonderful, but probably it could have been done anywhere else as well as IRCAM!! (laughs). I mean, it proves nothing for IRCAM".

Q: "Do you mean because it's basically *musique concrete*, treatment of existing musical objects?"

MC: "Yes, yes exactly. So what it means is that Harvey has a fantastic intuition and ear.. But.. IRCAM was used for nothing in that (laughs ironically), except for having the computer and tapes!"

The composers and pieces that MC mentions are among the four often cited when subjects are asked to name their most valued IRCAM music. The

four are: Boulez's 'Repons', Harvey's 'Mortuous Plango', Holler's 'Arcus', and WOW's 'Chreode I' (examples are found on Tape 1). Holler and Harvey are most respected by the IRCAM 'establishment' including the Artistic Director, WOW by IRCAM's younger and vanguard population.

But MC's comments reveal a further important level of critical doubt expressed by subjects from both within IRCAM and outside about the three most vaunted IRCAM pieces, by Boulez, Harvey and Holler. That is, the view that these pieces could just as well have been made without all the technological resources of IRCAM, with simple analog devices, and do not really utilise the unique possibilities of IRCAM's computer music tools. For example, an American computer music researcher-composer commented on 'Repons', a day after the premiere:

"I think it was a bad piece done very well, in which the 4X was incredibly underused. You could have produced the same results with just a few analog devices and filters. I think, from talking to everyone, that was a pretty general response... It was a farce, those five technicians sitting there in a row! Xenakis said to me 'Is this contemporary music?'" [JCh note].

The technological scepticism is not levelled at WOW's piece, which is taken to demonstrate the power of IRCAM's Chant and Formes programs. But it is this technological criticism that provides the basis of the ideology of IRCAM's musicians vanguard, as we see in Ch.6.

We can now see that, by contrast with the inarticulacy and sensory immediacy of lower status workers' discourse, IRCAM's intellectual staff do not in fact enjoy sophisticated and articulate musical-aesthetic forms of talk. There is a lack of a specifically musical and aesthetic discussion, and in its place a proliferation of scientific and technological theory and talk. I explore this in greater detail in the following two chapters.

5.1.2 Concert programming, the canon: certainty about the past

By contrast with the aesthetic uncertainty of the musical production culture, IRCAM's concert programming and courses, records and video cassettes - everything that contributes towards musical reproduction - construct and maintain an extremely consistent and forceful perspective on the modern musical past. In other words, they construct a canon: a view of the key, sacred 'landmarks' in modern music, a genealogy of modern music. With IRCAM, Boulez's genealogical and canonic statement occurs on a far grander scale than before, as with the *Domaine Musicale*. Boulez's success in institutionalising his own view of history is well known in contemporary music, and his is often acknowledged as the dominant view (3). Through its institutionalisation IRCAM's canon appears removed from Boulez's direct influence, since from early days the Artistic Director WV has been responsible for concert programming. This bureaucratic division of labour, then, confers even greater legitimacy on the IRCAM canon, since it is becomes less personally invested in Boulez. However, most IRCAM intellectual workers think of the Artistic Director as Boulez's right hand man, and as standing in Boulez's intellectual shadow (4); and certainly, outside critics see IRCAM as expressing Boulez's ideology of modern music.

The massiveness, the cultural megalomania, of the canonic statements that IRCAM has produced from the start can best be illustrated by the concert series *Passage du Vingtieme Siecle* that took place throughout 1977 in several major venues around Paris, to commemorate the opening of both the CGP and IRCAM. With around 115 modern composers played in some 70 concerts over 12 months, the sustained scale of the series is quite unique in the history of

contemporary music: a bid to gain for France, by this founding statement, the key legitimising role in modern music. Surveying the range of composers represented, IRCAM's canon may appear aesthetically broad and eclectic. But this impression is undermined by the absence of certain areas of contemporary music, by the very uneven distribution of pieces - ie whose works were most played; and by the nature of packaging and publicity.

Table 5.1 is an approximate analysis of the distribution of composers according to the number of their pieces played in the *Passage* (5). Despite its crudeness, the table shows the main characteristics of IRCAM's genealogy. Implicit in the programming is a classification of modern composers into three groups, by generation and by valuation: first, the 'classics' of the early century, those elected as the genealogical forefathers of the contemporary avant garde; second, those considered the leaders of the next generation that rose to eminence after World War 2, dominant from the late 50's; and finally, the rest - both the less successful from that generation, and younger composers. Amongst the 'classics', the table shows the pre-eminence of three composers, Schoenberg, Webern and Berg (the Second Viennese School), with a secondary presence of Stravinsky, Bartok, Ives, Debussy and Varese: a genealogy completely consistent with Boulez's own ideology, centred on the modernist serialism of the Viennese with the addition of other important early modernists. Predominant among the mid century leaders are Boulez's colleagues from the Darmstadt school - Berio, Stockhausen, Nono - and his teacher Messiaen, also an early teacher at Darmstadt: all in their time proponents of a generalised extension of serialism. At the head of this group is Berio, who was also in 1977 an IRCAM co-director; while Boulez himself appears in a retiring fourth

Table 5.1 IRCAM's canon: approximate distribution of composers by number of their works played in the 'Passage du Vingtieme Siecle' concert series, Jan. to Dec. 1977

Composer Approx. no. of works played

'Classics': early 20th C masters

Schoenberg	16	
Webern	15	(Second Viennese School)
Berg	9	
Stravinsky	4	
Bartok	4	
Ives	3	
Debussy	2	
Varese	2	

'Leaders': mid century generation

Berio*	9	d, c
Ligeti	9	
Stockhausen	8	d, c
Boulez*	7	d, c
Carter	6	
Nono	4	d
Messiaen	3	d
Xenakis	3	
Cage	3	c

Others: including younger generation, less successful, and IRCAM composers/directors

Maderna	2 (Ital)	d	(contd..)
Pousseur	2 (Belg)	d, c	Zimmerman 1 (Germ)
Kagel	2 (Argentinian)		Henze 1 (Germ)
Globokar*	2 (Yugoslav)		Holliger 1 (Swiss) c
Decoust*	2 (Fr)	c	Ferneyhough 1 (UK) d
Chowning*	2 (US)	c	Birtwistle 1 (UK) c
Babbitt	1 (US)		Maxwell Davies 1 (UK)
Crumb	1 (US)		
Rzewski	1 (US)	c	... etc: all other composers
Bennett*	1 (US)	c	had just 1 work played.
Risset*	1 (Fr)	c	
Manoury*	1 (Fr)	c	
Grisey	1 (Fr)	c	
Amy	1 (Fr)	c	
Eloy	1 (Fr)		
Jolas	1 (Fr)		

Source: Passage du XXe Siecle
concert programmes

Note:

- d - Taught at the Darmstadt International Summer Courses for New Music
- * - Past or present IRCAM director or worker
- c - Past IRCAM commissioned or visiting composer

place - (it would no doubt be unseemly for him to be too prominent). Added to this is a judicious mix of other leading composers of the generation, including two - Ligeti (6) and Cage - who, in different ways, have been powerful dissenters from serialism; and two other important leading composers: the American Carter, and Xenakis - a concession to Boulez's rival on the French scene.

The third category confirms the tendencies analysed above in that two of the six composers leading this group (MADERNA and Pousseur) are also important ex-Darmstadt figures; while three are early IRCAM figures. The group also includes a major recent teacher at Darmstadt, the British composer Ferneyhough. In this last group we see other forces coming in: both an attempt at a range of nationalities (as with IRCAM's commissions, with strong representation of Europe and the USA); and a good number of French composers - the kind of mix of nationalism and internationalism characteristic of the attempt to regain avant garde cultural hegemony. Finally, the group contains many of the lesser known composers who were, or have become, co-directors or workers at IRCAM (Chowning, Bennett, Risset, Manoury etc) or commissionees (Amy, Grisey, Holliger, Birtwistle etc). Together, the three groups portray a canonic genealogy leading, in essence, from the serialism of the Second Viennese School, through the mid-century generalised serialism and 'post-serialism' of the Darmstadt school, centred on Boulez himself, to IRCAM: a trajectory that many commentators would see as exemplifying high modernism in music.

The packaging and publicity of the *Passage* also convey the canonic aim, through a keen awareness of the importance of sophisticated marketing of modern music that has increasingly characterised IRCAM. The very first concert of the *Passage* (13.1.77) was called simply 'Today', a

statement of music of the present containing works by Boulez, Ligeti, Xenakis and two others including the young composer Manoury, later an IRCAM junior tutor. More common were concerts presented as classic statements, conferring canonic status on the past. The third concert of the series (20.1.77) was called precisely 'Classics of the 20th century' and included works by Schoenberg, Webern, Stravinsky, Ives and Varese. Similarly focused on early modernism, and marking the centrality of Schoenberg and his school, were concerts devoted to an 'Introduction to Schoenberg' (6.5.77), and a group of four large concerts (12-19.6.77) devoted exclusively to 'The Viennese School' (Schoenberg, Webern, Berg). To highlight the major developments of the later generation were concerts called 'Darmstadt and after', including the work of Boulez, Stockhausen and Nono; while exclusive attention was focused on others through the concerts *Atelier Ligeti* (2.6.77), *Autour de Berio* (11.7.88) and *Autour de Stockhausen* (29.11.77). Clearly these marketing strategies aim to produce a powerfully legitimate and universalised interpretation of music history.

Other aspects of the *Passage* publicity push home the genealogy in case the point has been missed. The series' book length program contains long historical essays such as 'The origins of the 20th century: the second Viennese School', 'Crossing the 20th century: beyond the Viennese' (by Susan Bradshaw); and others called 'Technology and music in the 20th century' (by John Pierce), and 'Invention/Research' (by Boulez himself), the latter essays conveying the turn towards technology and scientism in the Boulezian post-War modernist ideology. This turn is confirmed and naturalised by the inclusion at the end of the program book of a totalising overview called 'The 20th century: Music - Arts -

Literature - Science: a synoptic table' (see examples Ill.5.1, all titles my transl.) In the table, for each year between 1900 and 1970, the key historical developments in each of the four domains are laid out side by side, as though to assimilate them all within a grand evolutionary intellectual scheme. We find, for example, for 1913 on the left of the table the Parisian premiere of Stravinsky's 'Rite of Spring' posed against, on the right, Niels Bohr's founding of quantum theory, with Freud's 'Totem and Taboo' in the middle; for 1954, the start of Boulez's *Domaine Musical* and the premiere of 'Le Marteau sans Maître' posed against the first American nuclear-powered submarine; and so on.

As though to detract a little from this universalising rhetoric, the *Passage* program also contains a disarming, almost poetic, preface by Boulez (see Fig.5.1, my transl.). The piece at once supports the absolutism of the *Passage* and its rhetoric (talking of 'a statement.. on what exists: the reality..', 'what must come to exist', 'the necessity (of) our project'); yet it also softens that absolutism by speaking of 'constant contact with diverse publics', the avoidance of 'fixed ideas', IRCAM as a 'team' with room for different personalities, and a call for 'us (to) consider together' a balance between 'certainties' and 'uncertainties'. All of this dissolves the sense of historical givens into a more post structuralist rhetoric of pluralism, diversity and contingency. This contradictory balance between modernist universalism and a more post structuralist fragmentation, as I touched upon in App.6, is found more widely in Boulez's rhetoric, and in aspects of IRCAM's publicity (see also Fig.5.2) (7).

IRCAM's artistic policy since the *Passage* has been remarkably consistent and unchanging. Surveying the seasons from 1978 to '86, the same canonic names repeatedly recur: among the early modernist 'greats',

Before devoting ourselves completely, exclusively, to research,
IRCAM desires to make a statement - in public -
on what exists: the reality, immediate or distant,
as much as future perspectives, what must come to exist.

A permanent feature of our activity will be, in any case,
constant contact with diverse publics,
the investigation, also, of the different forms that this
contact can, and must, take.

At the threshold of our existence, then: Passage du XXe Siecle

What must not be done:
a statistical balance-sheet
straight lines
decided choices
fixed ideas

IRCAM is a research team;
it's as a team that we present these performances,
each series reflecting more or less directly the personality
of he who is in charge.

Passage:

This word describes our common attitude
towards the changes that have not ceased to modify
music itself
as well as the forces of the musical life.

Let us consider together
Let us traverse this century
with the certainties that it has abundantly provided,
with the uncertainties with which it is no less prodigiously
provided,
to confront each other will help us
to publically design our project,
each day to explain its necessity.

We want constant
transition
from the work (become) model
to resolute and adventurous experience.

Pierre Boulez

(My translation)

Figure 5.2 1982-83 IRCAM concert season brochure, opening page

To look at a program,
is to turn the pages of
a miniature encyclopaedia.
Everyone deciphers it in their own way:
how many new works?
how many repeats?
how many French?
how many foreigners?
how many classics?
what do I know about anything any more?...
Conductors, soloists, works,
all of this revolves according to the tastes
of each personal kaleidoscope.

Of course, these proportions,
these mixtures
- sometimes naive, sometimes scholarly -
denote the diverse,
even contradictory preoccupations
of the organisms that exist
to testify as openly
as possible
to creativity as it stands today,
to recall to mind the
important landmarks,
to give to those involved
the resources
to express themselves individually.

A program, it's a maze
of good intentions,
and it's a statement of present reality.

(...)

Pierre Boulez

(My translation)

mainly Schoenberg, Webern, Berg, Stravinsky and Bartok; among the contemporary leaders, Boulez, Stockhausen, Berio, Messiaen, Nono, Xenakis and so on (8). More diverse series also occur, such as 'Contemporary Polish Music' (1982-83) and 'Music Theatre' (1978-79). Thematic marketing becomes increasingly common, so unifying the programming and also making it more didactic. Two new concert strands appear: *Forum de la Creation*, consisting of invited contemporary music ensembles, and a series of 20th century chamber music concerts by EIC players. Both take place in the CGP, and attempt to draw a wider audience.

Overall, despite Boulez's sometime critique of traditional concert hall ritual (App.6), IRCAM's main concert series remain traditional, formal and reverent occasions, based doggedly around the canon. The highly elite audience drawn by IRCAM's major canonic concerts can be gauged by that of the first Parisian premiere of Boulez's 'Repons', in October 1984 in a special large hall of the CGP. A row of reserved front seats remained empty until just before the start, when a group of figures swooped to the front to fill them, among them leading right-wing politician Jaques Chirac - then Mayor of Paris, later Prime Minister - and Mme Pompidou. Days later, in the Sunday morning session of the International Computer Music Conference (ICMC) to which IRCAM was playing host, the crowd filling the Esp Pro were alerted by an unexpected police presence to the grand entrance, moments later, of Boulez accompanied by the glamorous Jack Lang, Socialist Minister of Culture, and his entourage.

IRCAM's musical reproduction, then, constructs an extremely forceful canonic genealogy of modern music, centred on high modernism and its legacy, and unchanging. This strategy of stasis reinforces its

universal and timeless legitimacy, since 'classics' must by definition be seen to be abiding and beyond the fluctuations of fashion. But from the early 1980's, this core stasis has been accompanied by a growing number of computer music related events that attempt to broaden the narrow canon by adding a parallel commentary with reference to computer music and younger composers. This broader programming was influenced by two American music directors, HY and RIG; and within computer music, it is also canonic. It has included concert series, courses and occasional conferences such as 'Material and musical invention', 'The composer and the computer' (1980-81), 'The concept of music research' (1982-83), 'Immaterial: technology and artistic creation' (1984-85), 'Perception and composition' (1983-84), 'Artificial intelligence and creation' (1984-85). Amongst the composers represented are some of those from the main canon, plus Holler, Harvey, Chowning, Machover, Murail, Manoury, Risset: unlike the main canon, all known particularly for their work with the technologies or the conceptual issues in computer music, and all with some association with IRCAM. By 1987, the concerts held to commemorate IRCAM's 10th anniversary contained only works by six recently recognised young IRCAM composers.

5.1.3 Dissident concerts: *Espace Libre* and improvisation

The broader conception of IRCAM's mission is best epitomised by some 'dissident' concert series organised by American directors HY and RIG in 1983-84, which caused controversy within IRCAM by combatting in different ways the established artistic policy. The series in question are HY's monthly *Espace Libres*, and RIG's two series called *Musique au Centre* and the 'Off Festival' of the ICMC.

The *Espace Libres* were sprawling, informal 'experimental' multi-

media events held in the Esp Pro and lasting from 6.30pm until after midnight. They attracted a large, young, intellectual and bohemian Parisian audience. The evenings began with a theoretical discussion for an hour or two, normally about a composer's work - on Boulez, Harvey, Manoury, HY himself - or introducing aspects of IRCAM's computer music and scientific concerns. There followed lengthy interludes of live performance, tape music, and video screenings, often interspersed with more theoretical talk or question and answer sessions between audience and panel. People would come and go throughout the evening, and IRCAM's intellectuals were available, if generally remote.

DLW's series were also informal affairs devoted entirely to improvised musics, closely related to free jazz. One weekly series was held in the modern art gallery of the CGP, in front of abstract paintings, where a small improvising group would play for an hour to a small audience sitting on the floor. Again, the audience could come and go and look at paintings. The other, the 'Off Festival' of the ICMC, coincided with a series of formal concerts running with the conference, and was designed as a space to show the live, performance-oriented developments in computer music: how small, portable realtime technologies could be used for improvised musics. The 'Off' took place in the main, small Parisian free jazz club a long way from IRCAM, to an audience of 40 or so mainly American computer music and IRCAM people. Photos 5.1-4 show scenes from one evening at the 'Off Festival' (9).

These series contradicted IRCAM's dominant artistic ideology in several ways: most obviously by their relatively unstructured informality, their 'unseriousness' and lack of focused, reverent ritual; by their inclusion of musics - jazz, improvisation, and rare references to pop - not deemed legitimate; and by their 'openness' to amateur and

51



81

52



24

5.3



12

5.4



12

professional musicians from outside IRCAM's usual network and aesthetic. The technological bent of the concerts was also mildly 'subversive', in focusing on live uses of small technologies, and on video (a medium developing a strong amateur culture as well as professional uses).

In the *Espaces*, the theoretical discussions drew mainly on well known IRCAM figures; but the performances, tape and video sessions brought in both less known IRCAM members, and works from unknown, 'way out' or amateur Parisian and American musicians and artists who had come to HY's attention by writing or sending in tapes. I mentioned earlier this chapter the playing at these events of music by IRCAM workers not officially considered to be composers: tutors, junior tutors, but also sound engineers, researchers and so on. Such an 'open' artistic policy is clearly antithetical to the authoritative proponents of the canon. But the 'openness' was limited. Only one *Espace* had an entirely open section, called '*Programmez-Vous*', for the public to bring in their own tapes (10). But most hearings were carefully pre-selected by TM, who is no aesthetic populist (11).

In terms of multi-media, the *Espace* included performance art as well as video. For example one evening, a long emotional performance piece called '*First Russian Testament*', using sounding objects and sculptures, movement and poetry, was given by a Hungarian woman to a hall full of Parisian Hungarians. The video component of the *Espaces* ranged between those of obscure Parisian artists and youngsters brought to HY's attention; to the latest fashionable video art from the American scene; to (rarely) recent mainstream pop videos such as those by Michael Jackson or Culture Club, that HY admired (12).

RIG's improvisation series included jazz and improvising musicians known to RIG from his own enthusiasm and contacts in those areas. As a

student, DLW was himself a jazz drummer; and he played for a short while with one of the leading black American free jazz groups, the Art Ensemble of Chicago. Since that time, he has retained contact with many leading black American jazz musicians, and was building up his European contacts - for example, through creating ties with the free jazz club. It is well known that Boulez is against free improvised music, as well as the frivolities of pop music and pop video. Thus, HY and RIG's series were destined to be opposed by him and the Artistic Director.

One *Espace* caused particular controversy within IRCAM, and exemplifies the ideological conflict that the events generated. Early in the evening, following discussion of a major IRCAM composer's work, came a showing of the Michael Jackson 'Thriller' video: then the most talked about phenomenon in pop. It was followed by a set of pieces by IRCAM workers - both tutors, and 'unknown' composers. Among these were a passionate tape piece by the sound engineer, dedicated to Allende's Chile and evoking the sounds of torture, and a tape and free saxophone piece by a squatter-technician. The evening ended with the first 'collective free improvisation' by musicians (including myself) and scientific workers to occur at IRCAM, with live realtime transformations of the playing by the 4X and Buchla machine. The concert was experienced as defiant and exhilarating, and the hall was full and lively.

But it caused great disquiet. An outside musician commented on the improvisation: "That was a political gesture, because Boulez hates, has always been against improvisation. It was very brave of HY.." [LN]. By the following day, HY looked grim and explained that he had been told off: "The Administration didn't like it.. It cost too much money!" This was puzzling, since the *Espaces* were cheap because no one taking part was paid; so that the only costs were travel expenses for visitors, hire

of videos etc. HY also seemed sceptical about this censure, but declined to say more. The events did cause some tension by depending upon the good will of the Esp Pro, Sound and Video teams who worked overtime for no pay. But the strongest criticisms, by the Artistic Director WV and Boulez, were of the 'unprofessionalism' of the events. They were expressed in muted, official form in the minutes of an Artistic Committee which also signal a reassertion of control. The minutes read:

"WV informs the Artistic Committee that Pierre Boulez wishes IRCAM to host different informative public events (13) to the *Espace Libre*... The AC arrived at a compromise to resolve the problems posed, first, by the availability of the Esp Pro, given the increased frequency of conferences and *Espace Libres*, and further by their length, as well as the heterogeneity that divides the first part (Portrait of a Composer) from the free and open part that follows. The AC proposes, therefore, that the conferences take place at 6.30pm (supervised by RIG), and that the *Espace Libres* be given at 8.30pm the same day. In addition, it is wished by VR, RIG and WV that the number of *Espace Libres* be reduced to one every second month" [AC mins 13.6.84, my transl.] (14).

5.2 Technology research and development

I turn now to IRCAM's technological research and development, and its autonomous preoccupations. These have to be understood within the history of the computer music field - a history fuelled by technological and scientific developments that intersect with, but are also largely separate from, that of high musical modernism. As background to IRCAM's technological culture and its aims, Appendix 7 gives an overview of the history and state of computer music prior to IRCAM, which I here briefly summarise.

5.2.1 Background: the history of computer music before IRCAM

From its inception, the higher aims of computer music centred on transcending the limits of electronic music and its analog techniques, whether those of the French school, *Musique Concrete*, or those of the

German *Elektronische Musik*. The former school was thought to use rich sound materials, but with poor control, while the latter applied sophisticated controls to poor sound materials. Computer music, it was hoped, could enrich both the quality of sound materials, by its capacity, in theory, to synthesise 'any imaginable sound' and completely new timbres, and the modes of controlling musical structure and process, from the shape of individual sounds or phrases to whole pieces.

Early computer synthesis of soundwaves, in the late 1950's and early 60's, was disappointing in two ways. There were technical problems, due to the limits of computing speed and power, given the extremely heavy computing demands made by the current synthesis techniques. There were also conceptual problems, since digital synthesis revealed the lack of adequately subtle acoustical analyses as models for synthesis. The latter led to the rise of psychoacoustical research, and increased concern with the subtleties of perception particularly of musical timbre (eg Risset's work on trumpet timbre, involving computer aided analysis and then synthesis). This development in turn signals the rise of a new kind of interdependence of research on computer analysis and then synthesis of timbre and other musical parameters.

By the 70's and early 80's, two major developments had occurred. The first generation of computer music synthesis languages, known as 'patch' languages, had become established (eg Music V, Music X etc, based on Mathews' work at Bell Labs). These require the rigorous specification of each acoustical parameter of the sound (see App.7). They produced improved sonic results, but were far from realtime, involving lengthy delays between the input of data and the eventual hearing of the sound (the 'turnaround time'). A technique of digital

synthesis by frequency modulation (FM) had also been developed (by Chowning at Stanford, as mentioned in Ch.2), which generated efficient ways of producing rich and complex timbres in realtime. FM was sold to the commercial sector, and became the basis of the new consumer digital synthesisers from the early 80's.

But the dominant computer music developments prior to IRCAM, such as the patch languages, rather than simply transcending the limits of electronic music, also involved the loss of some of its positive characteristics. First, the use of sophisticated patch software depended upon access to large, powerful computers, and so was confined to major institutions (universities, radio stations etc). This contrasts with the earlier development of small, cheap, portable analog technologies which enabled a wide diffusion and availability of the technologies among musicians, and their use in live performance. Second, patch languages are laborious and conceptually highly abstract, and not amenable to empirical musical use or gestural control. They depend upon the specification of each individual acoustic parameter and so make it difficult to work on their interrelation - a crucial factor in timbral synthesis - and are therefore strangely unpredictable. Above all, they involved a loss of realtime synthesis compared with analog techniques.

During the early 80's, some major advances were made by the commercial sector which centred on increasingly sophisticated realtime consumer synthesisers (based on digital FM). From the crude Casio range, to the Yamaha DX range, to the Fairlight synthesiser, these were oriented towards the non-technical user and offered a range of pre-programmed and programmable, discreet synthesised timbres controlled by a keyboard. Another major advance was the development of MIDI, an industry-wide standard allowing consumers to link up different digital

synthesisers and personal computers into increasingly powerful networks of musical instruments and controls.

5.2.2 IRCAM's technology research program: basic tenets

IRCAM's 1984 technology projects apparently aim in various ways to overcome the limitations of earlier high tech computer music, and to recapture some of the characteristics of good musical instruments that had been lost in the transition from analog technology: realtime response, empirical and gestural control, less conceptual complexity and a more appropriate interface with musicians. But they centre above all on developing the more unique and unprecedented musical possibilities of powerful computers. The two main research projects, the 4X and Chant/Formes, aim respectively to advance powerful realtime digital synthesis at the level of hardware, and to provide increasingly appropriate high level music software for synthesis and control.

Yet it is striking that within IRCAM in 1984, the commercial computer music developments described above, which focused on improved empirical and gestural control (15), realtime response etc, were rarely mentioned. They were a vague background, occasionally surfacing in discussions, and brought into IRCAM by 'dissidents'. In fact, one of the more-or-less implicit principles of IRCAM's dominant ideology at this time was a hostility and contempt towards all commercial developments and especially 'low tech' or small consumer technologies (see Ch.9); thus, it was held that IRCAM had nothing to learn from commerce (16). This attitude is consistent with Boulez's original vision of IRCAM, which as we saw in Ch.2 (App.6) he contrasted with the 'irrational' economic imperatives of the commercial sector.

A variant was also voiced by IRCAM tutors in the *stage*. When asked about IRCAM's relation to commerce, the tutors first sketched what they saw as the appropriate progressive role of the market: "In the beginning, around '57, the first synthesiser was enormous and very expensive. Now, each year they get cheaper, smaller, more efficient". The tutors described the two sectors' concerns as totally distinct. The commercial industries were, they said, oriented towards commercial synthesisers, "the pop market, the mass music market"; while IRCAM and other basic research institutions were concerned with "more subtle musical uses of technology, more abstract.. We're oriented towards research, computer science, music research, for contemporary music". Pressed by students as to why IRCAM does not pay more attention to commercial developments, and asked "Why is there no representation of the enormous pop market here?", the tutors looked annoyed, bored and defensive. One replied, "But it's the researchers in electro-acoustic music who originally developed the technology and electronic instruments used in pop music! The role of research institutes has always been crucial!". The dominant view within IRCAM, then, is a 'trickle down' model whereby basic research comes only from autonomous research institutes, and then diffuses to commerce: so that commerce becomes dependent upon and derivative of institutions such as IRCAM, which are seen to have the major pioneering role (17).

We will see, then, that certain major characteristics of IRCAM's research culture can be understood in terms of IRCAM's assertion of difference from the commercial sector, oriented as it is above all towards consumers or 'users'. The dominant thrust of IRCAM's research, despite lip-service, tends to neglect issues concerned with the needs of the user, issues of 'user friendliness', or 'user interface' (sometimes

called 'man-machine interface') such as gestural control and practical aspects of computer music. These issues are seen as not IRCAM's priority, since they are not perceived as 'basic' or 'fundamental' research.

5.2.3 Dominant technology projects: 4X, Chant/Formes

The aim of the 4X project is the production of the most powerful realtime digital synthesiser, with a strong emphasis on realtime: the capacity that had been lost with earlier kinds of digital synthesis. The project also centres on innovative hardware design: building a big machine. In fact, as we saw in Ch.2.3.1, the 4X did not long remain the most powerful realtime synthesiser. By 1985, the Lucas Film machine, the ASP, designed by the American HF (an earlier IRCAM researcher who left after falling out with Boulez) had overtaken it for size, power and generality as a sound processor, although at a higher price level.

The 4X project originated when the designer, physicist BU, was brought to IRCAM in 1975 by the composer Berio, then a co-director of IRCAM. Berio asked BU to build him a "realtime digital synthesiser with 1000 oscillators" - far more powerful than extant analog synthesisers and, being realtime, far faster than extant digital machines. The 4X is the culmination of a series of prototypes (the 4A, 4B, 4C) that PDG developed from 1976 on. These machines were increasingly powerful and adaptable and allowed a growing range of sound synthesis and processing techniques. The 4A, ready in '76, had 256 digital oscillators and envelope-generators, used for additive synthesis. The 4B and 4C added digital FM facilities from a smaller base of 64 oscillators and envelope-generators. All were controlled by a host minicomputer, the DEC

PDP11.

The 4X is yet more powerful and flexible: it is capable of both realtime synthesis and analysis of sound. The range of possible digital processing techniques available on the 4X include many known digital techniques and simulations of important analog techniques: additive synthesis, 'subtractive' synthesis by numerical filtering, FM synthesis; synthesis by sampling of acoustic sounds and then processing them; ring modulation, harmonisation, echo, reverberation, phasing; frequency and spectral analysis, and so on. The 4X was, then, unique in its power and generality in 1984, with no commercial rival - except for the up and coming Lucas Film ASP.

The design philosophy of the machine is to provide a basic signal processing hardware 'architecture' that can be used flexibly for different techniques. But one of the major weaknesses of the project rests on the fact that hardware alone is not sufficient to provide this. It also requires the development of appropriate software and 'peripherals' to add on to the main hardware in order for it to be fully, and musically, usable; and this next crucial stage was neglected in the early years of the project. BU was rumoured to have no interest in or knowledge of software. Indeed he was new to computer design when he came to IRCAM and may not have realised the importance of software, and so focused only on hardware. Further, we will see later that BU conceives of himself as essentially a manual and mechanical worker, and has little time for what he sees as the inflated claims of IRCAM's intellectual software group. So in 1984, a full three years after the final hardware emerged, the main 4X related work was the development of software and of peripherals such as the DAC's and ADC's, gestural control devices including a 4X control box with faders and joysticks,

and a keyboard attachment, that could enable appropriate use. The 4X Soft team, led by Boulez's tutor BYV, were developing both the basic operating programs within the machine, required for it to run, and the higher level programs that allow the user to configure the machine in the desired way, and enable it to interface to other machines and peripherals. The software tools and peripherals, then, were aimed to fill out the environment around the basic hardware to make a '4X musical work station' (18).

In 1984, all the project's work was oriented towards preparing for the 'Repons' premieres in which the 4X had a starring role. By 1985, the development of the 4X work station had been achieved (see Koechlin, IRCAM Report 39, 1985), and IRCAM built four such work stations for use within the institute. However, no 4X work stations were distributed to other computer music centres since, as we saw in Ch.2.1.5, the Sogitec/Dassault industrialisation deal failed to deliver musical 4X's and produced only general signal processing versions for the defense-oriented companies themselves. In summary, the history of the 4X reveals a stress on realtime digital processing power, based upon hardware innovation; but a relatively weak awareness of the necessity of both software and peripherals, and so of the musician or user-oriented end of the R and D process.

The composers who have most successfully used the 4X are those resident at IRCAM, such as Boulez, the Music Research Director HY, who saw himself as a pioneer user of the machine, the tutors and junior tutors. Speaking of the advantages of the machine, HY mentioned its marvellous instantaneous response, allowing empirical work - trying out ideas, hearing back sounds and modifying them in realtime; and its great

flexibility - the wide range of processing, manipulation and synthesis that it can achieve. Nonetheless, HY often relied on the help of assistants to use the machine, so his view is not that of someone struggling directly and alone to master its possibilities. There are a few internal critics, including tutors, who speak of the 4X as far too generalised, simply a grandiose and primitive simulation of analog techniques - "just a glorified patchboard with a thousand oscillators!". We saw above that similar criticisms are also voiced by some external computer music researchers whose sceptical reaction to Boulez's use of the 4X in 'Repons', and to the enormous expense of the technology in the piece, was that the same sound effects could have been achieved with simple analog technology. Among internal critics, the Chant/Formes group are the most vocal. They argue that the 4X technology is out of date, that it lacks musically appropriate controls, and neglects to explore the computer's potential for higher level music-conceptual development: concerns that are the basis of their own software work.

The Chant/Formes project is concerned entirely with high-level software, and aims to innovate both in synthesis techniques and in the structuring and control of sound for composition. Yet the software is not realtime; and it was in '84 dependent on a high tech computing environment (the research was carried out, and the programs ran, on the VAX).

The Chant/Formes project originated in research that the director MC came in 1978 to do at IRCAM on the structural analogy between speech and the musical voice, closely related to his doctoral work on speech synthesis. MC began a close collaboration with WLe, composer and early co-director of IRCAM, mentioned earlier in Chs.3 and 4. In time, WLe

"was obliged to say that it was not possible to do 'pure research' without any outcome, output" [MC] and there was pressure to orientate the research towards music production. The tension being voiced here between research perceived to be oriented simply towards greater knowledge, even if software related, and that directed towards music production, is a theme that returns in Ch.6. WLe asked MC to produce a synthesised singing voice for his own compositional use. This eventually became the Chant program. By late '79, WLe had finished a piece, the first substantial piece ever to use computer synthesised voice.

The Chant/Formes group see their work as the intellectual vanguard of computer science projects at IRCAM. They link it conceptually to recent developments in A.I. and its analogous application in fields as diverse as speech recognition and synthesis, computer graphics and animation. Both the Chant and Formes programs are informed by A.I. developments such as the language Lisp, the concepts of 'object oriented' and 'interactive' programming; and both focus on the time dimension of music.

In underlying philosophy, both the Chant and Formes programs aim to transcend the previous generation of patch languages and, broadly, prevailing software design. They do this at several levels. First, at the level of interaction with the user, the design of the programs is that of a branching tree of options. The group see this as 'user-friendly', since in theory any inexperienced user can sit down and simply follow a list of options, which are supplied with a set of default values, and produce a sound as a result. As the user learns more about the program, and is ready for more difficult uses, he can engage at a deeper level, experiment with different values, and hear the sonic results. The Chant user can economically zero in on the parameter or

value to be altered, leaving the previous options as they were. It is important to note, however, that since the program is not realtime, it takes time to synthesise a sound once the program has been launched.

Second, Chant and Formes are designed to evolve through interaction with the user. This means that beyond beginners' use, for more experienced and ambitious users, the programs are designed to be 'open' to change and adaptation. In theory users should create their own 'personalised environment' within the program, and should feed back improvements and ideas into its ongoing design. The programs are conceived, then, as evolving entities, collectively produced through their use. This underlying philosophy rests on two interrelated and utopian principles: first, a belief in the responsibility and creativity of the user; and second, a critique of the program as individually conceived, closed and definitive, and as the private property of the designer/author - an attitude towards intellectual property which returns in Ch.8. In revealing these principles, which they outlined in stage lectures, the Chant/Formes group also reveal their concern with politico-philosophical dimensions of computer science. In this regard, the group are the most outspoken, 'radical' computer science ideologues within IRCAM, hence their view of themselves as the computer science vanguard.

Third, both Chant and Formes are 'object-oriented' music programs. Two genealogies converge on this concept, one from A.I. and the other from *musique concrete*. 'Objects' are defined in A.I. programming terms as processes in time which have a unified coherence. The dual manipulation of objects (themselves processes) into organised hierarchies, and sequentially (in time), thereby constructing multi-

layered and recursive structures, are the basic principles of the A.I. language Lisp. Musically, the concept of a 'musical object' came originally from *musique concrete* where it referred to a unified sound entity - literally a sound extracted by tape recording from the total sound world - that could be used as a building block in a larger tape piece.

Finally, both Chant and Formes centre conceptually on time: whether the micro evolution of sound or timbre itself (Chant), or the compositional form and conceptual structuring of a piece of music in time (Formes). Risset's research showed that the micro evolution of frequency spectra in time is the most perceptually relevant and hardest dimension in the synthesis of organic-sounding timbres (see App.7). The problem of synthesising the independent evolution of several partials was for a long time a major impasse in computer synthesis of musically interesting sounds, and it remains problematic. Chant is meant to be a new departure in meeting these problems.

Chant is a synthesis program based on simulation of the physical laws of sound production in the human voice. In particular, Chant simulates the resonance and excitation processes that produce vocal sound. By manipulation of these simulated physical qualities, Chant allows a 'higher level' and more efficient control of parameters than the patch languages. In Chant, control of timbre is achieved by manipulating 'formants' - the peak resonances of a particular frequency spectrum (similar to a filter). The timbre of a vocal sound has 4 or 5 characteristic formants in its spectrum, which are determined by physical qualities: particularly the size and shape of a singer's mouth and vocal tract. In Chant, a synthesised formant can be changed in shape by changing its bandwidth, or moved about by changing its fundamental

frequency. By this kind of manipulation of formants in time, Chant can synthesise not just vocal sounds but a variety of other timbres; and most importantly, it also allows synthesis of the transition between distinct timbres, or timbral 'objects': a continuous timbral change. The idea of 'timbral transition' is a key interest of IRCAM's vanguard.

In this quote, MC described the origins of Chant in his doctoral speech synthesis research at a Nuclear Research centre. The quote conveys MC's excitement about his work, and certain themes of IRCAM's music vanguard, including a critique of the patch language Music V.

Q: "What was your speech synthesis research about?"

MC: "It's very simple, it's called synthesis by rules. You have a text such as '*Les petits oiseaux chants*' that's written in computer code, askey code;.. and the results should be as good a synthesised voice as possible saying: '*Les petits oiseaux chants!*' It's called 'speech synthesis from text', and 'by rules' because you have to go by rules of course from the text to the speech. And it involves many many aspects: transcribing from graphemes,..to phonemes, because phonetically that's L,L,A... so there is phonetics too. And there's prosody, which says how this is going to be said - for example I can say '*LES petits oiseaux*' or '*Les PETITS oiseaux*' and so on. Then there is the acoustic part, which says: when you have a phoneme L followed by a phoneme A, the acoustic of the sound should be that and that at every instance. And having all that information, you have to build a sound which has all those acoustic characteristics. So there was all those levels of interest in the field..."

Q: "Very much about linguistics in a practical sense, and sound..."

MC: "Exactly, and more than that: not only sound but structures (excitedly). Because all these are rules which have to do with the structure of the sentence, and more - even the paragraph, the section should be encoded because the prosody has to do with all of that: with the semantics, the syntax, the pragmatics, and so on."

Q: "Though this is all fascinating, was that work entering into the questions that became absolutely central to Chant, which is the question of formants and resonance and so on in synthesis?"

MC: "Yes, exactly: everything came from there. And it's funny that I didn't decide to work on synthesis, it was proposed to me. And at the time that it was proposed, I did not imagine that it would have some relationship with music!.. I was really not thinking of that (musical outcome). Then, as I was working on it, I said: 'But that's music really! That's the thing we need for music!' Because I knew, on the other hand, that we.. that people were working with Music V and all those stupid things (American developed patch languages) that, really, you cannot do music with!"

Q: "Extremely abstract, without any kind of physical reality?.."

MC: "Yes, nothing to do with it (music)! And the other side was that

system that I was building, which was so efficient! You typed on the keyboard, and instantaneously you got the output! So it was realtime. And you have a very direct input: anyone can type a text and get an output. So, we put the machine in some expositions, and people came and they typed, and they were - aah! - fascinated! They could stay there days and nights in front of the machine! For example they typed English, or German, to see how it would sound. And of course it sounded like French people speaking English or German! (We laugh). And it was very interesting musically: you could type T,P,T,C,P.. all consonants, and you could make a wonderful kind of rhythm with them! (He imitates). Or you could type only vowels.. it was a very good synthesis program, in the sense that you could tune everything. You could say: 'make the vowels longer, make the consonants shorter'. So I could imitate the accents of the south of France, or the accents of the north! I could play with the melody.. at the end I made it sing a little. It was quite ugly, exactly like a drunk! Very funny..."

Q: "So you could do dialects?"

MC: "Yes, and accents. For example, the machine sounded like a French person speaking English, because the phonemes are not the same: there is very little glide in French."

Q: "I've just been reading about the Dada poets who were making sound poetry. You could do wonderful things like that?.."

MC: "Of course, and I was contacted by people in theatre, for poetry too; and we made some radio also. We used it very little for these art things though, it was a bit too simple. It had to be something very economic because the goal of the Nuclear Energy people was to make something simple and fast and cheap."

The Formes program is not a synthesis but a control program that structures musical and sound materials to enhance composition. It centres on the concept of manipulation of musical objects. Objects can be defined in any way - from a single sound, timbre, or amplitude envelope, to a musical phrase or complete compositional structure. Formes manipulates objects in two ways, analogous to Lisp and other A.I. languages. First, objects are organised hierarchically: one level of the hierarchy controls the next level down, and so on. Objects can be extracted and re-used in different contexts, and at different levels of the structure, thereby fostering thematic and material unity within the whole. Second, Formes allows objects, and particularly the constructed hierarchy of objects, to be ordered in time. A piece is built up by the control of musical objects in time, through the construction of a 'syntax'. So lower objects are structured at the highest level by a

command process embodying an overall musical syntax or form. And within that overall structure, objects lower down the hierarchy, consisting for example of a certain phrase shape or amplitude envelope, in turn control the shape of different sounds or timbral objects at the next level down. The conception of Formes, centred on structuration and hierarchies of control, clearly relates to MC's work described above on speech synthesis and on the creation of meaning through 'rule-bound' syntaxes.

Chant and Formes are intended, then, to provide a more intuitively appealing software environment for musicians than the previous generation of patch languages, by employing concepts such as formants (upon which Chant is based) which the group consider musically meaningful. The group see the programs as more user-oriented, less complex and scientific than previous software, and as enabling each user to build up an individualised knowledge base. The degree of ideological division between the group and the proponents of patch languages can be illustrated by this tirade launched by a Chant/Formes researcher against RIG for his continued advocacy of patch methods, such as additive synthesis, for teaching students on the *stage*.

"How can you trust a man who's never touched the most important tools in this house? He doesn't know anything about Chant or Formes... It's an ideological battle. His position's very dated, his practice is out of touch.. He knows the connection between issues very badly".

The group's intentions of providing higher level, more sophisticated software informed by A.I., then, signal their aspiration to the role of IRCAM's computer science vanguard. The Chant/Formes antagonism to patch languages has clear nationalist overtones: a rejection of the limits of American software and a desire to supercede it with more advanced, French A.I. inspired programs. In fact, the Chant/Formes group are not the only researchers involved in these

issues; but they behave as though they are - with a close, intense group identity, and much devotional late night working. Thus it is striking that although the group appear as ideological proponents of collaborative and knowledge-sharing enquiry, they are seen by others in IRCAM as secretive and protective of their own research. For example, they actively excluded a former researcher who left the group to work elsewhere within IRCAM (see Ch.8).

Despite the group's aims, and like the 4X, the main skilled users of the programs in 1984 were composers resident at IRCAM, or regular visitors such as the British composer Harvey. In other words, long experience with the programs makes a great deal of difference to their use. Even with the aim of greater 'user friendliness', then, the programs remain opaque and recalcitrant in inexperienced hands, and their use is much enhanced by prior computer music and programming knowledge (as shown by the great success of WOW's piece 'Chreode I'). Unlike the 4X, Chant has been distributed around the computer music world, and is available in several other centres (eg at Stanford, MIT, the Swiss centre).

However, the programs also receive criticisms within IRCAM. Regarding Chant, for example, the junior tutor-composer KF complained of it being slow to use, over complex, and resisting many musical uses - not so different to the patch languages; and he much preferred to work in realtime with the 4A, an earlier version of the 4X (see App.9 p.3-4). Formes is claimed to be the first program that provides a means of creating thematic and material unity, of conceptual compositional control; but critics see all this as ephemeral, a high intellectual game of no real use to musicians or anyone: "just so much intellectual hot air". These criticisms came from high in the scientific sector,

including some in the 4X project. They also, therefore, mark a mutual antagonism that exists between the two main technology projects, which I discuss further in Ch.6.

5.2.4 Dissident technology: PL's small systems project

The two main technology projects, both oriented towards high technology, contrast with the one temporary project within IRCAM in 1984 devoted to small systems or low technology: that of PL. We can see between Chant/Formes and this one that research projects differ not only at the narrow level of technical and musical aims, but also in terms of the broader ideological and social attitudes that they express. In many ways, this project and PL's relation to IRCAM are unusual if not unique. With its implicit advocacy of small systems and of the commercial sources of these technologies, both contradicting IRCAM's dominant ideology, PL's project can be seen as the prime example of a 'dissident' research project within IRCAM in 1984.

PL is the only non-white intellectual worker at IRCAM and the project is his alone. He was employed at IRCAM on temporary contracts for about 2 years until summer of '84. PL's is one of two research projects on musically interactive uses of the computer in performance (19). But his project alone is based on the kinds of inexpensive, portable technologies widely available to musicians. PL himself is both a composer and a professional performer in many areas of music: avant garde and experimental musics, improvised music, jazz, rock and funk. PL is unique among IRCAM composers in continuing a busy performing career; in '84 he performed with a leading French jazz group, and toured with two major American jazz composers (Herbie Hancock and Gil Evans) including trips to Japan, the USA and throughout Europe, around which he

slotted his IRCAM work. This performing work outside IRCAM, then, involved kinds of music (jazz, improvisation, rock) that are well known to be disapproved of by Boulez; and although PL was discreet, no other IRCAM worker engaged so blatantly in officially 'unacceptable' musics.

PL's project is based on common Apple II microcomputers, for which he writes software using common and commercially available languages such as Basic and the low level assembler code. The project aims to create an interactive system based on small personal computers linked by MIDI to commercial synthesisers, whereby musicians and microcomputers can 'intelligently' improvise music together. It works as follows. A musician plays his instrument into a microphone linked by an ADC to an Apple II. This Apple's 'ear' software program analyses the musician's input according to certain underlying musical principles (of pitch, register - ie how high or low the pitch, duration, rhythm, loudness, etc) that have been programmed into it by PL. Having analysed the sound input, a program called the 'player' running on another Apple constructs a musical response to that input, again according to various pre-programmed musical principles of response, elaboration and contrast. That musical output, 'created' by the computer, is fed from the Apple through MIDI to a digital synthesiser which, through its own programmed timbres and DAC, 'plays' the computer's musical response. Finally, the musician responds to the computer's musical output by improvising; and so the whole interactive network begins again. PL is able to get this interaction to work in realtime: the computer's musical responses occur so fast as to appear instantaneous. PL's final version for his IRCAM premiere had three Apple II's linked up to three DX7 synthesisers, improvising with four musicians (20). Photos 5.5-8 show PL preparing his

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02

system for his premiere.

PL is auto-didact in computing, and passionately devoted to these small and widely distributed computer tools. Above all, he wants his system to be portable, practical, cheap, and yet conceptually and musically sophisticated. He believes strongly that the two are compatible; and he has nothing but scorn for those shortsighted snobs interested only in large machines who equate size of technology with quality of musical result, and who are unable to perceive the potential of small systems. As we also saw in relation to Chant/Formes, PL's interests in 'intelligent' systems and 'interactivity' link to ideas currently fashionable in A.I.. A philosophy graduate from Yale, PL is well aware of these implications, and his work is far from intellectually naive. He aims to show, then, that it is possible to produce ambitious, interactive and intelligent results using only the limited resources of small machines that are cheap and commercially available. For PL, the communications' revolution is small, 'small is beautiful'. The project exists to celebrate small machine power, and also the bounty of the 'start-up' commercial sector: small companies such as Apple that, growing from nothing, have challenged the dominance of manufacturers like IBM or DEC. In this 'David and Goliath' worldview, the force of progress rests with small, start-up venture capital which breaks the sluggish monopoly of the giants; and in PL's eyes, the character of each sector is concretised in the technologies that they produce. PL is, with his good friend the Pedagogy director RIG, a key proponent within IRCAM of the philosophy of small technology, and of the adventurous and enlightened commerce that produces it: a classic American free market liberalism.

PL got his IRCAM commission with the backing of American music

directors HY and RIG; his project had little appeal to the Artistic director. As well as being his IRCAM patrons, both HY and RIG are personal friends of PL, especially RIG whose links with the black American jazz scene that PL inhabits I mentioned earlier. In their life outside IRCAM, RIG and PL share the social and cultural milieu of Parisian black American jazz musicians. But in general PL feels patronised by his IRCAM contacts, and thinks that people treat his project condescendingly as a piece of fun. He feels that his position is marginal in the institute; and in return he is highly sceptical of IRCAM, its musical, technological and scientific pretensions. PL is critical of the philosophy behind the 4X. He scorns the institute's bureaucracy and politics, the endless round of meetings to which his IRCAM friends submit, and the importance within IRCAM of pretentious talk and theory, and of the politics that follow.

PL expresses his wilful marginality through various spatial, temporal and physical means (21). One such expression is his avoidance of the musicians' meetings, and so his non-belonging to the vanguard musicians group. It would be expected that he would belong: as a client of the organiser HY; as a composer, intellectual and programmer in touch with recent developments in A.I and computer music; and as a friend to many in the group. But PL prefers to avoid all IRCAM meetings except where absolutely necessary for the fate of his present project; (the one meeting I saw him attend involved a half-hearted attempt to propose a second project). PL's avoidance of musicians meetings, then, expresses his disdain for IRCAM's internal politics. He does not really want to depend on IRCAM beyond the present commitment. This is unusual among visiting composers, the majority of whom seek a continuing relationship

with IRCAM and its associated prestige. PL is cynical and straightforward about the careerist implications of working at IRCAM. He sees it as very important for his CV to have worked there, but he says there is more to learn and better music to be made outside.

Throughout spring '84, PL worked away at the 'ear' and 'player' programs, refining their musical principles and smoothing out 'bugs'. He took the system on trips in Europe and the US for solo improvising 'gigs'. Taking just one Apple, the system was portable and he could re-write and adjust the programs as he travelled. He also asked musicians, including myself, to improvise with the programs for feedback. The project culminated in an IRCAM premiere in May (Tape 1 contains part of a live recording of one concert). The concerts involved four well known free jazz musicians who played in various combinations with the system, while PL sat at the back of the hall manipulating the computer network with which they were interacting. The concerts appeared to go down well with the audience. But reaction from IRCAM directors and musicians was less warm, as the following excerpt from my diary note for the first night conveys.

"24.5.84: re PL's premiere last night:

The gig is full; people from IRCAM are fussing around worried that they won't get a seat. As often around PL, a festive and gay atmosphere - his perception that he's the in-house clown/entertainer.

I sit next to HY (Music Research director) and WV (Artistic director).

HY is excited, proprietorial about PL...

Start of the gig: PL ambles around, in his loosest style. Does a talking introduction, without notes and with little direction, very improvised.

HY gets impatient, fiddly. PL starts by talking vaguely through the system: 3 Apples, 3 DX7's, MIDI interfaces etc; says he's not interested at all in voicings/timbre synthesis, but in discovering and working with 'rules' and 'structures' of musical process in improvised playing. Thus he's put into the machine these rules, to interact with players...

Later: During the 1st or 2nd piece, a solo, HY whispers loudly and impatiently: "This is crazy, no good - he should be doing it with all four players, should start it that way!" HY wants a big impression to start: size, scale. He chides PL for this subdued start. HY: "There's no structuring of the evening: the players need that. The free improvisation sounds dated; I don't like (the guitarist's) playing."

PL asks of the room after a few pieces: "Shall we have an interval?"
HY and WV shout back together imperiously "No, PL!". PL calls one!
In the interval: HY and WV exchange opinions with each other (usually
rivals), and include me in this too: that it's a 'mess', not
professional, 'tight' or impressive enough." Once again, it seems that
the judgement of 'not being professional' is levelled at a concert whose
musical aesthetic was a source of disquiet and disapproval.
WV asks HY: "Is there a score? It sounds like there is (dubiously):
something must be directing it!.. (Half joking:) I'm not sure what the
contractual situation is if there isn't a score!..".
HY: (Disparagingly of the playing) "Bringing your oboe tomorrow night,
WV?" ..meaning, 'you could play just as well'." [BD].

In terms of musicians' experience of playing with PL's system,
despite having arrived some days earlier to get the 'musical feel' of
the machines, the guitarist of the group did not enjoy the computer's
improvised responses. He remained antagonistic and played in an
intransigent way, trying to give the machine a 'hard time'. This shows
that the aesthetic embodied in PL's improvisation 'rules' does not suit
all players equally well. My own experience, playing improvised cello
with the system, was that it was difficult to make musical sense of, but
interesting (22). More important are the insights gained into PL's
concept of the 'rules' of improvised music. From playing, I suggested
some ideas to PL that, surprisingly, he hadn't thought of. The main idea
was that the 'ear' program should search for both repeated rhythmic and
pitch patterns, ie listen not for individual but for grouped or
patterned events: a feature of many musics, and many kinds of
improvisation. Before this, PL had programmed the 'ear' to listen for
discreet parameters: the pitch, register, loudness, duration etc of
individual notes, or their difference from the previous one. He followed
my suggestions and eventually found ways, months later, to program the
recognition of basic musical patterns.

This story indicates, first, how crude were the initial musical
'rules' that PL was working with; and second, how writing these 'rules'

depends upon a prior selection of the key aesthetic characteristics of the musical genre in question or desired, and cannot avoid being aesthetically charged. PL's selection of 'rules' dictates both from which aesthetic standpoint the sounds coming into the 'ear' will be 'heard', just as his 'player' program will elaborate those sounds according to similarly aesthetically imbued 'rules'. PL's own perspective on this issue reveals significant contradictions. In individual discussion he portrays a sophisticated understanding of the aesthetic differences between musics, without which he could not play successfully in so many; yet he has little time for what he dismisses as 'musical relativism'. He says that his programs are based on the musical principles of improvised music; yet he employs the universalising rhetoric, common at IRCAM, of 'rules' and 'structures' and so implies that his programs express general principles of improvised music rather than just those of one genre or aesthetic of improvisation. At base, PL appears uninterested in taking up the issue of implicit aesthetic bias in his and other musically 'intelligent' systems, and prefers ultimately to present himself in a scientific way that ignores aesthetic questions in favour of quasi-universal 'rules'.

In summary, PL's project reveals IRCAM's containment of a project centred on small and commercial systems, and so apparently dissenting from the dominant technological and philosophical perspective. However, PL's position shows also that while technology and its social implications can be an explicit source of controversy, music and the aesthetic cannot be. Despite his very different external musical work, for his IRCAM musical work and at the level of rhetoric PL retains a universalist view of musical structures and 'knowledge'.

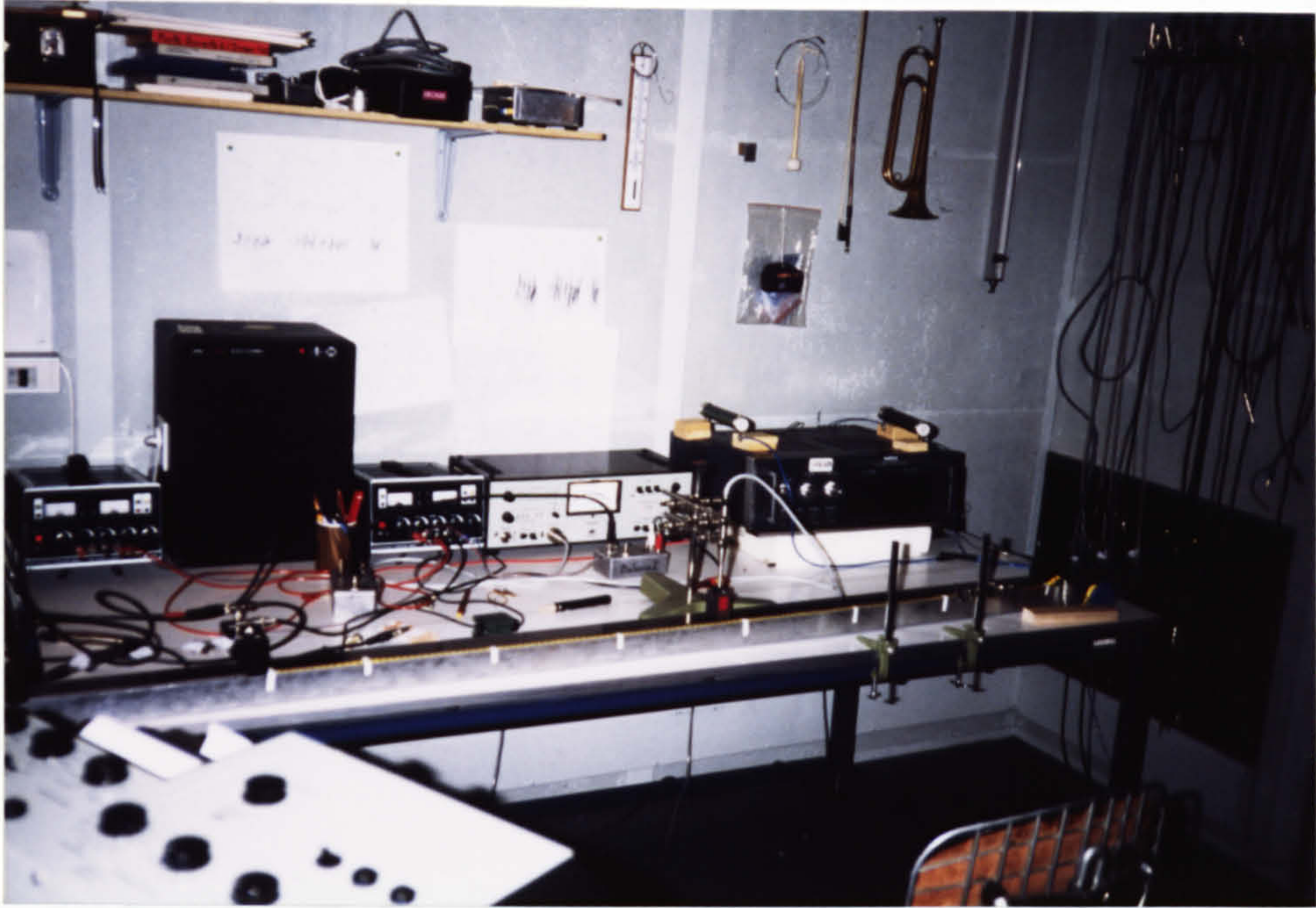
5.3 Pure acoustics research: resistance to rationalisation

We saw earlier (in Ch.3) the contradiction whereby IRCAM's pure research, which is so prominent an ideological feature of the institute, receives very poor resources: the Acoustics department with just one full-time post, psychoacoustic research entrusted informally to a few workers often busy elsewhere; and the discourse of music research propounded by an informal and self-constituted vanguard musicians group. While psychoacoustics and music research are central to IRCAM's intellectual culture, IRCAM's pure acoustical research has proven relatively undynamic, and remains socially and intellectually isolated within the institute's research culture. Photos 5.9-11 show the inside of the Acoustics research lab.

Most research coming from the Acoustics department concerns the physical forms of wind and brass instruments and their acoustic effects. For example, the main researcher XW has carried out experiments measuring the acoustics of brass instruments' complex bodies, and has then made computer models of the correlation between physical form and sound effect so as to predict alternative forms, new brass instruments. Acoustics aims, then, to demonstrate the uses of the computer for analysing and then modelling, or simulating, the correlation between instruments' physical forms and their acoustic properties. The research does not appear to have close relations with music or technological production (23).

The Acoustics' offshoot, the Instrumental Research Workshop (ARI), appears more productive despite being part-time. ARI research is mainly on the multiphonics of wind and reed instruments (24). Multiphonics are commonly used in avant garde and improvised musics, yet until now have

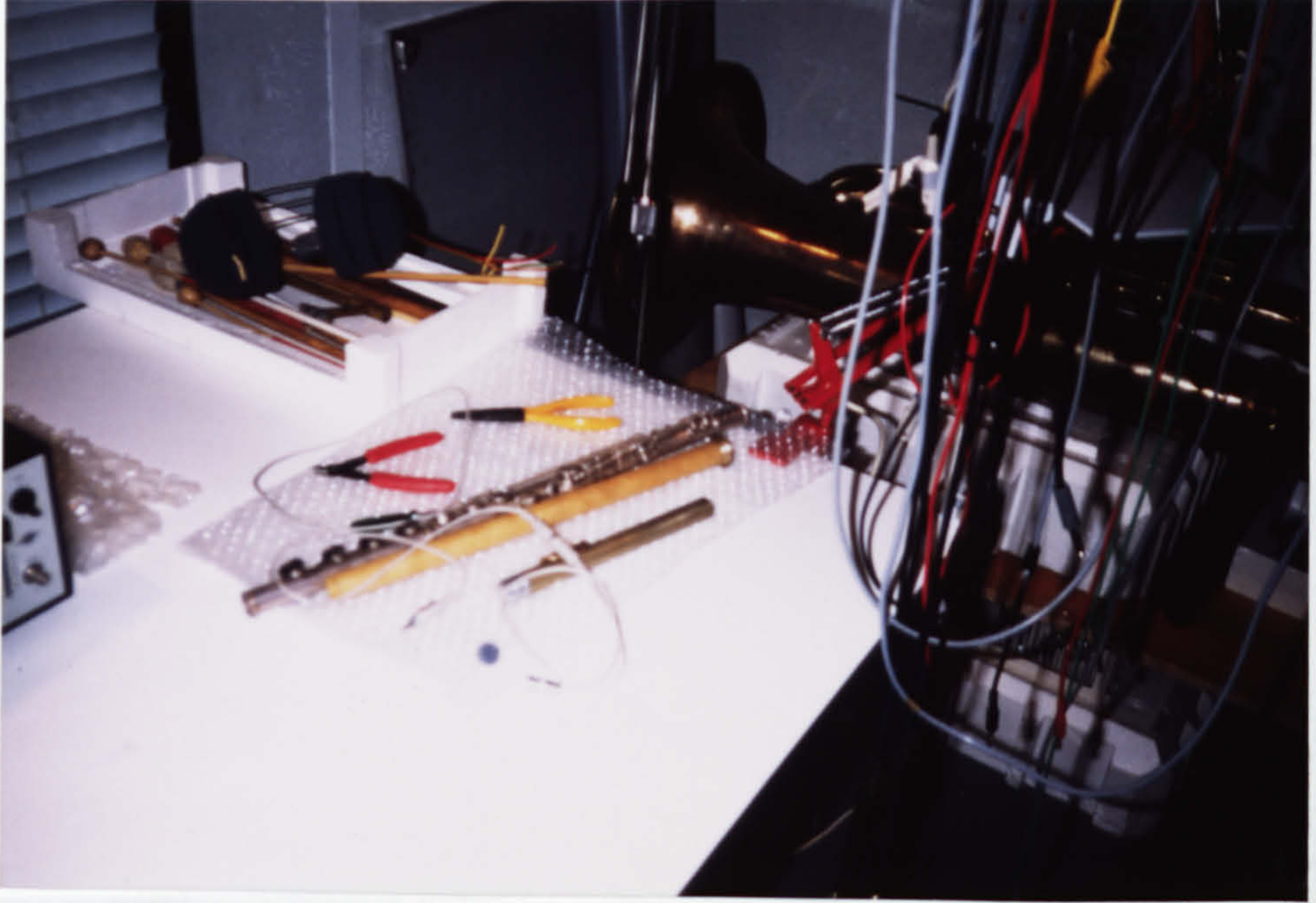
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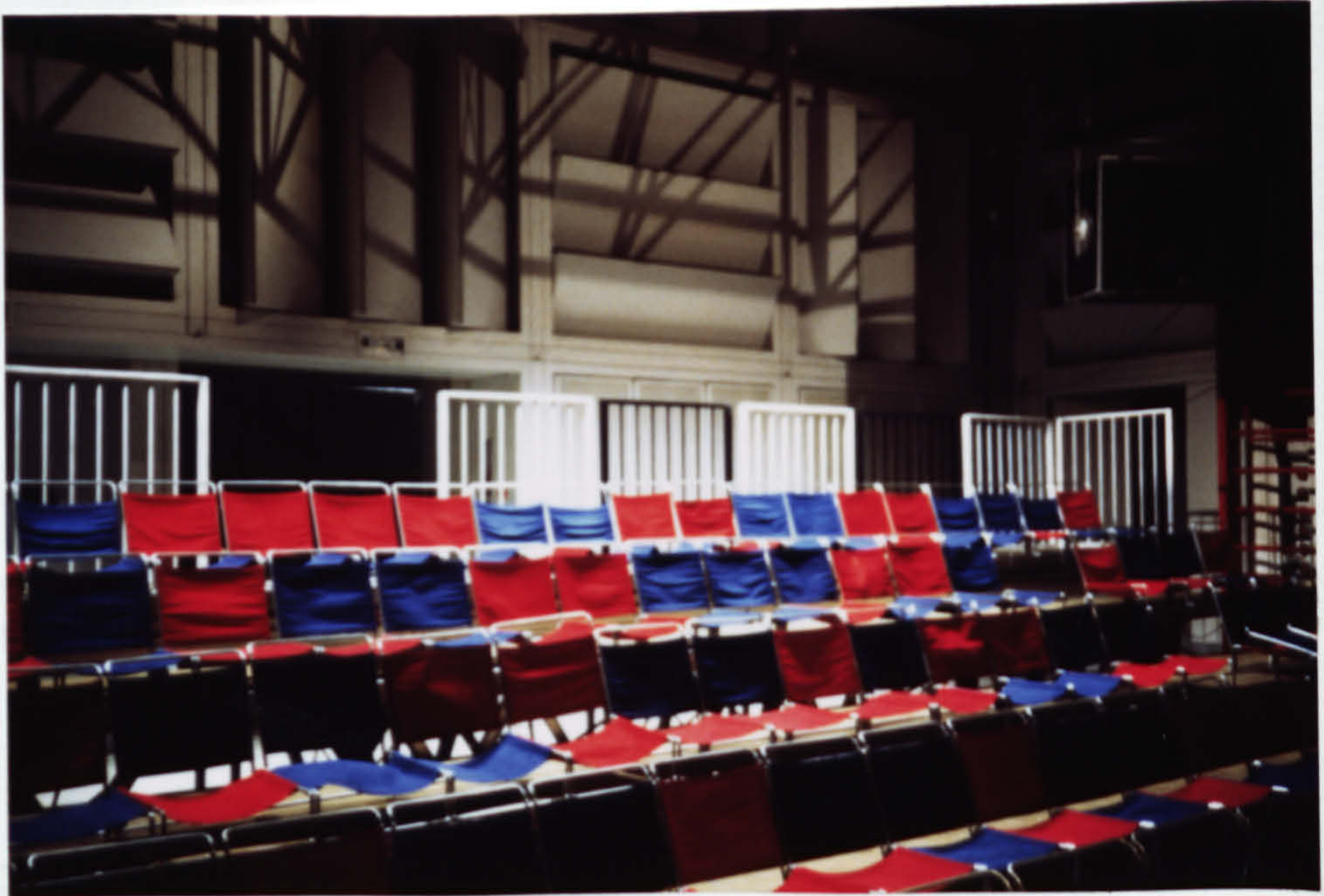
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escaped analysis and notation. The ARI has recorded a catalogue of wind and brass multiphonics, and has analysed them acoustically to discover their spectra. Psychoacoustic tests are carried out on subjects, to order the sounds perceptually by criteria such as density and perceptibility of one or more clear pitches. The acoustic and psychoacoustic data are correlated, and a formalisation and classification of the sounds is then attempted. There are two further aims. First, to use the information to synthesise new multiphonic-like timbres; and related to this, to develop the classification into a systematic analysis of their interrelation as 'sound objects' in 'timbral space'. And second, to develop from this systematic data an elegant and rational notation of multiphonics so that composers can precisely notate the techniques, previously dependent upon individual performers' skills, in their scores. The ARI aims, then, to increase the rational classification and compositional control of these previously aural, non-notated musical phenomena.

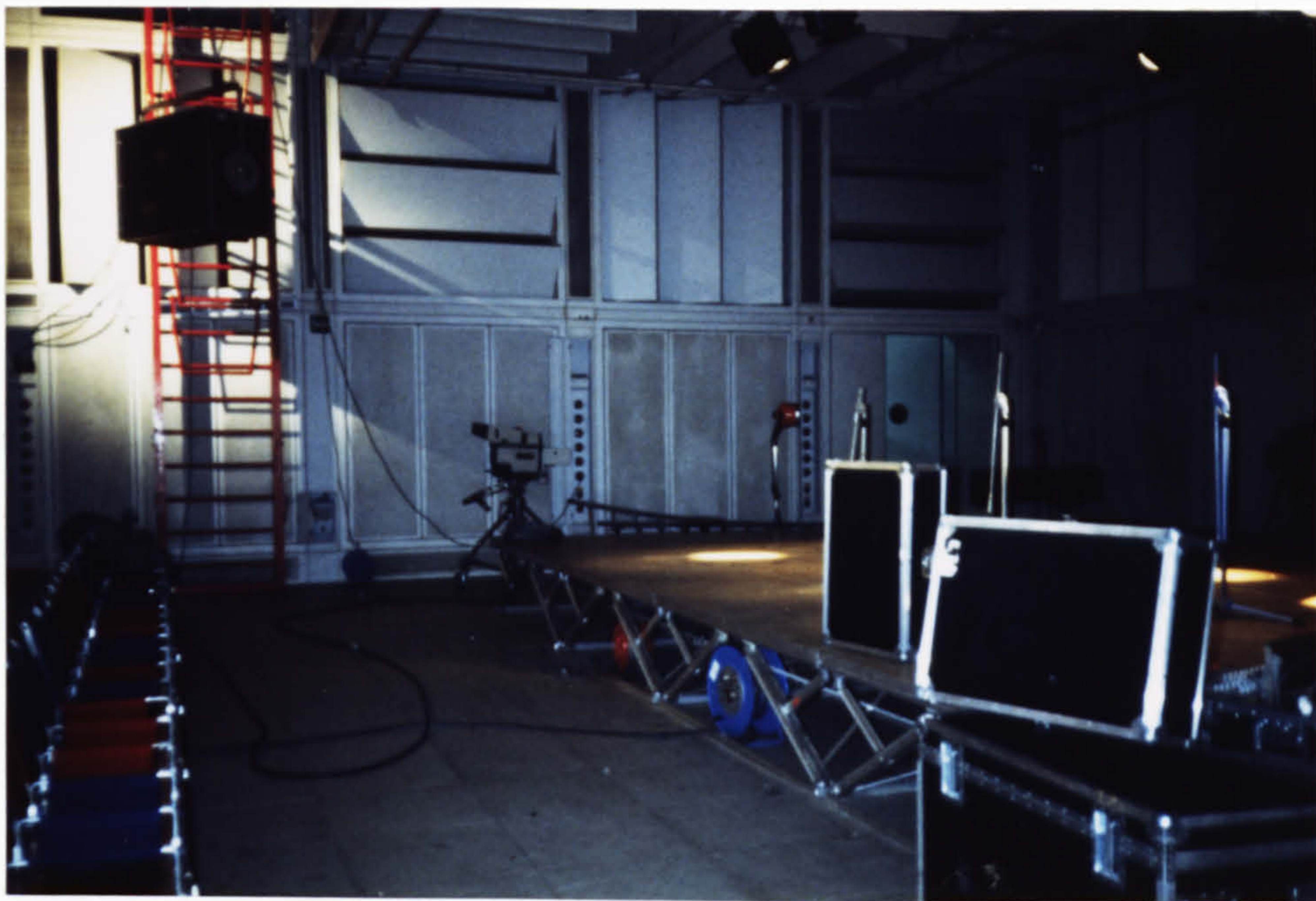
A further area of research central to the original conception and architectural infrastructure of IRCAM is room acoustics. IRCAM was built with two acoustically specialised rooms: the small anechoic chamber (a completely sound absorbant or acoustically 'dead' room), designed for both acoustical experiments and measurement without echo and reverberation, and for 'flat' sound recording; and the large *Espace de Projection*. The Esp Pro can seat up to several hundred, and is designed to be totally flexible, with mobile seats, platform, lights and loudspeakers. But the Esp Pro is renowned above all for being the only performance space in the world with a completely variable acoustic. This is achieved by its walls and ceilings being made up of several hundred rotating panels, each a three-sided prism with reflective, absorbant or

diffusing surface textures: a system called the 'periacte'. By moving the panels to different configurations, the room acoustic can change dramatically, from a reverberation time of 0.5 seconds to one of 4.5 seconds - "from a broom cupboard to a cathedral!" as one director said. So the Esp Pro's acoustic can be set up differently for each performance; and the original intention was for it to be able to change even during a piece by rotating the panels - in theory allowing the manipulation of the room acoustic to be written into a composition for the first time in history. Photos 5.12-14 show different views of the Esp Pro, including the *periacetes*, the movable seating, stage and loudspeakers.

However, the actual functioning of the Esp Pro falls short of this vision. The *periacte* panels are noisy when they move, so that it is obtrusive to use them during a piece. They have been ridden with technical problems, and are often not in use. For example, significant problems arose with the project to update and digitalise the *periacte* controls. The original controls, still in use, are a set of manual dials for the hundreds of panels, which are positioned according to the configuration of surfaces required - a laborious and inefficient method. The 4X Industrialisation director took on the task of digitalising the controls, but laid down faulty cables which eventually caused a fire.

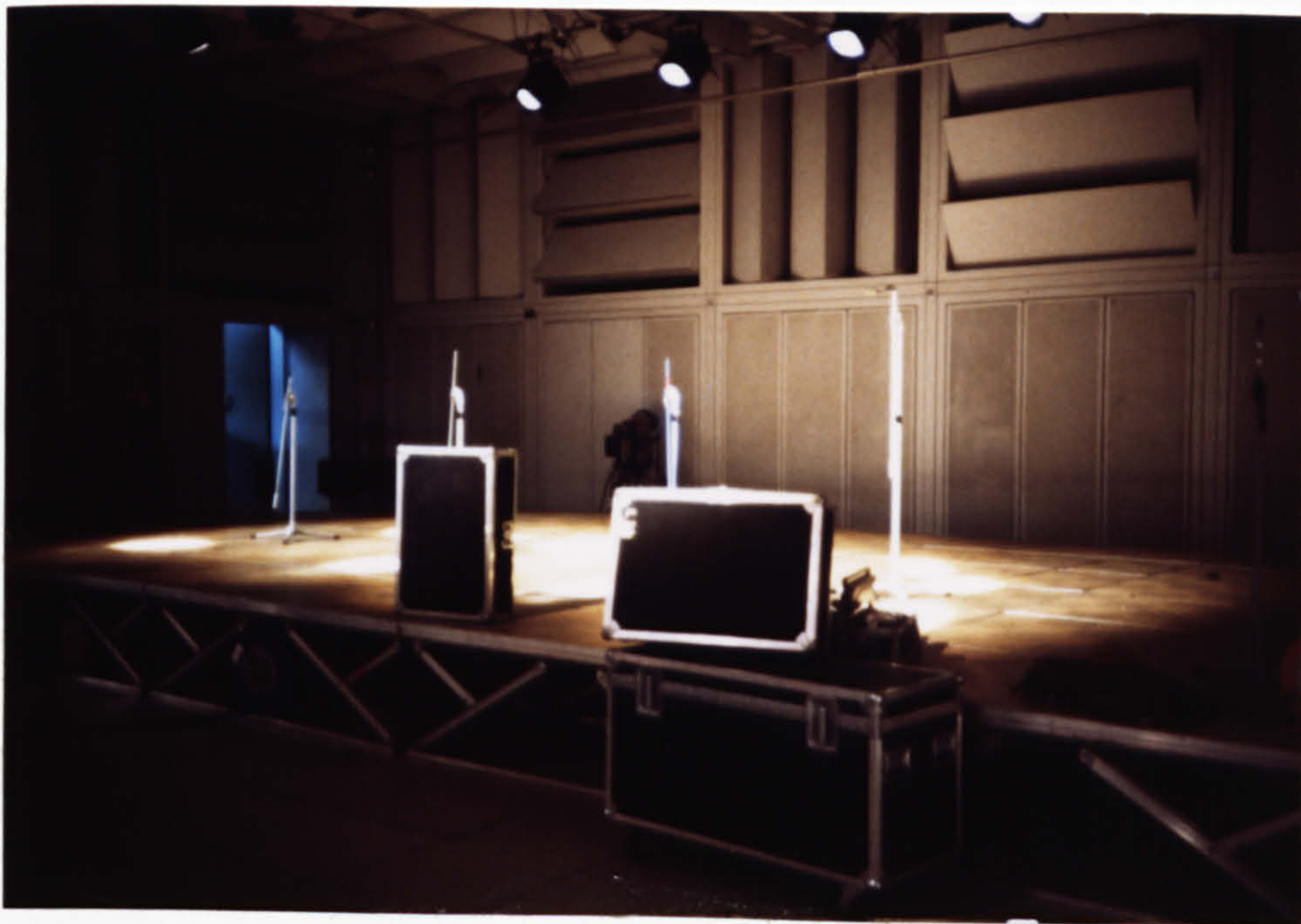
More important, however, are the deeper analytic problems underlying the issue of control. Room acoustics is an undeveloped and extremely complex area of acoustics, and IRCAM set itself the task, with the Esp Pro as its experimental space, of taking command of the field. Yet this has not happened. Despite the original claims made for the Esp Pro, IRCAM has produced no way of scientifically analysing, rationally

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6.1



notating and so reproducing the room acoustical dimension of pieces performed there. The reasons reveal the limits of computer-aided analysis of room acoustics. Although it is now possible to make a computer analysis of the acoustic dimensions of a hall (peak resonances, 'dead' areas etc), such a measurement can only be taken from specified locations within the hall. Because the acoustic varies according to where subjects are located in the space, there is no way of producing an acoustic analysis that represents all the possible subjective aural experiences of a particular space. There is no 'mean' of a room acoustic, only representations from specific sites within it. In addition, even with the complex computer acoustic data from a specific location, to notate this data elegantly requires some kind of meaningful reduction according to hypothesised causal factors or influences (room height or shape, wall material etc). So far, no successful mode of hypothetical reduction has been found, which means that there is neither the basis of an analytic framework, nor a shorthand notation.

The Esp Pro, then, has not yet played a central role in advancing the field of room acoustics, and remains a unique modernist cathedral. In order to reproduce effects, the only way of recording its acoustic is still simply to write down the positions of the many manual dials controlling the panels. Productions designed acoustically for the Esp Pro are irreplicable elsewhere: both because of its unique acoustical, and enormously expensive physical, properties; but equally because of the lack of a language of analysis and communication around it. Despite IRCAM's intervention, room acoustics remains an imperfect science and resistant to scientific rationalisation.

Chapter 6 IRCAM's psychoacoustic and music research vanguard: the material and the social

Introduction

"Research, which should form the basis of this new science - the science of art - has two goals and stems from two imperatives:
1. the desire to be aware, which comes spontaneously from the need to know, with no practical end in view: 'pure' science, and
2. the need for an equilibrium of creative forces, classified schematically in two categories - intuition and calculation: 'applied' science".

Wassily Kandinsky. (Quote from Cont. Mus. Rev. 1, 1, p.181).

This Kandinsky quote begins a paper by one of IRCAM's key young vanguard music intellectuals. Kandinsky's philosophy of uniting art and science through the concept of research influenced Boulez; so that the quote is a reminder of Boulez's founding philosophy for IRCAM. But I show below that while IRCAM's vanguard musicians group still propounds the values of open-ended, 'pure' music research, Boulez himself now appears to doubt its value.

The related domains of psychoacoustics and music research have a pivotal ideological position within IRCAM; and they are propounded by the vanguard musicians group as leading the way forward for musical composition. The group sees itself as uniting the most music-oriented intellectuals within IRCAM, and aims to bring musical concerns together with the highest level scientific and technological, mainly software, research. The voluntary musicians meetings were initiated in urgent response to a massive planning document for the future of IRCAM, written by the incumbent Scientific Director FOK at the start of 1984, which hardly mentioned music or music research at all. By autumn '84, FOK had left IRCAM, and his plans were never realised; but internal conflict between the scientific side of IRCAM and those who see themselves

upholding IRCAM's musical ideals is chronic and outlives each particular crisis. As the meetings developed, they worked on defining two levels of IRCAM's future music research: first, the major research themes; and second, an organisational infrastructure of research teams. It was a bid for more autonomy, power and resources for music research, which the group felt to be marginalised within IRCAM. The utopian aspirations of the group were expressed both in the idealistic and egalitarian discussions, and in the advocacy of new collaborative teams, recalling Boulez's initial Bauhaus model for IRCAM. By insisting on the centrality of the issues of IRCAM's future and long term orientation, its musical goals and social organisation, the group embodied a fundamentalist return to Boulez's founding vision.

6.1 Background: timbre, form, perception, and the computer

The intellectual concerns of the musicians group focus on the closely related areas of music research and psychoacoustics. And central to these are research on timbre, and on musical perception, the reasons for which must be understood in the context of historical developments arising from the impasses of musical modernism earlier in the century and their contemporary legacy. I here sketch these developments, which are elaborated more fully in Appendix 8.

In summary, there is a historical move over the century away from the primacy of pitch towards a rhetoric of timbre, as a way to conceive of both musical sound material and of musical form. There arises also with musical modernism an autonomous preoccupation with new forms and conceptual bases for composition; which converges later in the century, in computer music, with the development of A.I. and its implications for computer aided composition. The scientific study of cognitive universals

has been implicated at both levels: psychoacoustical study of micro perception of timbre, and cognitive study of musical structure. There is, then, a convergence from several directions on interrelated concerns with timbre and sound material, timbre and time, timbre and form, timbre and perception. All of these are considered to be enhanced by the computer as both an analytic device and a constructive tool; since, in theory, it enables 'any imaginable sound' or musical structure to be both analysed and produced. But we can also see that timbre becomes a rhetorical catch-all, subsuming many diverse preoccupations. These developments have their bases in major problems in 20th century musical modernism: the sense of sterility attached to serialism and other techniques of composition based on the primacy of pitch; the search for new sound materials; the sense of need for new musical forms to match the new sound materials; and the errors and weaknesses of mid century rationalism and scientism. Timbre is held, at IRCAM and more widely, to offer ways forward at all levels.

This can be illustrated by the following two developments derived from the problem of musical form, the first linked to timbre and its intimate association with time. Throughout the century composers have considered whether timbral change can structure music in time, for example in Webern's attempts to use timbral change as a formal device, to convey movement. The unique possibilities of computer music offer ways to further this area. In digital synthesis, unlike electronic synthesis, each simulated musical 'object' or timbre is built up out of its components from scratch (see Apps.7, 8) so that the objects are no longer inviolate but, in theory, infinitely malleable. The technology therefore provides the possibility of taking two such simulated timbral

objects and, through the analysis of their components, building a 'bridge' or 'transition' between them. To do this requires seeking the most appropriate aural route or bridge, and doing 'micro-surgery' on the components to 'join' the two objects. Meanwhile, at the micro level each partial is evolving rapidly in time, while at the macro level the transitions construct musical time, a 'timbral syntax'.

So one result of the interplay of timbre and time in timbral transition is that the internal, micro-temporal processes within the timbre, and the formal macro-processes produced by a sequence of timbral transitions, can become related. This has been linked to ideas about deriving macro musical forms from micro processes, so unifying these very different temporal levels: a concept of unifying micro and macro, sound material and form. We saw several examples of this in Ch.5., including the naive *stageaire's* idea of unifying the structures of the musical 'molecule, apple and tree'; and we will see that the notion of unifying micro and macro is now a powerfully autonomous rhetoric. In this project, then, timbral objects need no longer remain discreet, but can be transformed, 'melted' into one another, thereby providing a new way of creating structural movement, or musical 'syntax', by timbral change. IRCAM's Chant program makes this possible through its ability to generate timbral transitions, for example, between a simulated human voice and a simulated oboe. We will see, then, that central to IRCAM's vanguard are the unprecedented musical possibilities of 'timbral transition' or 'timbral syntax', based on the notion of timbre as a structuring, formal device, brought together with the unique potential of digital synthesis in programs such as Chant.

The second development around musical form involves a different level of computer applications. The work of writers such as Meyer (1956)

indicates the parallels that have been developed in the past between information theory and music analysis. In computer science related disciplines, we can trace a development from information theory through cognitive science to artificial intelligence: a kind of applied cognitive modelling with the computer both as analytic tool and means of simulation. A.I. is based on the analysis of forms of knowledge to extract their essential content and logic or 'rules', which are then re-described as a structure of inference and written as an 'intelligent' computer program, such as an 'expert system', that represents a simulation of that knowledge system. Similarly, in music there has been a development from music analysis as a purely analytic field to one that, employing the computer and in conjunction with the rise of A.I. and cognitive music studies, aims both to provide computer analyses of musical structure and also computerised models of 'musical knowledge' or 'rules' as aids to composition. The computer has become seen as a tool both for analysing the deep structures or 'cognitive rules' characteristic of certain musics, but equally for generating abstract structures as guides for composition.

There are two important observations to be made. First, we can see in these developments a subtle but profound elision between analysis and composition: the two are close to becoming as one (1). Second, the computer's ability to produce elegant abstract models has meant that its generation of new conceptual schemes for music, in particular mathematical and cognitive structural models, has become quite autonomous from the analysis of extant musics. This lies, for example, behind the A.I. influenced approach of IRCAM's Formes program, with its generalised and abstract, hierarchical ordering of objects and events in

time. This tendency, also expressed in the scientific conceptual foraging and constant search for scientific analogies outlined in Ch.5, has longer historical roots in musical modernism, as I show in Ch.9.

Overall, it is striking that the response to the deep musical and philosophical impasses that arose around early and mid century modernist serialism (see App.8, Ch.9) has been to amend and improve the rationalism and scientism through increasingly sophisticated scientific and technological mediation. Far from rejecting the deeper epistemological character of modernism, this is being refined and complexified, for example in the elision of computerised music analysis with compositional genesis. We will see, then, that the discourse within which IRCAM is situated is a scientific refinement of the classic concerns of modernism.

6.1.1 IRCAM's psychoacoustics: fusion, inharmonics, timbral syntax

This legacy, with little overt hostility to serialism (2), lies behind the interrelated interest in psychoacoustics, perception, timbre and form at IRCAM. We will see continuous rhetorical reference to these concerns by IRCAM's musical vanguard, who see the study of musical perception and cognition as means to lay the basis for new sound materials and new musical forms. IRCAM's own psychoacousticians, the Pedagogy director RIG and junior tutor (later Pedagogy director) HM, who both trained as cognitive music psychologists, have engaged mainly with producing increasingly sophisticated analyses of timbral perception. Since it is seen as so basic to computer music, HM taught a series of psychoacoustics lectures in the stage. He started by distinguishing between the physical and perceptual worlds of sound, as in Fig.6.1.

Figure 6.1 Stage lecture diagram: showing psychoacoustics as the study of the link between the physical and perceptual worlds

Physical world

Frequency
Phase
Amplitude
Duration
Structure



Domain of
psychoacoustics

Perceptual world

Pitch
Timbre
Harmonicity
Subjective duration, rhythm
Form (etc...)



HM's scheme gives a crucial role to psychoacoustics since, in bridging between the bald physical nature and the meaningful perception of sound, it appears to offer important information for sound synthesis and compositional organisation.

IRCAM's psychoacoustic research centres on examining how listening organises the physical world by differentiation and integration. The phenomenon of aural integration can be illustrated by pitch perception, which involves the unconscious integration of many different partials (frequencies within the harmonic series) into a single sound object; or, by analogy, by the perception of orchestral sound, which we usually perceive as one integrated object despite the many physical sources involved. This psychoacoustical phenomenon of vertical aural integration is called 'fusion', and is at the heart of HM's own research. The work on the integrated 'fusion' of partials in harmonic pitch perception has fed into that on the contrasting perception of 'inharmonics': those sounds, like bells, that have spectra (or component sets of frequencies) that are not based on one single harmonic series. It has been found that we do not hear complex inharmonics as fused single objects; rather, we tend unconsciously to search within them for the patterns of the harmonic series, and so to hear them as a set of overlapping, incomplete harmonic pitches.

Further research extends this discovery of our basic predeliction for harmonic perception. When we perceive a pattern of higher harmonics within an inharmonic, but the fundamental harmonic frequency is physically missing, the brain projects or supplies a sort of phantom fundamental to replace the missing one: a phenomenon known as 'virtual pitch'. We will see that these apparent details are major concerns of IRCAM's vanguard, since digital synthesis has the unique potential to

construct infinite numbers of inharmonics, and to change over time their 'internal' structure of frequencies (or spectra), so as to produce interesting senses of movement 'within' the sound: another kind of timbral movement or transition, called by some at IRCAM the 'evolution of spectral form'. Work on inharmonics, virtuals, fusion and the internal 'evolution' of sounds, then, are seen as potentially valuable directions for composition.

The issue of aural differentiation can be illustrated by timbre. We know that listeners have a well-developed capacity to differentiate relatively between pitches, so that subjects hear pitch intervals as relatively the same (eg a fifth, an octave) even if they are at absolutely different registers. Researchers have tried to understand whether subjects have a similar cognitive capacity to differentiate between timbres. Timbre is both physically and perceptually multidimensional (see Apps.7, 8). RIG's pioneering research in the 1970's, the early days of psycho-acoustics, was on the 'multidimensional scaling' of timbre, and on the notion of perceiving 'timbral analogies' (IRCAM Reports 12, 13, 1978). These studies involved asking subjects to judge the similarity or difference between pairs of instrumental timbres (an oboe and cello, clarinet and voice) sounding the same pitch. This gave a distribution of timbres according to perceived similarity and difference, but little understanding of the parameters underlying these judgements. Later research teased out the abstract perceptual dimensions that were most subjectively significant: 'brilliance' was most important, then rate of attack, then noise, inharmonicity and so on.

From his research on timbral analogies, RIG has drawn representations of timbral perception in terms of 2 and 3 dimensional

spatial distributions (see Ill.6.1). He sees this spatial representation as providing a predictive map of how to create perceptually interesting new, simulated timbres. He also sees it as predictive of possibilities for structuring the relation between different timbres in computer simulated timbral transitions, and so as giving perceptual meaning to the notion of a 'timbral syntax'. The research is aimed, then, to be of use to both synthesising new sound materials and creating new compositional forms, through timbral syntax (3). An implicit message is, 'where pitch was, let there be timbre'.

There are several observations to be made about this research and its limits. As well as being central to the stage, psychoacoustics was the subject of IRCAM's major 1984 public lecture series called 'Perception and Composition' (see Ill.6.2, the course overview). While much of the series dealt with timbre, inharmonics etc, it is striking that neither dealt at any length with rhythm as a musical dimension. Only the public lectures had a session on 'Rhythm and time perception', concerned mainly with macro issues of time, memory and duration, rather than with rhythmic issues of pulsation, beat, repetition: phenomena that are aesthetically associated with jazz and popular musics. Musical time and rhythm in the serialist tradition are conceived in terms of calculated durations, and involve extremely complex irregular rhythmic structures. RIG, who gave the half lecture on these issues and who we have seen is keen on jazz, nonetheless spent all his time on a critique of the total serialist approach and its lack of perceptual validity. He talked with relish, as follows.

"Boulez was a guinea-pig in an experiment in complex rhythmic perception at Bell Labs. The idea was: can a composer really hear the differences if a performer of his music plays very complex rhythms right or wrong? For example, in 6/8 a 7 over 6, or 19's over 13's, and so on - such as one finds often in the music, for example, of Carter or

Ferneyhough. The results? Boulez and a well known avant garde violinist called Zukofsky both showed great errors in their judgement of these complex rhythms, and in opposite directions! So this shows that the ideas of rhythmic perception of someone like Carter are wrong! They are impossible to realise on two levels: that of production by a player and that of perception by a listener, even a highly skilled one!"

RIG continued, ending his 30 minute talk:

"I was going to talk about another level - why one jazz drummer will have 'swing' and why another won't! But I guess I'll leave that for another evening..." [Lect.N.19.4 84].

Despite his 'dissident' interest in jazz, RIG could manage only a brief reference amounting to an evasion of the issue of sophisticated rhythm in other musics such as jazz; and this, embedded in an elaborate perceptual critique of serialist rhythm that signals his ongoing ideological battle with Boulez.

This incident indicates the cultural specificity of the musical terrain that IRCAM's psychoacoustic research addresses, and upon which it then erects its 'universal' models of human perception. In fact, during 1984 there was one research project devoted to analysing the 'rules' of jazz improvisation, which may appear to contradict what I have suggested are the aesthetic limits and the universalising character of IRCAM's psychoacoustics. But the project was weak, its status very low, and it was bugged by illegitimacy, above all because it was seen as not sufficiently generalisable, by contrast with the rest of IRCAM's psychoacoustics which is presumed to be (4). In his lectures, HM appeared to have a sophisticated grasp of the issue of musical-cultural differences, and openly admitted that "our cognitive and categorisation abilities are experience-based, culturally specific". Yet, challenged by a student who posed the extreme cultural determinist position - "But I hear no sound, nor any music, outside a certain aesthetic and historical context: it's all in these contexts!" - HM deferred and said nothing;

and the issue was never elaborated in lectures or discussion. Rather, another time, HM opted for a different perspective that evades cultural specificity: the post structuralist idea of music as a radically 'open text' - (sometimes also espoused by Boulez, see App.6). He talked of "creative listening, how listeners recreate music by their own taste structure, so there are a multiplicity of different meanings or readings in a certain music".

Finally, it is worth noting that the experiments for RIG's timbral perception studies involved the judgement of just nine subjects; and of these, I heard that all were IRCAM workers and one was Boulez. It is on the basis of these thin experiments employing very culturally specific subjects, then, that RIG drew data to be interpreted in terms of cognitive universals of timbral perception, intended in turn to generate apparently aesthetically independent techniques of timbral syntax. This must throw into relief the claims of the research to embody culturally independent, musical or perceptual universals; and it raises the ideological nature of the scientific claims to universality.

6.2 The musicians group vanguard: themes and debates

With this psychoacoustical research as a background, the musicians group saw as their common purpose the definition of future areas of research that would be of maximum musical use to composers. Over the months of meetings, the group's main interests were aired, scrutinised and then formulated for proposal documents to show to Boulez for his approval. Ills.6.3 and 6.4 are two such documents exemplifying those research areas (5). They show clearly the concern with timbre, psychoacoustics, cognitive structures and so on, and the commanding and utopian language that is used: a sort of internal marketing aimed at

convincing Boulez. Specifically, the five main groups of themes proposed for future music research were: timbre as a conveyor of musical structure, timbral transition, timbre as a musical concept involving the inter-dependence of previously distinct parameters (pitch, spectra, evolution of spectra in time etc); the formal generation of musical structures, and their relationship with time; an 'inharmonic musical expert system' (or 'computer environment as an aid to composition'); realtime computer/performer networks for live interactive performance; and information transfer of IRCAM software from the big machines to small systems. However, the themes were very unevenly supported in meetings: the first three received wide support, while the last two were vocally supported by just RIG, but no one wanted to take charge of work on them.

A glance at the recent external writings of members of the musicians group continues the themes analysed. I mentioned in Ch.1 the appearance of a new British journal, the Contemporary Music Review, that appeared in 1984 and had its first issue devoted to 'musical thought at IRCAM'. In this issue we find a collection of theoretical exegeses on composition and related music research by key musician-intellectuals from the group, all combining philosophical, analytical and computer science influenced, and some also technical, accounts of their work. For example, junior tutor-composer HU gives his theoretical exegesis for a major piece that was well received by the IRCAM establishment. He writes of time, perception and memory as they relate to the nature of musical time and form (see Ill.6.5). It is notable that HU employs, once again, the rhetoric of unifying micro and macro as the conceptual basis of the piece (6). Permeated by information theory, and weak on computer-related

expertise, others from the group dismiss these concerns as dated, old hat, far from IRCAM's cutting edge.

By contrast, future Music Research director WOW's article, subtitled 'The pathway to new music', concerns the rationale for 'Chreode I'. It is a sophisticated account both in philosophical and computer science terms, emphasising that what is new to computer music is the extension of composition to sound material itself, something enabled by the Chant program. With reference to A.I., WOW notes that the simulations enabled by programs such as Chant (voice, timbres) and Formes (structures) is not mimesis but "rather the formalisation of an implicit or explicit knowledge... When knowledge is 'realised', it becomes available for compositional treatment and manipulation... Through..modelling, musical knowledge tumbles into the universe of 'explicit control processes', and enters arithmetical space... For A.I., music represents an extremely rich and complex object of study, if only as a prototype for a science of organisation.. And here, there may arise a speculative and metaphorical interest in the comparison of musical organisation with processes of biological and genetic organisation" (CMR:182). WOW deploys scientific analogies from genetics and morphogenesis as metaphors for musical form, and also makes reference to Thom's mathematics and catastrophe theory. The article ends with a series of graphs representing aspects of the work (Ill.6.6) that convey scientificity and rigour, and are also visually elegant. This is WOW's model for a new visual representation of music.

WOW's rival, departing director HY, has an article explaining the bases of several works produced at IRCAM. By contrast with WOW, in addition to his own new graphic forms HY uses traditional music notation - perhaps a bid to assert the status of a 'real composer' (Ill.6.7).

Within a nuanced account fully aware of the excesses of metaphor (7), HY nonetheless makes mandatory reference to "the use of timbre, and of spectral quality and transition to define musical structure" (ibid:228) at the heart of his work.

Finally, throwing light on the character of music making at IRCAM and the relation between visiting composers and resident tutor-musicians, there are twin articles by the composer Holler and his (ex) tutor CX on the making of Holler's piece. The articles epitomise the division of labour between composer and tutor: composer as philosopher-theorist and tutor as technician-servicer. While Holler's piece concerns higher conceptual matters, CX's is a blow-by-blow account of his hardware and programming innovations that went into the actual making. Holler writes a philosophical treatise on 'organic form', 'sound gestalt' and 'time gestalt' (see Ill.6.8). He writes that in composing one can..

"..begin with a 'cell'..(and)..conceive of it in such a way that it already contains the plan of the whole, rather like a genetic code which, as microbiology has taught us, already contains all necessary specific information... Development is represented as a continuous process of projection of a microstructure onto a macrostructure" (ibid:36).

Here, again, Holler draws on genetics for the scientific legitimation of his notion of 'micro-macro unity'. Meanwhile, CX gives an account of recording the source material and creating digital sound files, customised computer programs, special programming 'subroutines' and so on. CX is also left to outline Holler's actual conceptual scheme for the piece (8); while his article ends with long, detailed technical appendices. (See Ill.6.9 for examples that show the dense character of the programming language and syntax, and their intuitive incomprehensibility). Holler is thus freed for pure, untrammelled

philosophical-theoretical exegesis. Comparing Ills.6.8 and 6.9, then, reveals the extraordinary difference in the forms of text and knowledge considered appropriate to the roles of composer and tutor.

CX ends his article with two interrelated comments that are veiled criticisms of the production and his 'servicing' role in it. First, he says that Holler's piece had "been conceived very much with analog sound transformation processes in mind..(and) could have been realised equally effectively and much more simply in a traditional (electronic) studio" (ibid:56), so that it did not require the resources of IRCAM. He then notes that in order to create a piece "more idiomatic of the (computer music) medium,.. this requires either some fairly intimate experience of the system or very detailed briefing" (ibid:58). He suggests that "It is much better that the composer should have his own hands on the apparatus, in that this theoretically permits him greater freedom to experiment and achieve the things he wants" (ibid). Given that CX is himself a composer with 'intimate experience' of the medium, these muted complaints speak not only of a profound dissatisfaction with the visiting-star-composer / tutor division of labour, but also with its necessarily compromised musical results.

The historical themes and form of discourse analysed earlier are therefore well represented in these musicians group's writings. Returning to the meetings, we can examine the work-in-progress discussion of projects. One major idea being discussed early in 1984 was HM's 'inharmonic musical expert system' project, that had just begun. The following notes from a meeting give a sense of how he explained the idea.

"This is to be an interactive environment, but musical. The inputs and outputs will be fixed, with well defined levels, knowledge formats,

so that later we can put in new modules. It will follow branching options: either by default or by user specification. We need a historical mechanism to be able to retrace the steps of decision making, back to before things went wrong! Rule specification will be derived from aural-perceptual research. The system will be organised as a hierarchy, like Formes; but additional to Formes you can make inferences by a logic (compositional and perceptual) within the system. For example, we'll have the possibility of manipulating inharmonic spectra, to bring out certain virtual pitches, and ways to change these (their pitch, relative weights etc). So we need rules of transformation, especially in this sort of area where it's not just one variable: we need complex multi-variable rules. The system will be interfaceable with all the synthesis systems in the house - 4X, Chant etc. Now, we'll have inferences of pitch, inharmonics; later, other aspects too. For example, you'll be able to follow the interior polyphony of an inharmonic spectrum. Two composers here are now interested in working with inharmonics, so we've started on this first for the system, and we already have some good models of the perceptual analysis of inharmonics.. Eventually we'll work on the organisation of inharmonics into 'scales', like harmonicity but of inharmonics!... My interest is the coherent movement of sounds: the organisation of auditory images, streaming, the unity versus multiplicity of sound sources, why things are perceived as unified and fused or multiple and polyphonic..." [HM, M.Mtg, 20.3.84].

This monologue combines musical interests (based here around inharmonics) with ideas concerning the structure of expert system software, a key dimension of A.I. (9). Expert systems have mainly been developed for industrial purposes, and more controversially for medical diagnosis: certainly, areas of knowledge in which interpretation is considered to play a minimal role. The idea of a musical, or creative artistic, expert system is therefore a radical departure. In fact, the IRCAM project did not survive the year. It illustrates, however, the importance of high-level software R and D and of programming for the musicians group, since they are researchers' means for producing both the most sophisticated general computer music possibilities, and also in specific projects the particular customised 'solutions', for the musical problems posed by composers. Much music research, then, concerns the interdependence of psychoacoustic and music research with the development of what are known as software 'tools'.

To give a sense of the meetings' critical exchanges, I here transcribe my notes from a later meeting at which researchers from each proposed project outlined their ideas to Boulez. It was the crucial decision making meeting: the talk had to convince Boulez.

"Boulez comes in early, with only 5 of us there. He shakes us each personally by the hand; lays out his watch on the table as he starts (this meeting has ritual aspects). HY comes late, looks cynical, fed up. Boulez starts: "Who speaks first? HY or WOW?"

HY: "WOW!" (Transfer of power from HY to WOW as director of Music Research accomplished, HY seems resigned to it).

MC: (Starts with the project 'Generation and manipulation of musical forms', involving Chant/Formes researchers MC and WOW) "We want to establish certain rules and constraints: to give choices to the composer within which to produce a piece; the structuring will happen out of the material developed by the composer.."

WOW: "They will be tools for realisation, very general and abstract. We begin to have an understanding of intermediary levels of work: for example, as Formes now allows us. But this is the first time such a thing has been realised..."

Boulez: (Interrupts) "What exactly do you mean by 'generation and manipulation of musical form'?"

MC: "I mean to allow a series of aesthetic choices for the composer: for example, 'Do I want a certain attack or articulation here? What kind? What timbre here?' and so on.. at the level of meaningful details".

HY: "You mean a library of possible effects and musical choices? I'm worried by such an attempt to set up a series of such composers' rules and constraints. It might in fact limit the musical choices, decisions and explorations".

HU: (composer-junior tutor) "I'm not interested in 'abstract structures'. I want structure to develop from the knowledge of the material, so if one changes the material the structure changes.."

Boulez: "But HU, one creates and chooses a certain material with a certain internal structure in mind: the material used and structure envisaged are totally interrelated! No one here chooses material with no structural idea in mind, do they? (Teasingly, rhetorically:) No followers of Cage here, are there?!!"

They move on to another project...

HM: (On the expert system project, also known as 'Evolution of spectral forms') "The basic questions here are to do with understanding problems of perceptual categorisation, identification in musical memory - cognitive bases. To describe processes so as to better synthesise them.. We need that information, on evolution of spectral form, to make inharmonics work in more musically complex ways.. This also relates to objects, how these are perceived in relation to evolution of spectral form.."

Boulez: "To be frank, I really don't see the musical significance of these ideas..."

Two projects begin to vie before Boulez...

MC: "Actually, your project and ours are very similar, overlapping in their aims.."

FOK: (Scientific Director) "Really, the work is on the trajectories of

sounds at different levels.."

WOW: "The difference between the two projects is really one of methodology. Ours gives choices, rules and constraints; the second project (HM, HU, FOK) is more cognitive, about basic knowledge, and more normative.." (etc...) [Mus.Mtg. 16.4.84, my transl.].

These critical exchanges show an openness to mutual criticism, but also rivalry within the group. They reveal, too, a peremptory scepticism from Boulez towards the ideas, to which I return shortly.

6.2.1 Utopian projections: the needs of the 'user', the researcher and the outside world

The musicians meetings were imbued with an implicit utopianism that was best expressed by two dimensions of the group's discussions, both touching on the social. First, the concern with small systems, with realtime gestural control and networks of machines for live performance. This had utopian leanings in as much as it expressed a greater awareness of IRCAM's relationship to the outside world, through projections of the needs of potential users beyond IRCAM and of the institute's potential wider progressive effects. The second dimension was internal: the proposal for a new social organisation of research, as a musical 'think tank'. I show below that these debates were characterised by an oscillation between a collective 'idealism' and 'realism'. The quality of communal projection - of predicting needs or necessities - was shown simply by the common use in the meetings of the phrase "*Imaginez que...*" ('Imagine that...').

Although, as I have shown, both the 4X and Chant/Formes projects originate in critiques of the extant limits of computer music, and a desire to improve it for musicians, both projects depend upon a high tech mainframe computing environment that by definition excludes the majority of musicians. Also, despite intentions to the contrary, neither

project successfully foregrounded the needs of the user, and both took years to arrive at the stage of development where they were fully ready for use. Thus, as suggested earlier, issues of user-friendly software, gestural control, man-machine interface have been marginal aspects not only of the main projects but more broadly within IRCAM, a situation resulting partly from IRCAM's distancing from the user-orientation of commerce (10). Against this record, then, the proposal to work on information transfer to small systems, on gestural control and small, realtime networking for performers is a radical departure. The idea for research oriented towards microcomputers was put as follows by HY in a proposal document; (he had just himself started working on compositional sketches using his new Yamaha DX7 at home).

"In the future, more and more composers will have access to inexpensive systems for computing and music synthesis. Although most composers will probably continue to prefer the sophisticated and costly technology that major research institutes like IRCAM will develop, their small systems will be perfectly well suited for many levels of testing, sketching, trying out ideas, and exchanging information. It is essential that IRCAM strive for total compatibility between small development systems and its own production facilities. But this is not enough! We suggest that IRCAM sponsor a long term project that involves the Information Transfer of programs and concepts from its large systems to a form that can work on small systems. IRCAM could conceive a working tool for commercially available small systems and in this way fill a strong need on the part of users.. and retain practical and conceptual compatibility with an ever-growing group of composers and researchers"

The other small system idea, to work on live realtime computer performance, on 'man-machine interaction' as in PL's project, was put forward by PL's friend RIG who envisaged it in these terms: "What I'm interested in now is live computer groups, a performance laboratory". This led to controversy within the group. The proponents argued that it was another important move towards closer relations with outside areas of musical work, and that it could influence, and receive feedback from, a larger community of musicians and intellectuals. RIG saw it as

centring on communication between musicians on stage: "This is an aesthetic problem!" Immediately, the 4X Soft director BYV contradicted him and relegated the issue, by saying "It's really just an applications problem". BYV continued that work of this kind was possible to do outside IRCAM, and did not make use of IRCAM's unique means and expertise, so it was not legitimate IRCAM research.

A meeting to discuss the small system proposal led to a polarised argument between members of the musicians group and the Scientific Director FOK, who spoke for the scientific sector. Those for HY's proposal gave two main reasons. First, pragmatically, because they thought that the Japanese were now ahead in digital technology, and that it would soon be impossible to stay ahead of them technologically. In the end, IRCAM could not compete or excell at the level of technology, but had unique music research resources. IRCAM would "become a fossil in the next ten years unless we fundamentally change direction". Second, implied in the long quote, was a desire to 'open up' IRCAM and give outsiders greater access by making links with networks of small-scale technologies. This was partly a desire to popularise the institute, partly a response to actual perceived demand, as HY eloquently explained:

"Essentially it's about external people's access to what we're doing here, making relations with the rest of the world... Every day we get hundreds of people phoning, coming in, sending stuff, asking about projects, suggesting ideas to do here.. We can never deal with the potential demand for this: hundreds of composers.. So we have to re-direct ourselves, make a structure of more relations with the outside".

It seems also a committment to, or belief in, the future decentralisation of information technology: as with PL, an optimistic vote for the future power of small systems.

Those arguing against the proposal made three points. First, FOK

appealed weakly to tradition and said that IRCAM had "always been developing large systems" such as the 4X. Second, he took the Boulez-ian stance and said that large system development was the unique responsibility of IRCAM because of its scale of resources, a view supported by the 4X Soft director, Boulez's tutor, who added that IRCAM's proper role was to develop things that the market would not, the "Rolls Royces of computer music technology". Third, FOK answered a criticism of the 4X implicit in his own previous point: namely, that it had been extremely hard to find an industrialisation deal for the 4X and that once produced the price would be very high, so that it had not yet found a market. FOK's answer was simply that, when the software was complete, if the 4X 'proves fit', the price may well drop and it may find a market - (which, in fact, did not happen). The argument reveals underlying conflicts and rivalries between music research, on the one side, and the scientific sector and 4X groups, on the other (11).

Embedded in this small systems debate are covert struggles of a different kind: for the appropriate character of IRCAM, but also for the control and character of projection. The debate reveals a deep tension between subjects' idealism and realism, over who are the 'idealists' and who the 'realists': a tension present as a continuous subconscious in many IRCAM dialogues. We can see that the views above for or against big or small machines were phrased either as what IRCAM should do in an idealist sense - for example, because small systems are the way forward in the democratisation of technology; or as what IRCAM had to do in a realist sense - for example, because there is no market for the 4X. The opposing view could also be put either way: for example, 'IRCAM should aim to build big machines because it is uniquely placed to do so' (the idealist, defending non-commercial freedom and responsibility); versus

'IRCAM should build big machines / do high level music research because the Japanese are way ahead on small machines and we can't compete' (the market realist).

The tension resonates, then, with issues of which of the public sector or market is most 'progressive', where the power is between the two, and where IRCAM should situate itself within them. But more fundamentally, this duality is both a rhetorical strategy, and it also reflects a deeper moral tension for subjects concerning the character of IRCAM. Must IRCAM be realist, and is realism in fact more material and 'better'? Or should IRCAM use its unique privilege to be utopian, to aspire to idealism?

6.2.2 Collaboration, 'research' and 'production': scepticism towards the vanguard

The other utopian axis of the musicians group concerns their imagining a new social organisation of research. The group sees the organisation of research as closely implicated in its success. From their discussions arose the notion of a 'musical think tank': several well-supported, long term, collaborative and egalitarian research teams, with a democratically elected revolving secretary of the group. The proposal put it thus:

"During our discussions, much effort was made to define the proper organisational structures that would make it easiest to achieve the goals listed here. (This led to) one concept which we all felt very strongly about (that) should be emphatically stated: the concept of IRCAM as a MUSICAL THINK TANK. We should strive to find an area where confidence and freedom are given to composers and researchers on a long term basis, so that exchange and conceptual fantasy can be encouraged. Only in this way can new musical ideas be born, and can that creative reflection (between purely compositional and tool-building scientific) which deserves to be called Musical Research be nurtured".

On the one hand, the 'think tank' was a pragmatic plan - the

closest the vanguard came to labour relations - motivated by the wish to improve upon the short contracts, poor security and pay of many of the junior tutors in the group. On the other, it is striking as the only explicit attempt within IRCAM's intellectual sphere to theorise or reform the institute's own social relations. With its utopian emphasis on collaborative and long term research, democratically managed and untrammelled by immediate production needs, the proposal strongly recalls Boulez's original utopian vision for IRCAM. The meetings themselves were held in this spirit, so prefiguring the proposal. We will see below that collaboration, central to IRCAM's scientific research and music production, is in itself a key utopian ideological principle for many intellectuals, and offers a sort of substitute gratification that weighs against their poor pay and conditions.

Advancing this idea, HY drew on the models of Bell Labs, MIT, and Rank Xerox's organisation of their basic research centre, Xerox PARC (12) in the USA, whose director Alan Kay - a leader in the field of small system development - he had just visited. His description in one meeting (without Boulez there) of Kay's set up, and the discussion that followed, illustrate many of the issues and problems around the organisation of research:

HY: "The reality of work at Xerox PARC, Bell Labs too, is that someone like Kay can support a research project for ten years, let it develop slowly and eventually produce results - or just end in a cup of coffee! It's that kind of commitment, confidence and support of intellectual freedom and long term development that's found there, but is completely missing at IRCAM!"

HM: "I agree. If I talk of my needs, the environment I want for my work on understanding the bases of musical organisation, it requires different tools, entry into synthesis, acoustic analysis - moving around freely between different things, and dialogue with different people".

JDK: (Tutor, not a composer) "But we need better definition of what you need and mean to do..."

HM: "It's work on inharmonics: HU's interested in it, and it fits in with UO's (postgraduate) thesis.. So we've had a few meetings, FOK too. It begins to be a good research group, working together.. but delicate

as yet.."

RIG: "So it begins to be an *equipe* (team) with different talents, skills, interests: that's what we want to happen. But when a composer's involved, as they should be, it shouldn't end with the production of a work. It's hard to get composer's to extract, after finishing a work, what's generally useful to the community to learn from the project developed behind the work. Someone should be there to theorise that, if not the composer.."

JDK: "But what are the musical aims?"

HM: "Our work is on the interior polyphony of a sequence of inharmonic sounds. That's a vast, central concern: not just inharmonics without musical implications.. The project brings together perceptual questions with the search for new information on inharmonics, towards musical problems..."

JDK: (To HY, who is thought not to document his work) "When will you write up your experiences in inharmonics which you've developed working on recent pieces?"

HY: "Well, I suppose I'll do it after I've finished the piece I'm doing now..."

JDK: "It seems to me that you composers writing up your musical aims, and the acoustic techniques you use to arrive at those ends, would be a very important input to our psychoacoustical research here!.. (To HM) How will you isolate your project's aims, the musical parameters of inharmonics? How will you do this? It seems to me you need the input of a composer to inform you of these."

HM: (Fed up) "But I've already formulated this, by talking to many composers!.."

HY: (Defending HM, to JDK) "What do you think are the musical effects of inharmonics? We'll use our ears! You have to begin somewhere, you can't take on everything at once!"

JDK: (To HM) "You see your project, finally, as a sort of secret garden. To develop your work, you need to clarify, open up, discuss exactly what you're going to do..."

[Mus.Mtg. 14.2.84, my transl.]

The scientist-tutor JDK is calling here for better communication between researchers and composers. He is questioning whether the psycho-acoustician HM is aware enough of the specifically musical possibilities of his research, implying that HM is not himself sufficiently a composer - a sore point with HM, who aspires to be. JDK also gently prods HY for not having written up the technical and research bases of the several pieces that he has produced at IRCAM: one example of the major IRCAM problem of lack of documentation of research.

Collaboration between composers and researchers to advance music research is in itself a central principle of the musicians vanguard.

This is nowhere better expressed than in the following exchange with the Chant director and (unofficial) tutor MC, who begins by describing his fruitful collaboration with the composer WLe, the early composer-director who brought him to IRCAM. It continues about his tutoring work for visiting composer AV (see also Ch.7), and then the start of his collaboration with the in-house junior tutor WOW, who was attached as a composer to the Chant group. MC depicts the good composer-tutor dialogue as the driving force for interrelated progress in both software design and music research, which are seen as for the common good rather than individual glory; and, importantly, as a prime means of legitimation.

MC: "WLe was at the point where he was unable to compose any more,.. because the globality of music in the century was.. where would it go? And he found that his work was to do research on music in the sense that it's building blocks that will help for the future; so that music is no more our own, the own composition of the composer saying 'Oh, that's nice, that's my piece, and that's genius!'. Now (WLe) was thinking 'OK I'll build research on music, pieces, but they will be building blocks; and we are going to build a wall that helps the future to go on,..' and to have progress in that sense.."

Q: "..In terms of providing a whole new series of tools and..?"

MC: "Not only tools but concepts, research and so on. And in a very non-individual way... Since the beginning I have been working with WLe. My experience was that it was very efficient with him. He's a wonderful man, composer.. We understood each other very well. I appreciated him very much and I think he appreciated me too, so we did wonderful, really fantastic work. (When I came) WLe was struck that I'd done that speech synthesis work on a small mini computer, and in realtime; whereas here it was necessary to use a huge, complicated machine to do realtime. WLe was hoping that I could do something with realtime, good quality, faster and with a simpler computer. This project used concepts that musicians can understand, like formants, fundamental frequency, rhythm and things like that... (But in fact the system used for a piece by WLe) was far from realtime. WLe conceived everything, and then the piece was physically realised by XX (American programmer). XX wrote part of the program, and really was the tutor for WLe in the sense that he did the tedious work of repeating the synthesis and all that... Not in the sense that tutors here are making things that composers cannot do, because WLe was able to do everything, learn any language, do anything like that...

When (WLe) was no longer here at IRCAM, I felt the lack of a composer, that it was absolutely necessary. I knew each time I'd been working with a composer - I worked also with other composers at that time - that something new happened. And that has been verified every, every, every time. The last time was with AV."

Q: "So you learn more about what you then want to do with the system?"

XR: "Yes, I really discover things that I cannot discover without

their.. probably their needs.. Typically, they (composers) want something and so I'm obliged to find a solution to the problem, otherwise I can think and think but no precise solutions come. But when they really need and want it, then, OK: and that's what happened with AV. He told me: 'Here's a listing of what I have with the Fairlight. I like it, it's very simple..' So I said: 'OK, I'll do it not like that but much better, and including that'. I made it, and it appeared that it was a way of considering Formes that was really one of the best...

(A few years back) we had a stage, and WOW was attending. I always like to hear the music done by people; my 'sound' is always open (13). During that stage I was listening to people, and one was interesting me, and it was WOW. I thought: 'A guy who makes that in a fortnight or something is really great'. And I was also planning my own job: I was working with the (simulated) Tibetan voices at that time, and WOW said: 'I like that, I'm interested, how do you do it?' So we began to talk. I said I'd like some help from a composer's point of view, because WLe had left by then... So I asked HY (Music Research director) what he thought of (hiring WOW). Finally we decided to ask him to stay for a year or something.."

Q: "A short contract? (They actually offered WOW several sequential 2 or 3 month contracts)"

MC: "Yes, for the first one, because he was just a *stageaire* before..."

Thus, in fact, the musicians group see aspects of their present work as already embodying their collaboration ideal; so the 'think tank' proposal is really a bid for legitimation and for a vote of confidence in this approach from Boulez, who, we will see, is sceptical. Others from the group also see the development of Chant and Formes as examples of the ideal research process, articulated here in different terms by HM:

"Formes was developed a little bit by MC and JDK (scientists), who tried to put in certain musical capabilities. Then XU joined and picked it up, who's a computer scientist, and he started developing all these incredible ideas. It then reached a sort of first stage of development, and then the musicians came in, OK: HY's used it, NR and HU have used it. They all found there were a great deal of problems, things they needed it couldn't do, which were sort of implied as possible. And so they started firing all this stuff at PC, and it went into this incredible stage of flux - because there was this very fast turn-around loop between a suggestion the musicians would make and its implementation by XU. So at that point Formes entered a very unstable stage, because the creator was getting a lot of feedback from the users.. who were themselves creative users. In a sense they were serving as developers, by imagining possibilities that weren't yet implemented, understanding at a pretty fundamental level how it was going on - they actually had to dive in there and learn some pretty low level things that they're not really interested in. But it's the musicians - especially NR - who dove in there and understood at a very basic level

'what is this program doing', so they could then suggest very concrete things to XU... So there's a constant movement between stability and instability, the fixed program and creative flux".

The issue that HM ends by raising, the necessity of stabilising research so as to make it communicable and so usable for production, is contentious within IRCAM. Internal and external critics argue that much IRCAM research is too 'in process' and chaotic to be usable, and so effectively meaningless. HM discussed stabilisation, and the problem of bringing long term research to fruition, as follows:

Q: "Do things ever stabilise in research, so they can be used widely even within the house?"

HM: "That's a real problem, that you can see, for instance, in the early stages of Chant: that it was always evolving, so it was very hard to use it as a tool for production. There came a point when they decided they'd gone far enough, and that any further things they were going to do they would move into another project - and that ended up being the Formes project. So, after a few years the Chant project sort of got fixed; and at that point it really entered into production. But you have to realise that took a number of years. And meanwhile people are saying 'Well, it's been a year, you know, and we don't have any tools that are useful!..' It doesn't work that way! You have to get to a certain level before you even dare to say: OK I'm gonna make a version people can use... That's the problem that Formes is in right now: it's been evolving constantly, and it's been a real frustration for people using it. Because every three days, they say to XU 'You ought to be able to do this!'; and in three days you can do that, but it changes a lot of other things; so they get what they wanted, but other things they knew change!"

Q: "So that's why there's been tension about Formes, with people saying it hasn't been diffused widely because it hasn't been stabilised enough to communicate?"

HM: "Exactly, it hasn't been stabilised yet because I think it's a bit too young. There's an agreement that they'll make a version in the next few months that'll be fixed and usable. And that should be documented. But it has to get past a certain threshold before it's fixable. If you do it earlier, it wouldn't be as interesting as a tool because it wouldn't have the musical power that you want".

HM ended by commenting on the misunderstanding of this process.

"The musical production wing over there, Boulez and WV, don't understand this at all, they don't really care. All they know is they hear a lot of talk, and (they) ask 'Why isn't this thing a tool yet?' Now if you want a tension, that creates a tension!! They refuse to understand what this (process) is, because they haven't been in there struggling with development themselves. I know the same thing's going to happen with the expert system that we're developing now, because we're right at the beginning and what we can do is very small, (with) minimal musical interest at this time. But the thing is, you can't evaluate it

musically right now: you have to evaluate it as far as potential for tools, OK? That's where the problem is.. They don't want to know about all that (research) 'garbage', they only want to know about the musical end. There's a kind of impatience, and I understand that impatience: I want to get there too. But I know that to get there, you have to go through certain steps. I could make a short cut,.. make a tool that goes straight to immediate demands, and it's good for nothing except that immediate demand. Whereas if I'm more careful about the path I take, and the possible spin-offs along the way, then this becomes a much richer domain and generates things as we go along: knowledge, in the sense of coming to know how to create a system as well as gaining an end goal".

HM's argument must be understood in the context of Boulez's profound scepticism towards this vision of research and, more deeply, towards the whole concept of music research that, despite his public pronouncements, he betrays at IRCAM internal meetings. At several meetings, Boulez chided researchers for failing to orient their work towards musical production, and for indulging in unproductive research, as shown by this exchange from one of the musicians meetings. The researchers had just finished outlining their proposals, and Boulez launched into a characteristic monologue.

Boulez: "I don't want IRCAM to become like the CNRS where researchers hide in corners for 30 years!.. I want tutors and researchers to divide their time between research and production. And I want all research to be tied into problems of production and realisation; so when a composer arrives..."

HM: (Interrupts critically) "This is all the short term perspective!"

Boulez: (Continuing) "I've just started. So, research should be totally tied into realisation of pieces. For example, when Stockhausen came, he needed research on tools for his piece, didn't he WR (the tutor)?.. I want the artistic year and research year to be the same, to underline the tied nature of these two processes at IRCAM: interaction between realisation and 'reflection' - this is the main thing I want to stress... We have a responsibility to all those who follow what we do here to keep in touch with the outside world! Everyone's following what we do here, so we have to have results to show for our work". [Mus.Mtg. 16.4.84, my transl.]

The sense of a major gap in understanding between Boulez and the musicians group was expressed one meeting by this joking exchange:

HM: "We need to translate all these ideas into '*les categories de Pierre*' (Pierre's categories)!!"

HY: (Laughing, with frustration) "Qu'est ce que c'est, '*les categories de Pierre*'?!!" ('What are Pierre's categories?!') [Mus.Mtg. 14.2.84].

The group were, then, fully aware of Boulez's ambivalence, his own oscillating attitudes, towards music research. A researcher put it thus:

"Pierre is hard to figure out, he's ambivalent. He agrees there ought to be the research, the 'pushing forward'; but he gets a little impatient if he doesn't see results soon enough, and starts giving a hard time.. One minute he's saying 'Why isn't anything being done?' and 'What's being done doesn't serve for anything at all!'; the next minute he's got his sort of '*utopie de la recherche musicale*' (idea) going on! (Doubtfully) He says he's committed to it..." [HM int].

Boulez implies above that his attitude stems from the responsibility to show results to legitimise IRCAM, in the face of critics. Yet his doubts about music research are deeper, and are shared with other directors: a fact satirised by the following joke model bibliography entry in an internal memo -

"BU and Boulez, P. (1985) - '*La recherche en musique?*', Revue de Neurospeculation, 69:123-145".

Boulez is not alone. Similar criticisms of the musicians group were also made in meetings by the Scientific Director FOK. In the following exchange, he charged them amongst other things with being too abstract, impractical and unreal; but also, for ignoring the 4X project in their proposals, for setting out to create boundaries between themselves and the scientific sector (although several were in fact also scientific workers), and for elitism.

FOK: "In such a document, outlining the main axes of research, you must include the research around the 4X!.."

HY: "But we've been trying to say for 15 minutes these are the musical research themes..."

FOK: "But these goals can also be stated practically! Either they are stated too abstractly, 'high up in the sky', far above the ceiling; or there are only two things actually cited: Formes and... there's very little practical suggestion..."

BYV: (Ironically) "Maybe as a scientist you have problems, FOK; but we're discussing ideas here, primarily: that's the whole point. We're not yet discussing implementation. You're setting up your water-tight compartments between music research and scientific research again, and we're back to that old problem. We're trying to get beyond that!"

FOK: "I think it's this document that's reinforcing the water-tight compartments, not me!... I don't see Pierre's four themes in this document. Anyway, how many people from the house have taken part in the

meetings which drew up this document?"

Angry groans...

HM: "Anyone and everyone could have come! They were publicised as open meetings to discuss the future of music research!"

FOK: "Look, I've never seen a 'research document' that's as abstract, as non-specific and impractical as this! It's inadequate. It's too, too general, yet exclusive! I think the majority of people not present here would think so too. The themes are too big, vague, their implications aren't explored... You must think about how do these things develop in reality... My function here is to react from the perspective of how could these things be developed practically, what are the scientific research implications" [Mus.Mtg. 28.2.84, my transl.]

The same issues continued at a later meeting, and the sense of a basic division between the musicians group and the scientific sector becomes even clearer. They were discussing the group of people who could constitute a future music research committee:

FOK: "It's too homogeneous: there's no one who can consider the musical utilisation of the 4X, such as BU (4X Hard director). There's no one from the 'other culture'!"

BYV: "It's heterogeneous!"

WOW: "But come now, is BU really interested in music research? Does he ever come to our meetings or go to concerts?"

FOK: "Yes he does, but there aren't many concerts that use the 4X!"

BYV: "Well, he does 'little pieces' to amuse himself on the 4X.."

WOW: "If BU has musical ambitions, we could discuss them, but he doesn't seem to have..."

RIG: "My main point is that we must efface the frontier between music research and scientific research. We must integrate and get beyond this boundary!"

HM: "But now we're back to the fundamental argument again: whether there are specific research problems that are primarily musical!"

BYV: "Otherwise, we'd see all the people working on software, the 4X and so on as doing music research!"

RIG: "But.. it astonishes me sometimes that we identify something as 'musical', and then if another person (who's not defined as a musician) suggests something, makes a contribution, about using a certain tool or whatever, then everyone says 'Oh that's not a musical perspective'!!"

[Mus.Mtg. 27.3.84, my transl.]

We see here, then, a basic conflict between the vanguard group, who see themselves as fighting to defend IRCAM's musical goals, and the scientific sector, who perceive the vanguard's high-level music and software ideas as impractical and elitist. This opposition between the musical and scientific sides of IRCAM takes other forms: most fundamentally, aesthetic differences and the antipathy that follows. In

the exchange above, BYV reveals a patronising attitude to 4X director BU's 'little pieces'. BU, in turn, intensely dislikes IRCAM music, and resents that his machine is used for this. He is keen on easy listening music, and has himself used the 4X to produce some jazzed up Corelli, hoping eventually to make a record like William Carlos' 'Switched On Bach' to show off the 'real' musical possibilities of the 4X (14). BU told me a story that epitomises his contempt for avant garde music. He said that one day, for fun, he'd set up the 4X and churned out a pseudo avant garde piece in just twenty minutes - a piece of cake, he said. An important visiting composer had come into his studio, listened to it, and was most impressed, asking who had made it, how long they had taken and so on. BU laughed at this practical joke, and ridiculed the hallucination of avant garde music with me. Photo 6.1 shows a sign notorious within IRCAM, half-joking but with very serious undercurrents: it is fixed to BU's studio door and epitomises his hostility towards IRCAM music and musicians, and implies 'Musicians, keep out!'. The 4X Industrialisation director VO is equally hostile to IRCAM's avant garde music: a major reason why he had fought so hard to find a deal to produce the 4X for outside musicians.

The conflict between the vanguard group and the scientific sector and 4X Hard groups takes, finally, another related form: an opposition between mental and manual labour. While the vanguard music and high-level soft researchers consider their work the most intellectually advanced, we have seen that they are disparaged by the 4X Hard and Scientific directors as producing abstract and ephemeral work of no real use to anyone, just intellectual 'hot air'. In opposition to this, the 4X Hard directors present themselves as artisanal, manual workers. The

4X Industrialisation director VO spoke ironically of his position vis a vis Boulez:

"Boulez is very fond of citing the Bauhaus, Mies van der Rohe: but I ask you, what about the little guy who built the building with his own hands!, who worked for 12 years, ran the budget!..He's not even mentioned by Boulez! I wonder about that when I read about the Bauhaus.. I'm the '*eminence grise*' here!"

VO, who was soon to leave, was resentful that when the history books came to be written about IRCAM, they would mention only Boulez, the 'genius', and would neglect the role of him and others - the 'little guys' - in literally building the place from scratch; and also the power that he had personally exercised (through budget control etc) behind the throne. BU, as we have seen, was devoted to hardware design and sceptical about software in general, let alone high level A.I. software. He believed, he said, in solid practical and mechanical skills as the basis of scientific research, and belittled the practical illiteracy of computer science hackers. He spoke of their work as insubstantial, ungraspable, and depicted himself rather as a mechanic who enjoyed working with his hands, building well structured things: things that you could get hold of. At the end of our talk, he drew some photos out of his wallet, proudly, to show me. They were of some beautiful, large wooden model sailboats that he had crafted by hand for his sons, that sailed by remote control.

We can now understand the basis of status conflicts around the institute's central division of labour: between those identified with music, and those with science. Publically, as we have seen, music and closely related pure research have highest status; musicians see the machines (especially hardware) as tools for their expression, and the scientists and technologists that produce them as servicing their needs. Thus, the musicians group have an implicitly hierarchical view of the

division of labour between themselves and the scientists: although they affect to respect the top hardware scientists, they see them as 'not musical' and not engaged in the most important research. But in their turn, through rejecting IRCAM music and the high intellectual and software research that surrounds it, IRCAM's hardware scientists dismiss also the whole basis of the status hierarchy in which they are meant to be implicated. This is nowhere better exemplified than in VO's contempt for Boulez's 'Bauhaus hypocrisy'.

6.3 The structure of oppositions in IRCAM's intellectual work culture

From the above analysis we can begin to discern a set of basic oppositions in IRCAM's intellectual work culture: the sphere of research and production. We have seen, most basically, a conscious opposition and some antagonism between the musical and scientific sides of IRCAM. In addition, we have seen an opposition between software and hardware embodied by the mutual antagonism between the Chant/Formes project, and more broadly the vanguard musicians group, and those aligned with 4X Hardware; and we saw, too, that this corresponds to an opposition between mental and manual labour.

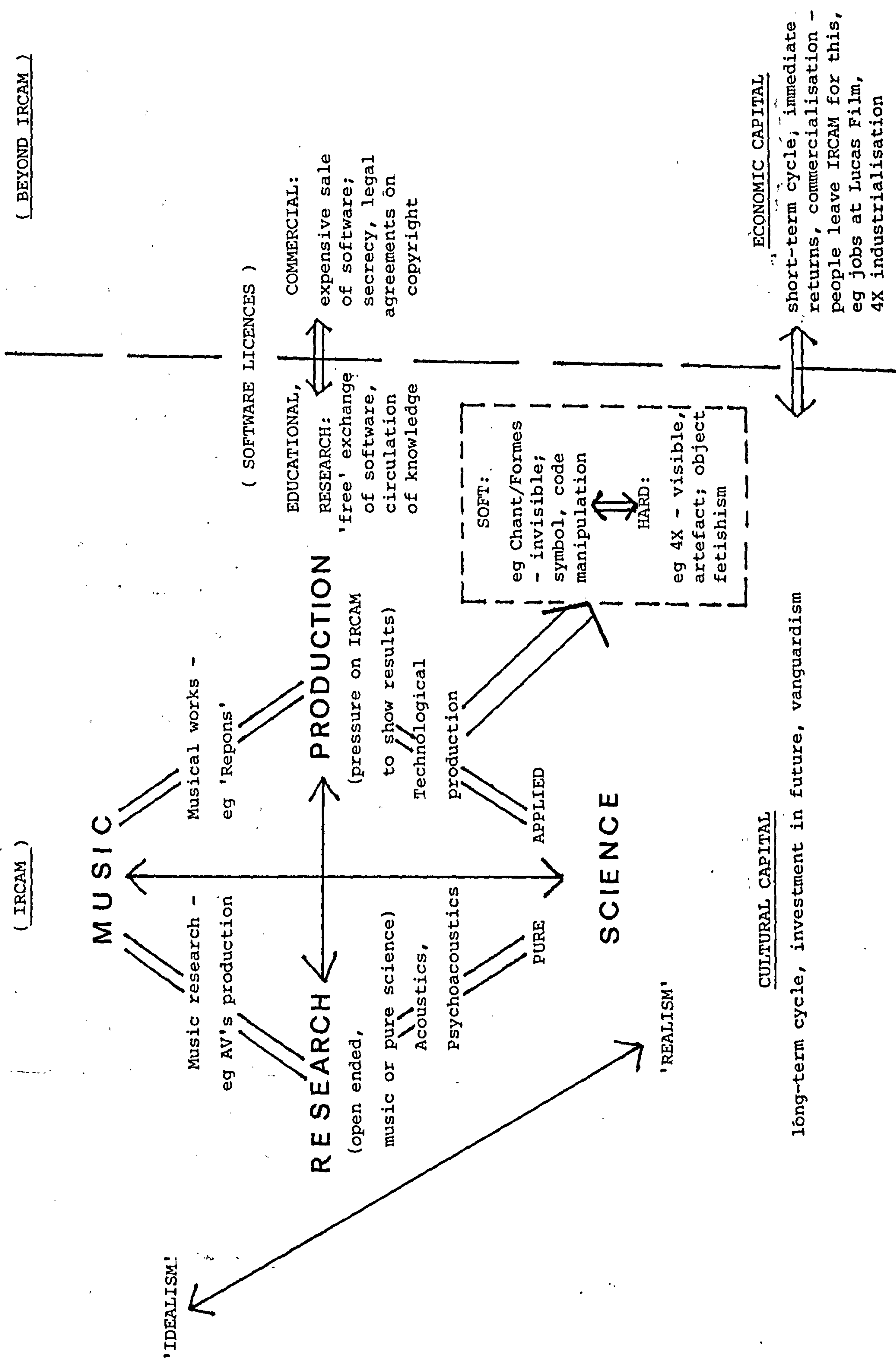
Returning to the 'think tank' debate described above, we can see that it raises other major, interrelated conflicts within the intellectual culture: those of long term versus short term research cycles, of the open-ended progress of pure research versus its stabilisation and implementation, or use, in an actual musical work (15). The musicians group argue that IRCAM must support long term fundamental research that is independent of immediate musical production needs, and that it currently fails to. Whereas Boulez and the Scientific

Director argue for research being tied to production, to showing results in a specified, shorter time. Here, within IRCAM's higher production sphere, 'production' and 'research' have specific meanings defined by opposition. While 'research' is defined as an ongoing process of experiment and knowledge seeking, 'production' is reserved specifically for the actualisation of research, for work that stabilises the ongoing flux of the research process and becomes allied to a result, either musical or technological.

This delineates, then, another set of basic semantic oppositions within IRCAM's intellectual culture, organised as a chain of associated oppositions whereby 'long term' is associated with the idealism of the musicians group, and with 'fundamental, pure research' that can disdain immediate results; while 'short term' is associated with 'production'-related or applied research that has more immediate ends in mind, seen by its defenders as 'realist'.

From all this, we can trace a structure of basic classificatory oppositions that constitute the differentiation of IRCAM's research culture. Fig.6.2 is a schematic summary of this structure. We have seen that the oppositions represent tensions and conflicts of ideology, legitimacy and practice regarding IRCAM's own work. They are not all identified one-to-one with specific groups or positions, although some do represent the affiliations of certain subcultures. Most clearly, the musicians group links a chain of associated semantic positions; thus the set of associated binary poles (music : research : long-term : idealism : software (Chant/Formes) : mental labour) together form an ideologically charged semantic field. But the opposite poles are not brought together in quite as monolithic a way; although there are similar, shorter chains of association, such as that linking

FIGURE 6.2: CHART 1 - STRUCTURE OF OPPOSITIONS IN IRCAM'S INTELLECTUAL WORK CULTURE



(production : short-term : realism) with Boulez, or the more extended chain (science : production : realism : hardware (4X) : manual labour) linked with the 4X Hardware directors (16).

The binaries delineate, then, a map of discursive positions (of ideology and practice) that IRCAM intellectual subjects can adopt, move between; and the chains of association are discursive strategies, alignments. The strength of the vanguard musicians group lies precisely in their appropriation of a powerful and ideological set of associations; and in this set representing a return to Boulez's fundamental values for IRCAM, apparently despite his own loss of faith. We can see now that IRCAM culture contains within itself, and is constituted by, a complex logic of oppositions. The unity of the field is thus produced by a play of difference, and by containing dissent: a phenomenon which, as Bourdieu (1968:183) and Williams (1981:225) suggest (see Ch.1), rather than weakening the culture may work to increase its authority.

But in more substantive discursive ways the authority of IRCAM culture is being undermined. In content, the debate around the vanguard plays out the broader contemporary questioning of the legitimacy or value of long-term, non-commercial, 'basic' research and 'pure' knowledge seeking. The meetings and debates represent a constant search for the means to internally legitimise this research while it is in progress, as though to counteract an underlying uncertainty and loss of confidence. Thus, IRCAM's advanced researchers are involved at the same time both in research itself, and in a search to formulate its legitimation. This recalls Lyotard's argument that, in general, science is always also involved in the need to formulate its own legitimation: "A science that has not legitimated itself is not a true science"

(1986:38). Moreover, the attack on the vanguard's support for the old modernist values of long-term basic research is made in terms of short term cycles and, most importantly, quantitative results (technological and musical). And this proposes a new form of legitimation, by results or performance. The debate within IRCAM thus also rehearses the shift in forms of legitimation analysed by Lyotard (1986: 37-47), whereby the old form of 'speculation' in the quest for truth has given way to a new form of scientific self-legitimation based on performativity: the "best possible input-output equation" (ibid:46), and this is deeply entwined with technology (17). The two positions taken in IRCAM's research debate, then, epitomise the conflict between two (modern and post modern) discourses of scientific legitimation.

Given the symptoms also of aesthetic uncertainty (Ch.5), it is interesting that despite combining within itself the hitherto most highly legitimate and unquestionable spheres of modernist cultural value - aesthetics and pure science - IRCAM rehearses the crises in their self-evident value within its own intellectual culture. And even without embarking in a commercial direction, IRCAM management feel defensive and under pressure to pull in short term, 'hard' results similar to those required by commerce. A final observation summarised in Fig.6.2, then, is that while IRCAM objectively inhabits the state subsidised, non-commercial sphere - Bourdieu's domain of cultural capital - management is beginning to favour the production of short-term, 'hard', visible and audible results, and performance-related contractual status for creative staff.

In conclusion, the outcome of the musicians meetings was uneven. We saw earlier that Boulez overruled the group's democratic initiative by himself putting forward the junior tutor WOW as the new Music Research

director. Of the research themes outlined above, those centred around timbre and form continued to develop. Led by the new leader WOW, the group organised a major professional conference on timbre in mid 1985; and timbre remains a broad organising concept for much IRCAM high-level work. However it is notable that the more utopian themes, touching on the social - those centred around small systems and the reorganisation of research - were received with hostility by Boulez and others in 1984; so the dominant technological ideology and orientation of research remained intact, while the 'think tank' idea as a whole was dropped.

A final irony of the musicians meetings concerns the previous director HY. Despite holding the job of director of Music Research, and being a prime theoretical and rhetorical proponent of musical research, HY told me that he was sceptical about too much theory production: that this was lifeless academicism, irrelevant to his music. He said:

"I don't believe in music 'researchers': we all do music research as part of our work process at times - me, for example, Boulez for 'Repons', Harvey have all done some music research towards our pieces".

When I suggested that XX was possibly an example of someone successfully uniting a music research project with their composition, HY doubted that this researcher was a good composer.

"Well, I don't really think XX is very talented compositionally.. His talent is for analysis, theorising: I've suggested for years that he should take the role of theoriser and communicator of what's going on at IRCAM in music research for others, to diffuse the information".

HY feels, then, that the categories of composer and music research theorist are mutually exclusive; and, like Boulez, he is ambivalent about the value of pure, autonomous music research. There is thus a disjuncture between HY's private belief and public self, his practice and his theoretical rhetoric. I discuss the implications of this kind of contradiction further in the Conclusions.

Chapter 7 Making computer music at IRCAM: mediations, practices, social and technological relations

This chapter describes the character of those IRCAM activities most involved in the production of new music. Central to these are the use of IRCAM's existing computing tools; and, at a higher level, the research and development of those tools. We will see that the writing of new programs and modification of extant software are necessary parts of each music production process, since they provide the fine tuning of the technology and so create a custom built compositional 'environment' for composers' specific needs. Central to these tasks, then, are tutors: members of staff who mediate between visiting composers and the technology, many of whom are adept programmers - a crucial skill given the importance of programming to musical work.

First, I characterise the dense mediations around IRCAM's musical work: the forms of language, texts and codes, the objects and machines. To exemplify the process of musical production, I then describe the visiting composer AV's experience of a commission visit to IRCAM.

7.1 Mediations: talk, text, code and object

7.1.1 Talk: the rhetoric of IRCAM

In the last chapter we saw many examples of IRCAM rhetoric, and of its scientific character, due to the constant conceptual borrowings and metaphors drawn from science. We saw also that the commonest way of talking about music is that mediated by the scientific concerns of psychoacoustics and cognitive music psychology, which tend at IRCAM to be drawn into speculation upon universal structures of perception and deep structural musical rules, in turn related to composition. The

following discussion between the psychoacoustician HM and myself, about the composer AV's project and HM's contribution to it, conveys the strategy whereby issues of perception are brought in as a hopeful way out of what has been, essentially, an aesthetic failure. The failure was an attempt to create a musically meaningful 'interpolation' between two distinct timbres by making 'glissandi' (slides) between their component frequencies. Rather than ask himself whether such an aim is unmusical, HM prefers to think of the aim (a key principle of the music vanguard as we have seen) as correct, but the method used as perceptually at 'too low a level'. The answer, for him, is therefore not to think of a new musical/aesthetic aim, but to be more scientific. The exchange also conveys the use of terms like 'object', 'behaviour', 'syntax' for music that are redolent of the linked domains of cognitive psychology, A.I. and computer programming itself.

HM: "In his first visit in '82, AV wanted to work on timbral transition - from an oboe to a soprano voice sound - and we did that using Chant on the PDP10 with MC's help. Then he wanted transitions from very complicated inharmonic sounds like a gong or tam-tam into a soprano. We were trying to figure out ways. The problem there is: even at the level of physical modelling, there's no similarity at all between those two things. We tried doing that one with additive synthesis. I wrote him some (software) instruments that would allow him to take any given set of frequencies and have them interpolated in some bizarre fashion with some other behaviour. The first trial on that was a total failure. We tried just 'glissing' the frequencies of the gong into the frequencies of the soprano; all we got is this large glissando which was not at all satisfactory as far as timbral transformation. So we started to think of other ways...

So we learnt that it's not just to do with the frequency dimension. It's much more complicated... I've been playing a lot recently with this notion of the coherence of the behaviour of sound objects. And there you see that what coherence means in one case is totally different from another case, so for that to be successful you'd have to be making the interpolations at a much higher level of behaviour of all the elements, 'cos simply thinking at an acoustic level is not satisfactory. We did get some partially satisfactory results, based on a notion I came up with in '81 of a sort of pivot - a period of time in which things decompose and recombine into other objects. So we tried that, and that was much better: we'd totally disintegrate one sound and then have it re-form over a specified time into the other sound."

Q: "What you seem to be saying about this notion of timbre

transformation..is that this whole notion of interpolation being a sort of continuous process is now being contradicted by realising how precise are the coherences of timbres as discreet objects..?"

HM: "I wouldn't say it's contradicted: I think it is contradicted at the level we were trying to deal with it. But that's like, you know, trying to talk about social organisation at the level of molecules: you can't ever get anywhere near social phenomena in discussions of molecules. So, there we were trying to deal with it at too low a level. It implies having a much better knowledge about what we mean by coherence in each case; and then when transformation takes place, it takes place at a perceptually relevant level. So that coherence is maintained, or an incoherence if that's desired, at a level that's believable to the ear."

Q: "So you're still then convinced of the idea that there could be a syntax of the transformations of timbres that could in itself be some kind of syntactic language?"

HM: "Yes, I think so."

The rhetoric of IRCAM is, then, imbued with more and less arbitrary intertextual reference to science and computing, including as we have seen biology, maths, physics, structural linguistics, but especially to the overlapping domains of cognitive music psychology, cognitive science, A.I. and computer science. The implicit principle is that these areas can provide a metalanguage not only for music analysis but also for musical composition: the basis of a new aesthetic. Although some subjects admit the primarily metaphorical quality of this rhetoric (eg TM and Boulez himself), they do not and, it seems, cannot provide an alternative metalanguage and in fact employ the same rhetoric themselves. Not only composition, but also issues of reception and audience pleasure, when they are addressed, are also conceived in terms of the scientific and universalising rhetoric of perception.

7.1.2 Texts and codes: multiplication, hierarchy, and translation

Phenomenologically, IRCAM's intellectual culture is marked by an extraordinary antinomy: by a vastly multiplied textuality on the one hand, and its character as an oral-aural culture on the other. I show later that these are both in contradiction, and yet also interdependent.

Computer music at IRCAM involves a multiplication of mediating texts and codes, knowledges and authorities around music, both laterally and vertically. With its retention of the conventional musical score alongside the new textuality of computer music, IRCAM is characterised not by a search for notations and codes to supercede the previous conventional music notation, but rather by the addition of many more, new codes and texts. IRCAM is, then, strongly text-centred. Yet this proliferation of texts and codes fails as yet to solve a central problem in computer music, inherited from electronic music: that of finding a specifically musical textual representation, a musically appropriate and expressive notation, for aural, tape-based musics.

At IRCAM, the central authoritative text remains the conventional musical score with its strong visual focus, often buttressed by theoretical exegesis. This contrasts markedly with the displacement of the score in electronic music history, in which conventional music notation was often considered inadequate for the complex new sound-world. IRCAM's score-centredness can be illustrated in several ways. From the early 1980's, the kind of piece most fashionable and prestigious among IRCAM composers was one mixing the resources of a live orchestra or ensemble, requiring conventional scoring, with computer-generated tape or live computer transformation (as with Boulez's 'Repons'). This kind of piece is prestigious both in commanding vast resources, and in retaining the conventional musical authority of the score. Scores are also the focus of the judgements of the twice yearly *Comite de Lecture* (score reading panel): IRCAM's attempt at an open competition to discover compositional talent (1). Despite composers' choice to submit either score or tape, and despite computer music being

primarily a tape based medium, the Panel overwhelmingly receives and judges by scores (2).

Further stories convey the importance within IRCAM of the visual look of the score. At the start of fieldwork, a music director told me bemusedly that Boulez was to conduct the orchestral music of the avant garde rock musician Frank Zappa in a concert of American music. He said: "I haven't heard it, but the score's good: it looks like a real score!" Implicit here is the belief that the music's legitimacy rests upon its looking like a 'real score'. After the concert, this director's judgement was that the music was "pretty boring really". Issues of the valuing of visual scores over the aural, of the judging of music by its look, its visual hyper-complexity, are contentious more broadly within contemporary music. A visiting IRCAM composer commented cynically that he knew this score-centredness well, that composers were steeped in it by their training. He told an apocryphal story to illustrate the hypocrisy around the issue. A well-known contemporary music quartet were playing a concert at Darmstadt a few years ago. They decided to alter the order of the program, and played a piece by composer XX earlier than printed on the program. This composer was late for the concert and missed the announcement. After the quartet had finished his piece, the audience applauded and called for him to go up on stage. The composer refused, pointing to the program note and saying "It's not my work!" The moral: the composer did not know they were playing his piece, because the score was so complex that even he could not imagine the sound of his own piece; he knew only the look of it from the score (3).

On the other hand, a story told by an IRCAM music director indicates how, for composers dedicated to difficult scores, computer music can appear a salvation. Early in his career this man had written a

string quartet, but the score was so extremely complex that he found no quartet able to play it. He recalled that, having become involved a few years later in computer music, he had finally been able to hear his quartet accurately for the first time: by programming the computer to play it in its full complexity, a task that had defeated human musicians.

The power of the visual within modernist music is not limited to the fetishism of the score or technical texts. It derives also from a longer term mutual fascination in modernism between the visual arts and music (4). This points to a blurring of the boundaries between different media in modernism, which may have encouraged the tendency for the visual qualities of the score to be 'read' as indicative of musical value. A recent example from computer music takes this further. The small computer music studio led by Boulez's rival Xenakis has produced a digital machine called the UPIC. It works by the user drawing visual designs with a special pen onto a computer screen. These visuals are immediately translated into synthesised sound: the visual becomes the aural. The UPIC raises starkly, then, the question of to what extent visual signs deployed to 'drive' the aural are musically appropriate.

The contents of the *stage* indicate the lateral extensions of knowledge involved in computer music apprenticeship. There are four specialist areas of knowledge considered necessary to becoming adept at computer music: general computing (5); acoustics and psychoacoustics; electronic music techniques; and the dedicated area of computer music itself. Beyond all this, a knowledge of conventional music theory and notation is assumed. On the *stage* in early 1984 we were supplied with an enormous amount of written material on basic computing, on acoustics and

psychoacoustics, and above all on the Cmusic software (the patch language that was being taught), for which we received a 300 page teaching manual. There were, however, no materials or formal teaching on electronic tape music or studio techniques: an area considered by IRCAM to have an aural-empirical method and in which notation remains problematic. We were also given few actual sound or music examples. The stage, then, neglected the aural and the non-notated electronic music techniques, while steeping us in the burgeoning textuality of computer music. Fetishism of textuality accompanied a lack of priority given to sound itself, and to music not grounded in the authority of the text.

In terms of the multiplying vertical mediations in computer music, we must first note the multitextuality inherent in all computer software: a key characteristic of this new medium. The use and the development of software involve the writing of coded instructions within a software 'language', or of a completely new language, within the context of a hierarchy of such languages. At each level of the hierarchy, a translation occurs between any two adjacent languages or levels of code. Instructions from the language at a higher level must be translated into a form whereby they can be 'read' and executed by the lower level code or language without any loss of 'meaning'.

The hierarchy of codes that normally operates in a computer's software includes, at the lowest level, machine code: the coded instructions that drive the hardware, written in binary form; at the next level up assembler code, made of mnemonic abbreviations of machine code; above this, the general operating system that provides a basic framework and set of services; and above this, any of the major languages such as Fortran, Pascal, C or Lisp. The point about these higher level languages is that they provide condensed ways of expressing

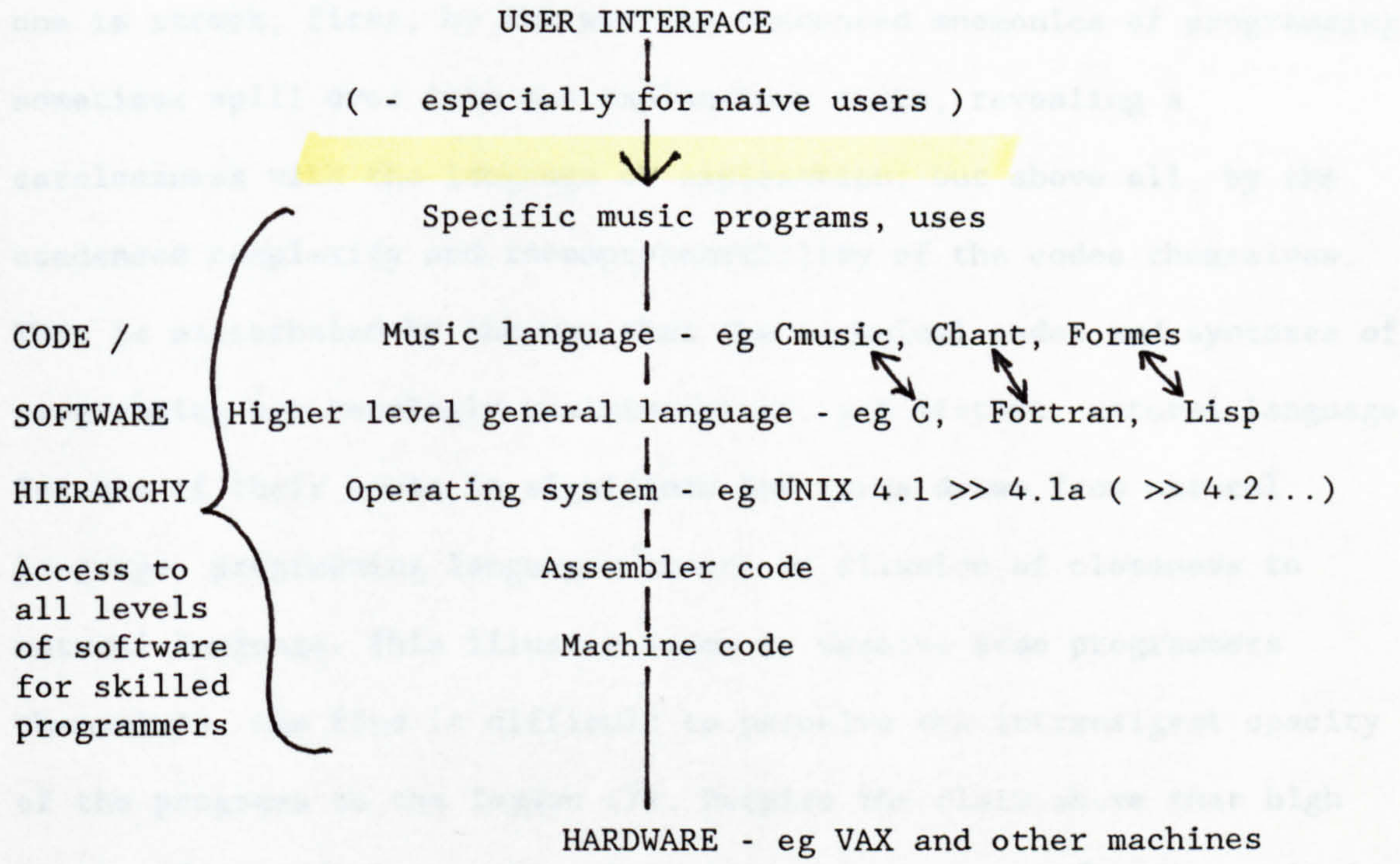
many thousands of lower level operations in assembler or machine code: thus extremely complex instructions can be encoded with economy. The rationale is also that, compared to assembler, they provide more conceptually meaningful forms of expression (6). The history of software development, then, has apparently been a search for increasingly technologically and conceptually economic and powerful languages for 'applications' or 'problem-oriented' software.

Computer music software such as that used and produced by IRCAM adds yet a further level of mediation, hierarchy and translation, since the main music languages are themselves based upon, or written in, established general languages. Thus, Music V is written in Fortran, Cmusic in C, IRCAM's Chant in Fortran, and Formes in Lisp. See Fig.7.1 for a crude outline of the hierarchy of encodings.

These are not passive levels of mediation, since in order to become a skilled user of Chant or Formes it is also necessary to be knowledgeable in Fortran or Lisp. For example, the IRCAM composer-squatter NP, in setting out to learn how to use Formes, first spent some months learning Lisp programming. The problems can be illustrated by the following diary note from a *stage* session one month in to the course, in which we were learning how to use Chant.

"We're working with the Chant Manual on 'user subroutines' - sections of the program amenable to user manipulation. WOW writes up a new kind of syntax on the board, and before we've written it down he rubs it out! Everyone gasps, laughs, looks baffled. "Leave it up till we've copied it down!" But WOW's moved on already. *Stageaire* VT protests: "But you've written it in Fortran! How can we learn how to use Fortran so quickly? It's impossible!" WOW explains that we need to use Fortran to use some Chant subroutines: this is the first we've heard. Comment: WOW baffles us by giving us too much to take in, a completely new language, and rubs it out before we've even taken it down, as though aware that it's impossible for us to learn this level of control" [St.N. 4.2.84].

Figure 7.1 Vertical mediation: an impression of the hierarchy of computer codes in IRCAM's computer music system



What is the character of the texts and codes involved in computer music? In the last chapter we saw examples of psychoacoustical texts and of the music vanguard's theoretical writing. Ills.7.1-4 are examples of introductory computer music texts from the *stage*. Looking at these texts one is struck, first, by the way the condensed mnemonics of programming sometimes spill over into the explanatory texts, revealing a carelessness with the language of explanation; but above all, by the condensed complexity and incomprehensibility of the codes themselves. This is exacerbated by the way that the technical codes and syntaxes of programming are teasingly reminiscent of, yet distort, natural language. Because of their basis in signifiers and terms drawn from natural language, programming languages create an illusion of closeness to natural language. This illusion seems to deceive some programmers themselves, who find it difficult to perceive the intransigent opacity of the programs to the layman (7). Despite the claim above that high level software deploys expressions appropriate to its functions, it is hard to see how these codes can be seen as appropriate forms of expression for musician users: rather, they necessitate lengthy apprenticeship into complex technical knowledge and codes with only extremely mediated relations to music. It is notable that the sceptical composer-programmer PL, working with small machines, decided to program not in higher level languages but in assembler. He did this, he said, because the programs ran faster and he could control them more directly and easily in assembler than mediated through higher languages; he found assembler just as amenable to expressing and encoding his musical needs.

Beneath computer music's surface textual complexity, then, lies a great density of lateral and vertical, conceptual and technical mediation. To use the patch languages and other computer music software

for even the simplest exercise requires knowledge of several domains. These enter directly into the description of the sound desired, or into the manipulation of parameters, such as simulated formants in Chant, that produce the sounds. And skilled use requires programming knowledge of the computer language underlying the music program. To produce sounds with a patch language, the user must build up complete acoustical and psychoacoustical descriptions from scratch, and then encode them into the language. The user writes a computer 'score' utilising a code with a very precise syntax, in which every tiny detail - spaces, commas - must be correct. The smallest error of code or syntax creates a 'bug' (logical error) and prevents synthesis taking place. The 'score' file contains two kinds of information: an 'orchestra of instruments', ie coded instructions corresponding to simulated analog sound generators or transformers (eg simulated oscillators or filters); and a list of 'events', ie code for a sequence of sound events to be produced by the generators. For each event, all basic parameters - starting time, duration, frequency, amplitude - must be specified, and each 'instrument' fully 'described'.

Let us look closely, as an example, at the simplest 'score' file given in the Cmusic teaching manual (Ill.7.5, pp.49-57 from 'CARL Start-up Kit'), introduced with the disarming disclaimer that "This example is so simple that it wouldn't even sound very good" (ibid:49). Example Ex3 on p.50 is that 'score' file, and it is used to introduce for the first time the exact code and syntax of Cmusic scores. It then takes a full 2 pages of text to explain the reasoning behind the coding, which involves first an overall protocol - lines 1 and 2 of the score being the program's way of opening any file; then the 'definition' of an

'instrument' according to the principles of electronic music patching (illustrated in Figure F1 on p.51). Ex4 on p.50 gives the precise syntax of the instrument definition, aspects of which have yet to be explained and are far from obvious ('increment', 'table', 'sum'). The coding of the instrument involves abstract terms such as 'b1' or 'p5' that correspond to different components: 'b1' the 'output block', or simulated monophonic patch line out, from the simulated oscillator; 'p5' the oscillator's amplitude, and so on. These codings depend on a prior conceptualisation of the electronic instrument patch to be simulated, as given in Figure F1 (p.51), which in turn depends on a prior understanding of electronic music patching. The instrument definition ends on Line 5 of the score; but while other minute elements of syntax are carefully explained (see p.54 paragraphs 2 and 3 on the functions of blank spaces and semicolons) the function of Lines 6 and 8 being completely empty are never explained.

Line 7 defines a so-called 'wavetable', the simulated oscillator that will produce the sound; however the explanation of this part of the score (paragraphs 4 and 5 of p.51) is extremely dense and unclear. To understand the heart of the explanation depends upon both sophisticated acoustical knowledge and a growing grasp of the program's logic:

"Gen5 creates a function table by reading triplets of numbers, H, A and P, from the gen statement following the function designator, where H is a harmonic number, A is a relative amplitude, and P is a phase offset angle. Any number of triplets may be given; the resulting function will be the sum of the specified harmonics at their respective amplitudes and phase angles... The length of the wavetable is equal to the default function length in Cmusic" (ibid:51).

The 'sense' of this explanation is far from self-evident; for example, that 'function', 'stored function', 'function table', 'wavetable', and 'lookup table' all "refer to the same thing" (ibid:51) is simply asserted without explanation of the looseness of the

definitions. The last paragraph of p.51 and top of p.52 explain Lines 12 to 19 of the score: the syntax and code of the actual sound events, or 'note list'. The explanation has a careless error: it says that the first note lasts 0.15 seconds, yet on the score it is actually set to last 0.10 seconds.

We can see, then, even in this attempt at a careful pedagogic explanation of this 'most simple score' a curious oscillation between extreme precision, looseness and imprecision in defining higher functions, absence of explanation, and even some faulty explanation. Faced with this kind of text, apprentices can become bewildered by the combined excesses of trivial technical information and the highly mediated nature of the medium. Thus, of an overall cohort of 12 on the stage with me, two dropped out within the first two weeks; while another stageaire confided, four weeks in, "I haven't understood anything for days!" (8). Also significant is the realistic view expressed confidentially by IRCAM tutors and junior tutors, mentioned earlier, that to begin to be truly skilled and 'at home' with IRCAM's technologies takes several years' full time application. They cited this figure in discussing the unlikelihood that visiting composers on three or six month visits could do interesting work, which must also throw doubt on the educational function of the six week stages.

There are several interrelated problematic effects - concerning opacity, instability, constant debugging and re-translation - of the complex character of mediations, and vertical hierarchy of codes, in computer music. I will outline them briefly; they return below in the substantive case that I describe. The problem of opacity seriously affects both skilled and naive software users. Skilled IRCAM programmers

complain that, looking back on programs they have written in collaboration with several others, the complexity of the codes makes it extremely difficult for them to reconstruct afterwards from the codes themselves exactly what was done in the bits of code authored by others, and why, without asking colleagues. Complex programs at IRCAM are often put together over a period of some months by several collaborators: a gradual, collective *'bricolage'*. The process is very far from being totally preconceived, and the programming solutions to problems and aims that arise in the course of development are tried out, altered, and kept or discarded often without any record being kept of the why and how. One tutor-programmer described his fantasy of a program as a sort of monstrous baroque or roccocco construction, made up of many fussy crustations added on to the main body, until the original body becomes almost indecipherable.

In other words, due to social and temporal mediation, programming code - despite its image of transparent logic - is far from 'open', self-evident and transparent to decode, even for the highly skilled writers themselves. Programmers seem to delight in this intransigent opacity since it makes programs appear artful and unstandardised expressions of collective imaginative labour.

For unskilled users, we have seen that it is impossible to intuit the implicit logic of the codes, so their use requires guidance and lengthy application. Even then, unlike skilled programmers, naive users learn to control and interact with only the surface level of the hierarchy of codes; so that if there is a 'bug' they are powerless to enter lower levels of the hierarchy to work out and correct what is wrong, just as they are relatively powerless to alter or improve the system as a whole as they might want. This problem lies behind the A.I.

aim to design 'interactive' systems that allow users to create 'custom built' software environments for themselves. However, this aim cannot escape the basic phenomenological character of software: even with an interactive program (as Chant), there are still layers of code underlying the program that a naive user has no skill to enter and modify. The technological and coded mediations are therefore far denser than for either traditional score and notation-based music, or analog electronic music (9). Fig.7.1 indicates the different relations described of naive and skilled users to the vertical mediations of the technology.

Other problems deriving from the dense vertical mediation of computer music relate to the chronic instability of the wider technological environment. Computer technology changes constantly and rapidly so that IRCAM's environment is very unstable, which causes a continuous process of adjustment to new variables. Each individual (especially infra-structural) technological change has repercussions within IRCAM's total technological configuration: with every significant change of hardware or software, all other levels of software have to be adjusted. For example, when the UNIX operating system software was upgraded from the extant version '4.1' to the new '4.1a' in 1984, all the programs in the house had to be re-written or re-translated according to the code for the new version. For this major task, two American consultants were brought in full time for several months; and one expressed the opinion, even while bringing in '4.1a', that in order to keep abreast of wider developments IRCAM should really already be investing in the next generation of UNIX, '4.2'. The re-translation of programs into '4.1a' - the re-writing of every part of higher code into

a new lower code - caused severe problems, as we will see. Each new translation raises the risk of new 'bugs' or logical errors of programming, which necessitates much work 'debugging' the system. Because of bugs, the IRCAM system became very fragile during this time and the VAX 'crashed' constantly, often many times a day.

But re-translation, and the risk of bugs and need for debugging that it causes, are not simply 'enforced' by the revision of external technological standards. They occur also due to voluntary experiments in bringing in new hardware and software, when researchers are tempted by new possibilities; and due to the desire to adapt their programs to run on new systems (for example, Chant and Formes were adapted in 1984 from the VAX to the 4X). So that researchers court the constant re-translation of programs for new contexts. Programmers say that each such process yields useful knowledge; but we will see that, due to opacity and IRCAM's related problem of lack of documentation, programming adaptations are often ad hoc and remain 'one-offs' rather than being fully analysed and documented for general use. The inherent vertical mediation of software, then, can induce a constant tinkering, a constant play of re-translation between codes, of re-adjustment to complex and challenging new circumstances by skilled programmers, the longer term productivity of which is questionable.

7.1.3 Objects and machines: fetishism, surveillance, discipline

With the aid of photographs, I now describe some of IRCAM's key objects, machines and physical features. Photo 7.1 shows the 4X prototype machine, with a protective red wax seal. The 4X itself is quite small, less than a meter tall. Its rather ordinary surface appearance - just a small steel box with some controls - belies the

7.1



7.2



7-3



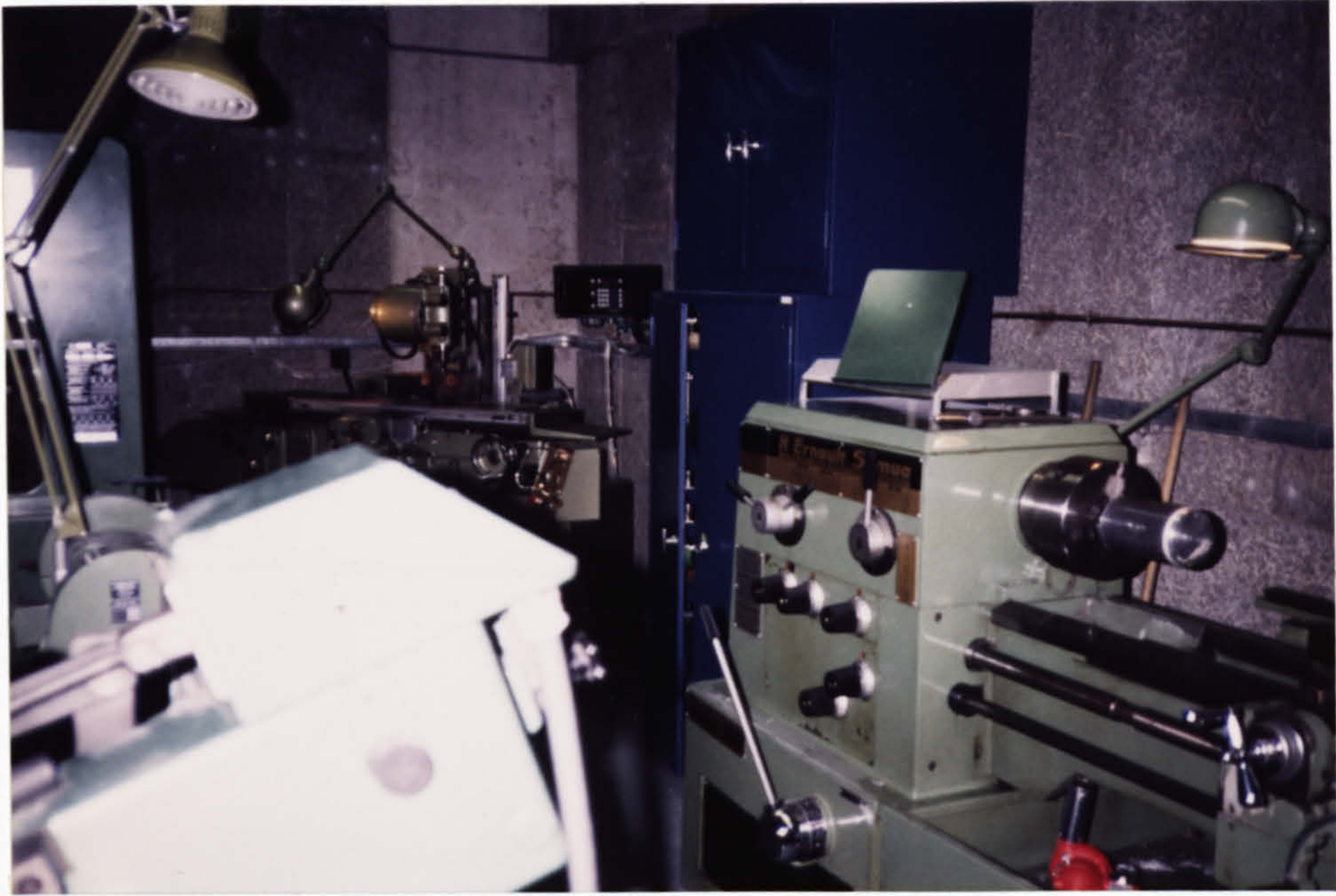
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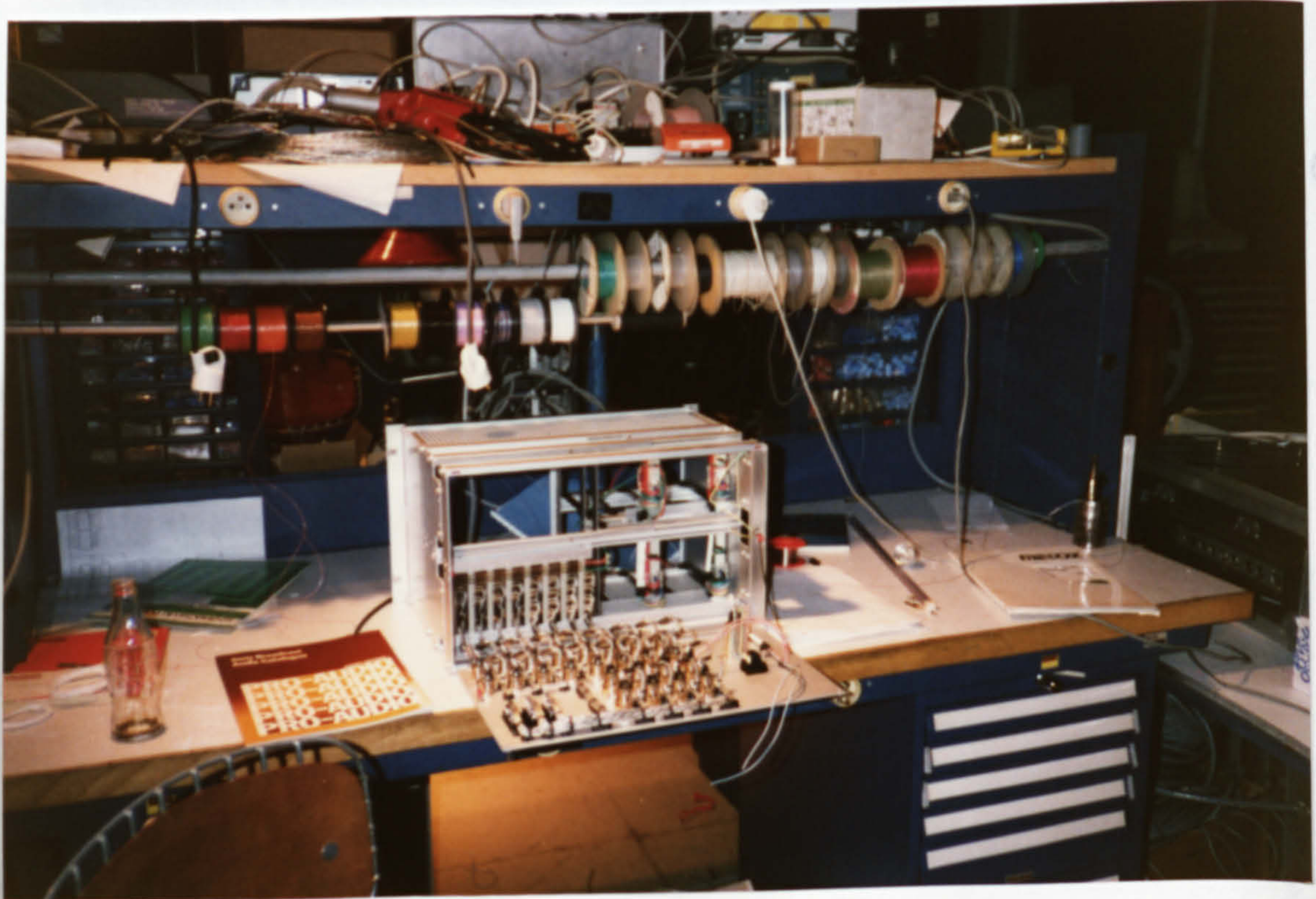


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intense interest in its inner workings. The story goes that when the Sogitec company, who were to industrialise the 4X, came to visit and see it, the designer BU refused to let them know the machine's secrets; so Sogitec had to build up their understanding of the machine from nothing. BU's reluctance may partly have derived from his dislike of the company. But the lack of help was also due to BU's refusal over the years to document the workings of the 4X: there were no written accounts of the technology. This, in turn, relates to an early IRCAM myth: Berio, who first brought BU to IRCAM and asked him to build what later became the 4X, had decreed that IRCAM should be an oral-aural culture, passing information from person to person, centred on sound. Paradoxically, what had started as an anarcho-utopian principle became, around the 4X, a preservation of secrecy encouraging a fetishism of the machine's mystery.

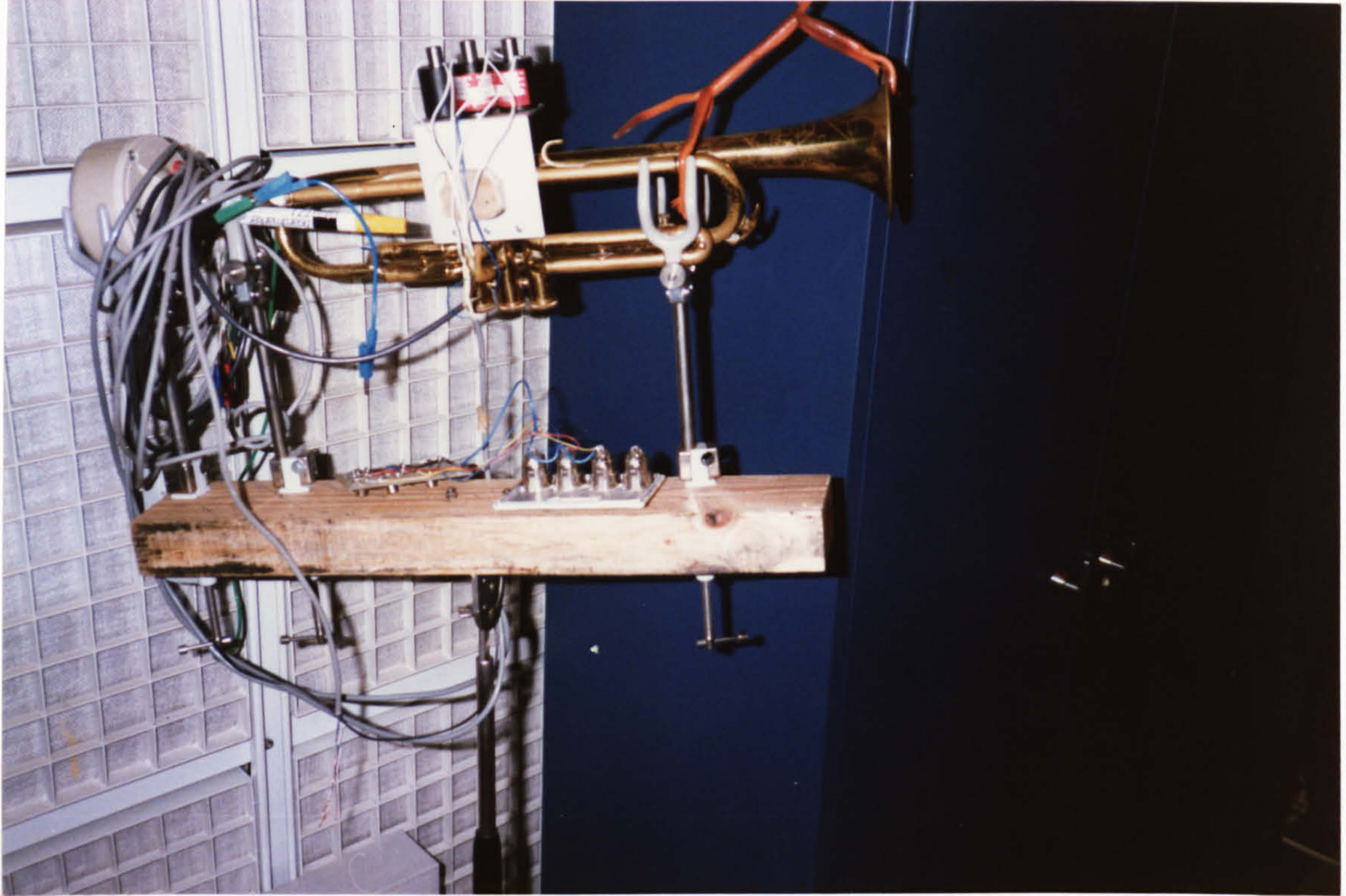
Photo 7.2 shows the 4X sitting next to its host computers in a small room dedicated to them, where the ventilation and temperature are closely controlled (as for all main computer rooms within IRCAM). Photo 7.3 shows the IRCAM lower corridor filled with the flight cases used to take the 4X and other computer and audio equipment on 'Repons' and other tours. A visiting Canadian computer music researcher, seeing the many well built and expensive flight cases strewn along the corridor, commented drily that with the money spent on them he could have kitted out an entire new computer music studio. That so much money was spent simply on protective casing for the 4X rather than on musically productive machinery was, to this man, indicative of its fetishisation and of IRCAM's irrational budgeting.

This links also to the proponent of manual and mechanical values

by the 4X Hardware directors, which are held to be embodied in these machines. These values, and a corresponding admiration for machinery, are held more widely in IRCAM, especially by technicians. Photos 7.4-5 show IRCAM's own mechanical workshop, kitted out with a full range of industrial metal and wood lathes, sited in the bowels of the institute. The workshop is manned by YR, known as the in-house wizard craftsman-mechanic who can build any physical object (10). Photos 7.6-8 show the electronic technicians' labs: an area strewn with physical tools, cable, wiring, in which they repair and build equipment. Against these manual/mechanical aspects of IRCAM culture, in which objects are held to physically embody mechanical values, as we saw in the last chapter the software and programming dimensions of IRCAM culture are denigrated for having no such physical embodiment, no visible, object form, and so for being insubstantial and ephemeral. The discursive conflict between hardware and software is thus played out at a phenomenological level: the phenomenal form of hardware bestowing an objectified legitimation.

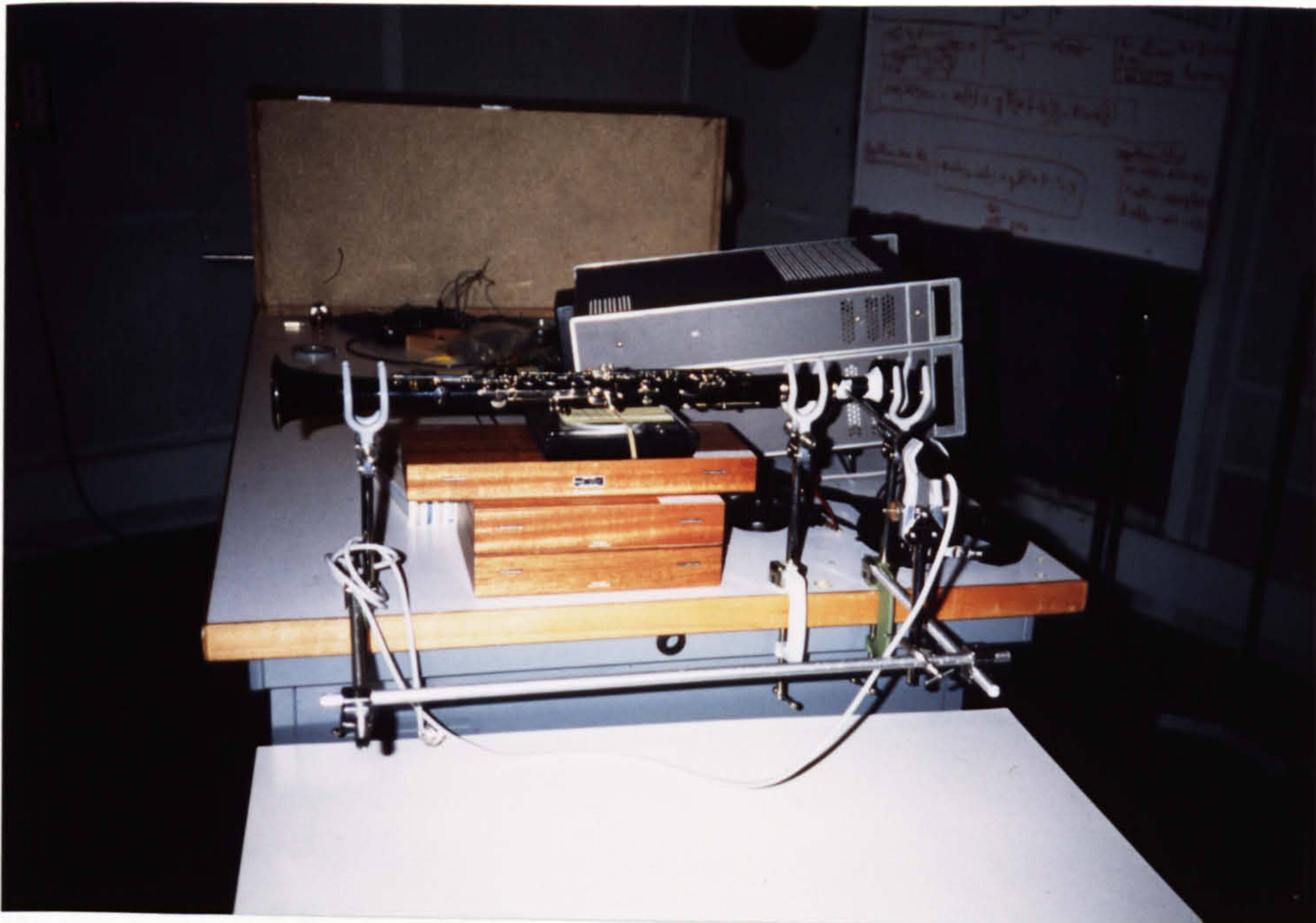
Photos 7.9-10 show two ordinary acoustic instruments - a trumpet and a clarinet - bound up in electronic wiring for acoustical experimentation. The clarinet was one of several currently being measured as part of research in an Acoustics studio; while the trumpet was long since experimentally obsolete and stood around in a studio, a pet object of delight and a butt of jokes. The story was that the trumpet had been elaborately wired to measure the acoustics of trumpets, but that the set up had not worked, so that it was a pathetic reminder of experimental failure. The instruments, trussed up in wires for measurement, pierced by intrusive electrodes and electronically monitored, the trumpet sacrificed to failed experiment, represent a kind of torturous binding of the musical body, an attempt to capture and so

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7.12



rationalise their complex, organic aural workings (11).

Photo 7.13 shows a studio containing one of the suspended loudspeakers that forms part of the interconnected speaker system throughout the house; while Photos 7.14-16 show different views, from inside out and outside in, of the rows of glass-walled offices. These features embody the IRCAM principle of aural and visual openness. Thus, anyone can hear sounds being made using the main system over the interconnected speakers; and anyone can look into the studios and see what is going on. But this 'democracy of information' is also experienced ambivalently by workers as a form of constant surveillance (12). So they close off the speaker system, work at night to avoid others hearing their sounds over the speakers; they put up posters, and move cupboards in front of the glass walls to block them and prevent people from looking in. This tension between openness and privacy returns below.

Finally, Photos 7.11-12 illustrate the physical objects used most continuously for all IRCAM intellectual work: the computer terminal, consisting of a keyboard and VDU screen linked up to the VAX or 4X systems. The objects are designed for solitary work, the user engaging with the machine by tapping into the keyboard and gazing into the screen. This work, then, involves no aural stimuli, a very reduced and unspecialised gestural control (compared for example with musical instrument playing), and only the impoverished visual stimuli of the VDU. If we compare working long hours in this way to previous ways of producing music, it comes close in terms of sensory deprivation only to the act of composing simply with a pen and paper. Also striking is the chronic isolation of the long hours of computer work necessitated by

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learning and using the complex mediations of computer music.

Workers maintain their actual isolation while indulging in the computer's enjoyable form of pseudo sociability, its substitute for direct human contact: computer mail. All workers, when they first 'log on' to the VAX in the day, read the computer mail or messages that have been stored for them. Messages come from workers at other institutions to which IRCAM is linked by national and international computer networks, and throughout the day from individuals within the house; they can interrupt one's work in progress by suddenly appearing on the VDU screen. Mail is either purely informational, or more commonly also fun; the language is often colloquial, the tone joking, teasing, and between the sexes flirtatious. Fig.7.2 shows six examples of computer mail sent and received by me (13). There are also ritual communications shared by all members of the VAX 'community': system messages sent out every morning by the Systems manager, informational and often joking (see Figs.8.1-8.3 below). Having logged on to the VAX, users deploy a command that lists all the people currently logged on to the system, and where they are located - at which IRCAM terminal. These forms of computer-mediated sociality become substitutes for direct contact: a worker can go in to the house, log on to the system and work at his terminal all day, he can exchange computer mail with someone in the house and know exactly who is there and what they are doing, and yet never physically meet another person. In summary, then, terminal work involves extreme physical, sensory and social discipline, balanced only by its cerebral challenge and its capacity for distanced and simulated sociality.

But workers have other ways to combat the isolation and 'socialize' the technology: the work culture involves much informal, spontaneous and short lived oral consultation, and longer term collaboration. Three such

From born Mon Jul 9 15:38:51 1984
To: born
Subject: etre ou ne pas etre

Je serai a l'IRCAM du Lundi 30 Juillet au vendredi 3 Aout,
ensuite je pars au USA jusqu'au Lundi 20 Aout.

Voila voila [pie]

From gel Wed May 2 03:30:46 1984
To: born
Subject: the shit

the shit finally started happening about 1:30 am, my time to smoke, as usual
once you realize how simple these things should be, especially when complex
isn't time-effective, you could stay up forever.

Yours truly,
Nervous Nellie

From born Mon Apr 30 15:15:09 1984
To:
Subject: wilder; and 'real' help needed...

OK: 1) you spell 'leasure' 'leisure': don't forget your language just cause
of the darned machine;
2) sure, chocolate drops: but (the doctor speaks) you seem to have some
association of love and violenza as a reccurrent association...
3) help! If we're going to continue this passionate terminal exchange, then
could you please tell me how to delete old mail?!!! Chronically yours,
Margaret Mead.

From born Wed May 2 11:12:19 1984
To:
Subject: reply to your memo... (!)

well, I never thanked you for all this help, and never replied to the
point re not letting you give help I don't need: point well made and
interiorised by me. Yes I'll convert the O's to O's* how dumb of me...
What a horrible day out there. Computer culture gets much brighter when
life 'out there' is ghastly and wet, dontcha think? I could sit here
merrily tapping and receiving mail all day!!!

From born Wed Jun 27 12:27:54 1984
To:
Subject: anthropologie... au sujet d'un entrevue

Cher
est ce que nous pourrions rencontrer pour faire un entrevue quelque
fois dans la prochaine semaine, si vous avez le temps? Je suis tres
libre, alors si vous pouvez envoyer moi 'mail' pour dire quand vous
avez du temps. ca sera tres gentil. On va prendre 1 ou 2 heures, au
sujet du role de tuteur, etc.
many thanks,
Georgie Born.

From born Tue May 1 20:17:58 1984
To:
Subject: your score...

is tout pret and exists in my file 'NY.sci'. Looking forward to the check out,
and see you tomorrow. Message re NY flight passed on to George... Adio, GB.

social, collaborative moments are shown in Photos 7.17-20: the first (17) a spontaneous group in the Systems team room, with three men - two IRCAM staff, and a visiting American researcher - looking at a problem together with some enjoyment; the second (18) a group of hardware technicians and researchers examining a piece of hardware together; the third (19, 20) from a longer term music research collaboration between IRCAM psychoacoustician HM and composer-squatter NP. These two would meet and work alongside one another every few days for some hours at a time, HM bringing greater scientific and programming skills, NP posing problems arising from her compositional work.

7.2 A music production visit

I will describe the composer AV's production visit in order to convey the social and technological relations of music production at IRCAM. It cannot be considered a 'typical' visit, since it was dogged by many problems. Yet there is no 'typical' composer's visit to IRCAM, and each involves specific computer music 'solutions' to unique compositional aims. AV's experience nonetheless illustrates some of the characteristic features and problems of music production at IRCAM.

7.2.1 High aims, abortive result

AV's 3 month visit to IRCAM in 1984 was his third. He had taken the IRCAM stage in 1980, and had made a 'research' visit of 2 months in 1982, to learn the technology and prepare for his later production visit. AV is a young composer based in Britain. He was well liked within IRCAM following the stage in which, it was thought, he showed an aptitude for computer music. AV trained in two electronic studios in London, in one of which he had worked extensively with the Fairlight

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digital synthesiser. Most important for IRCAM management, AV had recently won first prize in the major European electronic music competition at Bourges. AV was thus highly regarded as a promising young composer who already had some knowledge of computer music. For all concerned, this was to be an ambitious project.

During his 1982 visit, AV had worked with Chant on the PDP10. After 2 months he had produced one minute of music based on timbral transitions between a simulated voice and chinese oboe. The 1984 visit was supposed to extend this work with more powerful technological means so as to allow a far longer piece to be made along the same lines, exploring timbral transitions as themselves carriers of form: creating a syntax of timbral changes. This was an attempt to put into practice the research of AV's friend the psychoacoustician HM, whose ideas were illustrated above. AV described the aim thus:

AV: "I wanted to work with recognisable timbral identities modelled on known sounds - voice, gongs, oboes or whatever - not necessarily to keep them identical to the original 'real thing', but modelled on the behaviour of those instruments. Because I believe that it's the particular behaviour in time of those instruments that conveys eighty per cent of the identity of the sound. So I wanted to model this type of behaviour and then interpolate between these different types of behaviour. In other words, to go from one type of behaviour to the other and find if possible, in this going from one type of timbre, or identity, to the next, some kind of syntax: some way of going, of evolving in time, which would belong inherently in the process, which would be a syntax developed from the way of going itself, not just borrowed from another type of music where the syntax is related to a different process.

For example, the musical syntax of polyphony is related to the way that the voices interact with each other, and each note is a self-contained timbre. But if you're working with timbres that are continually changing in time, then obviously the syntax has to be related to that process inside the note, as it were. I wanted to work and experiment with those changes to see if it was possible to extract some common rules - maybe 'rules' is too intellectual a statement - some common type of behaviour that could somehow be generalised. For example, the way you go from tonic to dominant in tonal music: there are different ways of doing it, but each way of going from A to B, one tonality to another, is done through some syntax, a harmonic process. So my linear conclusion, derived from that, is that any other way of going

from A to B could have its own syntax which would make it much more coherent and much stronger, convey it in a much more convincing way. For the reason that if tonal music works that way, then I assume that it has to do with the way we perceive things; we want to perceive things - processes - and ways of going from A to B in a way that the language itself is also related to the process, is the process. Therefore I didn't just want to have timbre A and timbre B, and just play a succession of transformations; I wanted to see if there was any way of creating a structure, a syntax, taken from the wave behaviour".

We see here again the search for a 'language' unifying material and form: a syntax derived from the 'wave behaviour' of timbres. But for various reasons, the 1984 production visit was a frustrating failure and produced only abortive results: after 3 months' work, rather than a full commission AV had produced only 72 seconds of sound. (The 72 seconds are given on Tape 1).

Because of his aim of making a piece consisting of timbral transitions, AV's project was extremely demanding of computer resources. In many synthesis based pieces, each discreet timbre or small section can be digitally produced and then transferred on to analog tape to be gradually built up into the overall piece. But working with continuous mutations of timbre is a far more demanding task for digital synthesis. The synthesised timbres must first themselves be sufficiently complex and organic, already demanding of computing power; and as well as this, the computer must be able to produce time sections of the piece long enough - perhaps of several minutes - to convincingly convey the gradual, continuous timbral changes. The amount of computing power and memory required to sustain such long and complex synthesis files is enormous, and the synthesis time can also therefore be lengthy. Every time the composer wants to alter something and re-synthesise can take a great deal of time. So the technical aim of the production was to provide AV with a less lengthy, closer to realtime working environment. At the end of his 1984 visit, bitter about its failure, AV recalled the

early intentions and development of the visit as follows.

AV: "When I did the research period last time I was here, in 1982, I worked on the PDP10... It was clear then that I could not produce an entire piece on that system, because after 2 months I came up with only 1 minute of sound that was really together... That was alright because the aim was only to produce examples of what I would do afterwards in a piece. But it was clear..that there's no way that Chant could produce on the '10 or any (such) system a large scale piece with enough feedback to modify things as you're doing them. I mean, we had some very lengthy experiences with files running for one, two, or even two and a half days just to turn out a minute and a half of sound that was eventually wrong anyway!... If you're going to wait, say, 10 hours to hear 1 minute of sound - which was by no means strange with the '10..."

Q: "Well, even this morning NP took 2 hours to get 10 seconds of sound through with Chant and Formes on the VAX..."

AV: "Yes! It's still the same, the VAX is no faster than the '10.. even with the Array Processor (14). So it was clear that it would have to be a realtime job, if I was going to work with that kind of heavy calculation and control and be able to change things quickly enough to make something really articulate.. In realtime systems, the 4X was the new thing around, so I was to be asked back when the 4X was running. So I waited till the 4X was installed and running. And then reports started coming back to London that in fact the 4X wasn't as magical, or as realtime, as everybody thought!.. There wasn't a very clear picture of what could be done."

Q: "You say you couldn't work with Chant running on the '10 or the VAX and get enough control, but then how did WOW do 'Chreode I' with Chant on the VAX, non realtime, and get such good results (also of timbral transition)?"

AV: "Well, but it took him a year and a half, working in the house all the time! Which is the ideal situation.. If you live here, you run a job, like on the '10, and it runs for 2 hours or a whole day, and it's ideal: (with irony) you go to your meetings, come back and it's still there, so you go to a second meeting!!... So finally, before coming, I said let's have a meeting to decide what I need and can use. So I came over for a week: and we had a meeting, with MC, RIG, all the people concerned - except the Systems people, which I realise was a shame, because now I see they're the only people objective enough about how the load of the system works. They could maybe have said that certain things wouldn't work: like the problem of the fast link, they may have said 'we've got a link but we don't know if it'll hold up in such a demanding situation'.

There was a lot of pressure from the (IRCAM) environment of this kind: (cynically) 'We (IRCAM) cannot afford another (commission) failure.. because it would mean to the world that our all-mighty, all-powerful doomsday machine, the 4X, is not able to do the jobs we thought it was able to do!' And so they wanted to give it a go, anyway. They were very optimistic and prepared to work very very hard.. But they were over optimistic... They gave me a demonstration of the 4X with Chant when I was here, and I wasn't pleased with it. It's system of filters is a bit like the Vocoder, not so flexible.. I said, 'Why don't we wait till the Array Processor is ready' (which it only is just recently) 'and I could use my old Chant instruments and programs with it?' But they

said: 'Look, there's another possibility: we'll have Formes on the VAX, with a set-up almost identical to what you had before on Chant. And that could be transferred into data for additive synthesis instruments; and we could have the 4X patched as an additive synthesis instrument, taking this data from the VAX. And at the composer's level you'd be dealing with a file system and an operating system that would look almost the same as Chant, and you would be putting in information with the same criteria as Chant. So it would be like working with Chant on the '10, more-or-less.

So the idea was that MC and other people that know Formes inside out would write very quickly, theoretically, a program just like Formes - which is very flexible - in the VAX, and that data would be transferred by another program - that I would never have to deal with - into additive synthesis data for the 4X, which would have a configuration inside - which is what HM wrote, a patch - to behave like an additive synthesis instrument. MC and XH were writing, when I came, the 'Roc' program and the new Formes program. Roc runs on the PDP11, takes the data from the disk, gives the data from the VAX to the 4X: shoves that data into the 4X in realtime, and the 4X plays it. But there's another Roc program before that transfer, in the VAX, that changes the data from Formes into additive synthesis form."

Q: "Who thought this system up?"

AV: "RIG, and he was overly optimistic; but he made some general arguments. There was the need for an additive synthesis machine: there was no system that would allow quick and efficient and powerful additive synthesis, so it would be useful generally. It could be developed for my piece, but it wouldn't just be for my piece.. The scale was rather gigantic, not the kind of thing you want to get into just for one piece; the amount of work and number of people involved were out of scale for one piece! But (the idea was) it would stay as a general instrument to be used by other people, *stageaires* and so on. So they said, 'Let's do it anyway!' I was cautious. I said 'OK, as long as at the end of the day if I say it's not working we cancel the concert, and you bring me back to IRCAM when the Array Processor or a more suitable environment is working'. They agreed, so when things started to go wrong I thought, well, I'll come back another time, but I'll experiment this time... I don't want the same things to happen again: next time everything will have to be working before I get here, because next time (fed up) a piece has to be produced!"

7.2.2 The work process: time, collaboration, tutoring

The above quotation also illuminates two central dimensions of the work process: time, and collaboration between the composer and tutors.

The time involved in AV's production can be divided into macro and micro aspects. At the macro level, we have seen that in 3 months' work, with the part time help of three tutors, he produced just 72 seconds of music. This represents, very crudely, an overall production ratio in the

region of 54,000:1; ie it took some 54,000 seconds' labour to produce one second of sound, or c.900 hours to produce one minute of sound (15). Functionally, the time was divided between bouts of software writing by the tutors, and then AV's use of the system and feedback on problems and improvements that he needed. Because of the technical ambition of the project, much production time was taken up by writing, re-writing and de-bugging programs (16).

At the micro level of daily working, there are revealing discrepancies between AV's and HM's accounts of the turnaround time. HM told me that AV was getting a 30:1 ratio, ie that it took 30 minutes to synthesise one minute of sound, and he contrasted that with the 'bad old days' of computer music a few years back in which ratios of 300:1 were, he said, common. But it is clear from AV's earlier quote that he actually experienced far worse ratios. In his previous visit he talked of ratios of some 900:1 (1 day for 1.5 minutes of sound) or 600:1 (10 hours for 1 minute); while for this visit he described a ratio of 180:1 as common (3 hours for 1 minute). In the quote I interrupted him to mention NP's experience of waiting 2 hours for 10 seconds of synthesised sound: a ratio of 720:1. Thus the delay involved in complex synthesis in 1984 was clearly still lengthy and very far from realtime. This was so even deploying the 4X, and so contradicting the aims of that machine, and even with the use of IRCAM's three other main pieces of hardware: the VAX, PDP11 and new Array Processor. However, it is striking that in-house researchers and tutors such as HM experienced that time as far shorter than visiting composers - in fact, a distorted perception.

AV's project tapped the utopian spirit of the musicians group in several ways: in its technical and musical ambition, based upon the

latest psychoacoustical ideas; in its aim of being not individualist but of use to the whole music research 'community'; and in those ideals being embodied in collaborative, supra-individual practices. We saw earlier (Ch.6) that collaboration between composers and researchers to advance music research is in itself a central principle of the musicians vanguard. For AV's project there were three tutors involved, none of them actually employed as such: MC, HM, and XH (17). Here is AV's grateful account of his fruitful collaboration with MC; as he admits, MC was responsible for designing the overall 'architecture' of his work environment.

AV: "MC and XH were writing the other bits of software (apart from HM): basically MC did most of the Formes stuff, and XH's job originally was to write the conversion from Formes to the 4X, into additive synthesis; and once he did that, he was also involved in re-writing some of the stuff that MC wrote in Lisp into C to make it faster, because it was very slow at the start. Let's say the architecture and the conception of it was produced by MC... (The first month) I wasn't working all that much. I was just following MC's development and would say: 'That particular function I would like to be able to control in this way', and he would say 'I think it's working' and I would go and try it, and I'd say 'It's not doing it, or it's doing it but crashing, or it's doing it in a bizarre way' or whatever. So he'd say: 'OK, let's see what the problem is' and he'd get deep into the system and would try to debug it; and I would sit next to him watching him debugging it, and eventually learn what was happening inside the system as well, what the system was all about.

So from the actual point of view of writing software, I had nothing to do with it except to say 'I would like certain parameters and I would like to control them this way, to give data to modify this' and so on: specific musical needs, put precisely as technically as possible. That's the good thing about MC: if it's possible he will find a way of doing things. He's always very receptive. If you can put forward to him a problem in.. maybe not one hundred percent scientific way, but if you can clearly define the environment, the parameters involved, how you want to control them, and what you want them to do, he will do it, he can realise what you want. He'll say: 'Are you sure, do you really want that much control? That'll be really heavy, it's a helluva lot of work!'. And you say 'Yes, I need it for that and that reason', and he'll say 'OK, well, that's a composer's decision, then you must have a good reason' and he'll go and do it and be excited about solving that problem".

The work done by AV's three tutors was, then, programming: writing new programs that built an entirely new configuration of IRCAM soft and

hardware in order to achieve new realtime power. It was in fact the first attempt to unite Chant and Formes running on the VAX, via various links, with the 4X. The system and its development, involving close coordination between the three programmers, is described here by HM.

HM: "I did the additive synthesis instrument for the 4X... You have to juggle around with these realtime things, because of the limited resources. (AV) had to think what he wanted musically. For example, we started out with 42 partials, with amplitude and frequency control on each one. The reason it was limited to that was because AV wanted everything at 32K sampling rate, and a very rapid uptake... It turns out you can run the logic unit things which control the ramps at 16K and still be running your oscillators at 32K. So we turned out to have much more resources, and so we ended up getting an 84 partial version going.

The new thing was driving additive synthesis on the 4X from the 'Roc' program hooked up to Formes: the combination of Formes and the 4X. Formes makes a file (on the VAX), you transfer the file to the PDP11; you feed it to Roc, who feeds it to the 4X. MC wrote the Roc program. Roc is just a coal shoveller: doesn't do anything intelligent at all, just shoves information into the 4X... XH wrote the thing that prepared stuff for Roc in Formes.. (it) translated all that into Roc format; and then MC actually built the environment in Formes for AV. Right at the start I had to make the 4X additive synth instrument - a patch, because all the rest of the stuff had to depend on what the 4X had to receive, what its limits were. So I made this patch in the 4X; and so then you just load the patch into the 4X, and then the Roc file says: 'At a certain time, I shove these values into these registers'. So this (Roc) program has to know beforehand what the registers are (on the 4X). So there was really close coordination between me and XH, XH writing the Formes to Roc file translator and me writing the instrument, because that had to be sure to get frequencies in the right registers, amplitudes in the right registers and all that...

What MC did is he came up with some routines that allow you to describe things in the same language as Chant, where you describe spectral forms that evolve in time, but then you can add other things like how many partials you want and so on. So it just took those spectral forms that it derived from the Chant algorithms and then applied them to partials in an additive synthesis instrument. So there's a translation from the formant shapes (of Chant) into a spectral envelope which can move in time... that translates into amplitude movement in time. So AV could use his knowledge of using Chant before and yet still be doing it in an additive synthesis fashion. He also then had the control you can get over the imaging process with additive synth which you can't get in Chant. You've got discreet control over each partial. So then you've got this kind of global control from Chant, and then you go in and further modify, say, these partials: in addition to what they're doing in a general fashion, you have them behaving locally differently from the others".

Fig.7.3 outlines the rather baroque configuration, involving several new links and versions, that HM describes. The point was to

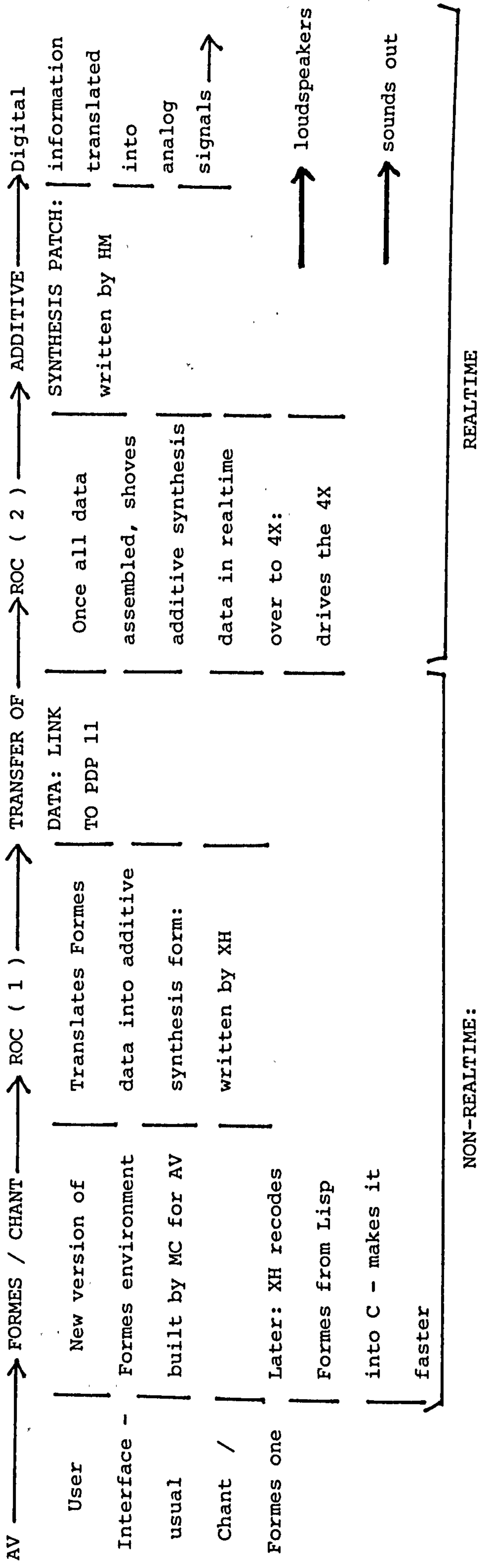
FIGURE 7.3 AV's PROJECT: TECHNOLOGICAL CONFIGURATION AND MAIN CONTRIBUTIONS OF TUTORS

V A X

P D P 1 1

4 X

D A C ' s



allow AV to use the same Chant and Formes 'interfaces' that he had used before and knew musically how to control; but by linking them up to the 4X, to have them more realtime, and by having them 'drive' an additive synthesis patch on the 4X, to have greater detailed control over each component partial than was possible with Chant.

7.2.3 Musical programming and problem-solving

The quotation also touches on the character of debates that occurred during the work process: the musical 'needs' posed by AV for his tutors to find solutions to. HM mentions one of the first issues: AV wanted to have as large a number of partials as possible, so as to be able to produce really complex and organic timbres. They started with only 42, but some weeks in discovered a way to let him control 84 partials at any one time. Another question was the amount and quality of organicity. AV discussed these issues as follows.

AV: "HM's instrument was something to be discussed. It depended on certain choices that I had to make, and the limitations of the 4X: whether I wanted maximum oscillators - 84, a lot more oscillators with much less control, or 42 oscillators with more control.. Or what kind of global control I wanted. And then, of course, noise; and then I wanted the instrument smaller to give me another function. HM worked on the preliminary version that was only 42 oscillators, that was the biggest we thought you could get with great control; but then someone suggested a way of doing it bigger, so then he had to do it all over again. Because of that the program that was doing the conversion from Formes to the 4X patch also had to be changed - and every time you change something there's a bug, which takes time. So there were several stages. So I started with 42 and ended up with 84 partials, with added noise".

Other key issues during the production process concerned the quality of attack - the very beginning of the sound, and a crucial timbral variable - that AV could get with the software. This related in turn to two technological variables: first, the 'quantum' of the synthesis program, ie the time between each update of information. The shorter this time, the finer the 'grain' of the material and control,

and the more demanding of computing power. This was set at 30 milliseconds, which was, apparently, quite slow. The second variable was the transition time between two notes, depending on a sub-program called 'TTR' (*temps de transition*). The slowness and quality of the quanta and TTR were unsatisfactory to AV since he believed they produced sluggish attacks, which in turn affects the brilliance of the timbres as a whole.

The following notes from my diary covering two days of the production convey the character of the work in progress half way through AV's visit.

"16.4.84, 5 pm: AV and XH on 4X in studio 3. WR (another tutor) comes in to advise them of his inharmonics program. Question is: how to work with inharmonics. AV wants to be able to specify inharmonic partials both at the bottom and top of the sound, not all clustered at the top end. WR suggests: "I have a code in Cmusic where you specify three variables: the fundamental frequency; the 'distance' between partials; the subdivisions of the octave. For example, to get a series of inharmonic partials all a minor third apart you'd put in: 100 Hz (fundamental), 3 (ie 3 semitones apart), and 12 (ie semitones or divisions of 1/12th of the basic octave space). You can also do it with non-octave space, then you need a fourth variable". AV and XH discuss how to rework WR's program in Lisp for the 4X; and how to make more disk space to allow this. AV goes out to get a sandwich: "It's breakfast time for me!" He was up last night till 7.30am working. XH and I stay, XH programming. XH: "I'm working on getting more partials out of the 4X for each sound: previously we could get only 42 partials, now we can hopefully get 84. Also, I'm trying to get each to have a noise surround.. But either the machine crashes, or nothing happens at all! - another form of death!" XH manages after an hour to get a complex noise around his partial: one oscillator to try it out, then to be applied to many oscillators or partials. We hear it, and alter the degree of noise. Then we have to leave the studio at 6 pm, for WR's turn with the 4X.

17.4.84, 4.30 pm: AV, XH and WR in 4X studio 3. WR: "Roc causes the PDP11 to crash more. Have you noticed how the '11 is crashing more often these days?" AV and XH laugh knowingly and say: "Yes, as we told you!" AV teaches WR about the 'TTR' sub-program: it controls the transition between two notes; AV and XH have used it in AV's sounds. WR calls in BYV (4X Software director and Boulez's tutor) to sort out a problem with the DAC's, which are producing a chord (a tritone of course! (18) as the test tone rather than the correct single tone. After 10 minutes BYV has sorted it out; he and WR leave. AV asks XH if he can speed up a process running as a sound file. XH, annoyed, snaps back: "I'm not a computer scientist!.."

AV and XH equalise the mixer and arrange the patch board linking it to the 4X to hear the sound out: 84 oscillators, 16 audio channels at 6 per channel.

AV jokes ironically about how computer music is the highest state of human experience because one has just to engage with and enjoy the actual process of work, rather than it being about the end result of a piece: renouncing the gratification of a result.

We chat about the music research meeting yesterday in which Boulez stressed the need for research to be directly tied into production and musical results, to which AV says unhappily: "Well Boulez should come in here and try producing a piece and see how long it takes him to get good results! If only..."

AV and XH spend c.1 hour tracing a strange problem. The amplitude meters on a couple of channels in the mixer show a fluctuation: the needles are waving around at us wildly but regularly when no sound is emitted. Why? They try to trace it. A phasing problem? Or because of the noise they've put on each oscillator? They get it better, try to isolate the problem. It changes each time we try something. It seems to be caused by the noise, because empirically it gets better when they get rid of the noise effect: though they cannot understand why this happens.

6.30 pm: MC comes in. He and AV immediately discuss a problem with how the TTR transition seems to affect the attack on each note following it: does it affect the following envelope? AV is unhappy with the current state of the program and asks MC how they could achieve a more variable start to the envelope. So he draws on paper what he'd like to be able to get, and MC tells him how he can already. AV complains that he can't get a powerful sharp attack now, except on the first note of a phrase. MC thinks and comes up with a way; but they leave it agreeing that the current possibility is too slow for a sharp attack.

AV and XH discuss and work on the idea of a transition (frequency-wise) from an inharmonic spectrum (eg with each partial a minor 2nd apart) to a harmonic spectrum.

AV keeps posing the questions to XH and MC from his compositional desires: "How do I get this?", "What if I wanted to get a transition, a sharper or more variable attack?"

AV leaves for half an hour; XH and MC discuss possible variables in the recursivity of the noise program and negotiate programming possibilities. Here, XH poses the problems and MC answers with what's 'easy' or 'not possible to do'."

AV's work schedule involved him coming in every day for about 10 hours. He was given 6 timetabled hours a day with the 4X during which he could actually try to hear the sounds; this was usually at night, either 6pm to midnight or midnight to 6am. In these night periods he sat alone (or with my company) in the 4X studio 3 at a terminal, using the Chant/Formes interface to rewrite his files, for many hours at a time, as shown in Photos 7.21-24. When the files were rewritten with new variables, he would 'launch' the program, thereby setting the synthesis

7-21



457

7-22



457

7-23



5-7

7-24



5-7

program in motion to produce its millions of samples. Due to the length and complexity of his files, the sound samples would be ready some hours later, at which time he could hear what he had done, re-modify the files again, and start all over.

"In a day I could try out about 3 or 4 changes at the most. That means that you really have to work out everything in your head beforehand, get your data theoretically right; and not expect to get feedback from sound itself, but do it preconceived from theory - which is not the right way of doing things.. I prefer the realtime aural environment, much more empirical, flexible, where you can try things, re-try and re-try as with the Fairlight: that's still not possible here".

During the day, AV would spend a few more hours at the VAX terminal preparing his night's work. He could not launch his files during the day, and had to work at night, because his files were so big and demanding on the system, including the VAX, that they overloaded it in the day causing it to 'crash'. This was seen as anti-social to the community as a whole. So he could only work when no one else was running programs on the system. AV drew criticisms for his megalomaniac files, which he defended as follows:

Q: "People say: 'Oh AV, he just writes these outrageous files, too complex and long'..."

AV: "Well I've stated clearly, if I was doing a piece that is about notes, then obviously I wouldn't have that problem. I'd just do short runs of two, three, ten seconds and then edit them together using analog facilities: I wouldn't waste time with computers! But since the whole point of my project, the reason why I'm here and commissioned, is to do something that has to do with evolution of timbral identities in time, and the perception of those identities in time, then we're talking about the evolution of continuous sounds, and therefore I have to work with long stretches of sound. So that's what the piece is all about! There's no point in saying 'Don't do what we brought you here to do, what we're paying you for - to make long files!!'".

The main work, then, was sitting at a terminal for many hours re-writing files, and then waiting while the hardware churned out the sound samples. Only a very small proportion of the working time involved hearing back the sounds. During the long hours' waits AV would work on

other musical dimensions, for example the harmonic score of his piece, which flowed in and out of polyphonal harmonicity; and he would amuse himself, when frustrated, by asking me to play piano for him. The quality of AV's experience, and his frustration, can be gauged by computer mail messages that he sent to me during the visit, shown in Fig.7.4. These messages convey, with witty desparation, his frustration with the recalcitrant slowness and unmusicality of the system (19). The technology comes across as almost a wilful adversary (20).

7.3 Local conceptual and technological problems: noise, and the absence of 'rational' technological equivalence

I discuss next chapter the larger technological problems that were ultimately responsible for AV producing only 72 seconds of sound. But first, I outline the finer conceptual and aural problems that point to the limits of the technological system that he worked with. The most significant was that concerning the simulated noise that was supposed to enrich the timbres and make them more organic-sounding. AV found the noise provided by the complex additive synthesis set up inferior and cruder to that which had been possible on previous visits using Chant. He expressed it thus at the end of the visit:

AV: "From the very beginning, we knew that I needed noise, because my preliminary research used noise - a very specific type of noise that Chant can produce which is nicely modelled on some filter, or formant, shape; and that means it really follows the model of the sound itself, so it's not kind of detached from the sound; while the noise that we've got now on the 4X is not shaped in the same way, and is therefore kind of detached from the image of the sound you're producing. It's like: it sounds together with it, but it doesn't fuse."

Q: "What control of the noise did MC offer you?"

AV: "(Disconsolately) Well basically no control at all other than amplitude. He said: 'Unfortunately, that's all you can have', and I said: 'OK, I'll give it a try, but it won't do the job'. So there was no particular control or variability of the noise."

From vin Fri May 18 18:56:54 1984
To: born
Subject: a nice chat...

A.V.: Hi there its me again !

V.U.: Vaxo Unmusical
IRCAM login:

A.V.: I said its me !

V.U.: password:

A.V.: MEEEE !!!!

V.U.: login incorrect
login:

A.V.: look here, we haven't got all day, you know..

V.U.: password:

A.V.: say.. what's the matter with ya ?

V.U.: login incorrect
login:

A.V.: (ok...Ok..) vin

V.U.: password

A.V.:

V.U.:

A.V.: that's better !!

V.U.: systems message: System going down in 30 secs!!!!

From vin Mon Jun 4 01:45:37 1984
To: born
Subject: but with a nail.
The Concise Pocket Ircam Encyclopedia
page 874, second paragraph.

nail : analogue device made of metal or other resistant material.
Figure of speech. (nailed to) as related to terminals.

where else you twit !! I was running not one but two jobs when you came in. But, alas, I had momentarily left the building to attend important matters concerning my bodily subsistence... well.. we could have gone on a bender.. if you would have only been a little patient... had a good trip? hug? Whats the island like ? still grumpy? (I mean the island).

Hey .. I got a rough mix of my voice in 4 channels... you better finish your antro job before the close the joint.. seeya tommorrow.
lotsa luv.

From vin Sat May 5 21:07:56 1984
To: born
Subject: Vax 11 vs. Alejandro

think:
a Vax 11 can on average do operations 1 million times faster
than Alejandro,

yet

if the Vax gives Alejandro 1 second advantage
it will never catch up again.

Don't believe it?

listen carefully :

We said the Vax gives Alejandro 1 second
advantage. It's the VAX's turn Now!

It does an operation that lasts 1 second. The Vax and Alejandro
are neck to neck now,

but !

Alejandro being 1 million times slower
covers in that time 1 millionth of a
second.

The Vax covers that 1 millionth of a second

but,

Alejandro being 1 million times slower has
covered 1 million over 1 million of a
second

and so on till the end of times, or the VAX
crashes

see ya

From vin Sat May 5 20:41:55 1984
To: born
Subject: the sands of time....

"don't let the sands of time get into your sandwich !"

From vin Sat May 5 20:45:38 1984
To: born
Subject: CONRAD

"..... silence was being murdered by the atrocity of those
vulgar sounds..."

Joseph Conrad (from "VICTORY")

In the last days of AV's stay, an informal 'post mortem' meeting took place in the 4X studio between him, MC and junior tutor WOW to discuss the major problems in the project's higher research aims. The discussion illustrates again positive aspects of the tutor-composer interaction: MC asks for feedback on how AV experienced the technology, with a view to future improvements; and AV conveys, sometimes brutally, the failures in what they provided (21). Despite the technical character of the discussion, it nonetheless contains some of the most musically nuanced exchanges that I heard within IRCAM.

AV: "The 72 seconds only achieve 55% of what I wanted..."

AV plays the 72 seconds of taped sound that he has produced. After playing it:

AV: "(Grimly) That's about it!"

MC: "OK thank you..."

AV: "I still prefer Chant..."

MC: "What are the 45% percent missing?"

AV: "Ah, noise... (Starts from the top) Well, at the level of syntax, I would have liked to be able to run this 20 times, to change things all the time instead of being worried about getting it to work and spending 90% of the energy on getting it to work and 10% on the actual syntax - by that I mean the process of transformation, the ways to apply dynamic and all the other parameters, to enhance that (syntax) and make it develop as some kind of language. Although I'm quite happy in a general way with the direction of that, I don't think in this example it comes across 100% as I would like. Particularly with all the () involving amplitude and vibrato: I'd like to be able to experiment a lot more with that. (Exasperated) But each run, when I want to change something, it takes so long that..! At the level of sound: that's where I think it's weaker, the actual timbre itself. I don't mind so much not having the kinds of attacks I would like to have, which is due to the fact that we've got those 30 millisecond quanta and the 4X has that delay.. because I could mask the attacks very easily: either with Chant or with a Fairlight or whatever I could make a mix and mask it, it could be a mix trick - I don't mind. But it's actually the lack of noise in the evolution of some sounds makes them really, ah, too compact in a way."

MC: "Ah..."

AV: "If it weren't for the extremely different vibrato rates which I've used - which in fact is not natural because voices don't sing with such different vibrato rates; but OK, maybe it's not natural, maybe it doesn't matter. But if I would have wanted to use voices that were sort of straight forward, like in the previous version of Chant, sort of close miked voices.. then with that kind of voice you would have heard just a mass of sound with no identity whatsoever: I've tried it. You can hear one voice on its own and it's clearly a voice - it's a synthetic voice but it's a voice; you put four together and it's no longer a voice. And that's because they fuse: you use several additive synthesis

instruments and they fuse. And unless you've got noise that evolves in some characteristic way with its own envelope, like in Chant you can have it - like in my earlier Chant example I hardly use vibrato, and when I use it it's certainly not to create the voice image, I used to just, you know, play around with it - but here, without the vibrato it's nothing, it really doesn't work. So I think that straight additive synthesis with just partials is maybe very powerful to create single sounds, but to create evolutions it has the problem that.. OK it helps to control the fusion very carefully, but on the other hand you end up with a product that doesn't sound very.. that turns very easily into a mass, just a thick layer of partials. On the other hand I have done mixes with the voice where if you take steady state voices and you mix them like that, they start sounding like (laughs) electronic sounds!.. But you can always get that breath image from very close, which has a very definite contour; and it gives you a close up presence that this hasn't got. These voices sound like they do not have enough energy in the top, and they have plenty, more than they need!

MC: "They don't seem to have..."

AV: "Exactly, and that is (lack of) noise, there's no question about it. You can have some noise at minus 70db, a little bit, all the way up to 16k and.. 'Cos it's true, you analyse a real voice and, sure, it doesn't go above 6 or 7k in any significant way; but you record a voice and you cut off above 8k and you kill the voice completely. You do a spectral analysis and there's nothing up there; yet you.."

MC: "I believe you, yeah!.. microevolutions..."

AV: "It's not partials, it's rubbish (ie noise: he means it positively). But you get rid of that rubbish and.. it moves in some way that's greatly effective. Then one can say: so what? Why should we be so hung up on having biological sounds, why not just explore?.. So I have in a way accepted that, OK, I'm not going to get that quality; so maybe I should explore the actual sounds that this system can produce... That's why in the end I've been concentrating more on the actual syntax, because at least if that's strong then... But it's such a long process! The old idea of having a few faders to play with on every run and say 'More of this' (doesn't exist). What do you think they (sounds) lack that could be easily implemented on the system now?"

MC: "I dunno.. We could look at every detail of the variations within the 4X in order that they run really fast.. (pause) It was impossible to use noise on the 4X..."

AV: "It doesn't seem to be a relevant parameter.. That generalised 4X noise was just hovering wildly around the partials without any control of it.."

MC: (Contradicting AV) "You have control over it!"

AV: "Well, you only have control of the proportion of it.."

MC: "And the bandwidth, and the location..."

AV: "(Frustrated, forcefully) And the quality of that noise is.. it's a really shitty noise! It hasn't got any warmth at all. It adds garbage: when you add that to a voice, what you hear is a voice with some noise in the background, like you've got some interference, I mean: 'Have you got a radio on or something?', you know, that's how you feel: 'Can you turn that noise off!' It doesn't fuse at all, it has no.. it's definitely not the kind of noise you get in Chant."

MC: "Explain that to RIG! (who suggested doing the project in additive synthesis rather than in Chant). I mean, it's really important because he thinks this works!"

The sense of AV compromising his musical needs, of his weighing up the project against other experiences, comes through strongly. In admitting that he had given up searching for a better quality of sound material and concentrated on syntax without that, AV admits defeat on the project's basic aim: developing a syntax out of the improved sound materials, timbral transitions, themselves. He conveys that the noise, and so timbres, that he has been given on the 4X were crude, inorganic and unmusical, totally different to that with Chant. Further, he hints at a psychoacoustic puzzle whereby the scientifically analysed spectrum does not, when strictly technologically reproduced, have enough high frequency energy - what he calls 'rubbish' - in it: '..you cut off above 8k and you kill the voice completely. You do a spectral analysis and there's nothing up there..'. These observations are important because they highlight some phenomenological limits of the technology. First, AV is pointing out that, against expectations, additive synthesis cannot in practice equal, or provide the same timbral qualities as, Chant. This contradicts the view that computer music technologies can through translation, when given enough sheer power, provide absolutely equivalent facilities. This omnipotent view of the technologies as extremely general and so infinitely adaptable, of any one technology being transformable into another by sufficient translation, is widely held within IRCAM. The story suggests, then, that the different technologies have specific inherent qualities and limits, and are not ultimately assimilable: that they are not infinitely malleable, 'open' texts.

Second, AV has raised how even computer-aided analysis of the spectra of complex timbres fails to capture some extremely subtle

movements of very high frequencies - the 'rubbish' or 'microevolutions' - which are not either, then, modelled by the software. This points to another important phenomenological insight: the technology's non-equivalence to 'real' sound. Again, it is held within IRCAM that computer music technologies, despite their inherent digital approximations of what are complex physical processes, can and do provide aural simulations that are functionally and perceptually equivalent to 'real sound'. AV is questioning this view and pointing to the limits of computer analysis and simulation, and the problems with computer timbres achieving fully organic timbral qualities. He is raising the non equivalence of the two domains of aural experience. Such a view should not, of course, be news to IRCAM intellectuals: what is surprising is their willingness to forget that computer generated timbres are simulations, representations, of extremely subtle physical and aural phenomena and are therefore likely to differ. But IRCAM ideology holds to the computer's power to produce absolute equivalence, rather than being interested in the possibilities of difference - the computer aesthetic lacking some organic qualities but providing others. These questions return below.

In the end, MC asks AV to tell his criticisms to RIG, whose idea the whole technological configuration had been. Underlying this is the nationalist and ideological tension whereby RIG thinks that additive synthesis can in principle do anything Chant can do, while MC, leader of the Chant group, believes that it has unique properties that patch languages such as additive synthesis - whatever sheer computing power they have driving them - cannot achieve: a view that AV has just corroborated.

Chapter 8 Technological and social problems around production

This chapter broadens out to discuss some general features and problems of research and production raised by AV's project: issues of technological dependence, instability and neglect, and scientific management; of collaboration, and the patronage and exploitation entailed; of intellectual property, security and secrecy; of IRCAM as an oral-aural culture, and its chronic lack of documentation.

8.1 IRCAM's technological culture: instability, standardisation, dependence

We have seen that one of AV's main complaints concerned the lengthy delays and slowness of the system, compounded by its constant crashing. These chronic problems can be illustrated by the following particularly crisis-ridden week from my diary.

"14.5.84: Big problems with the VAX and 4X: the VAX is crashing all the time, and was down a lot last week. There is much competition for 4X time: AV, HY and WOW as his assistant, and QG are all vying aggressively, tension is high. HY is desperate: he has to finish the computer tape for the premiere of his new piece at the CGP in 4 days. At midnight, after the *Espace Libre*, there is an argument in the hall over access to the 4X.

AV says: "I've had 4 days with no progress or time - because the 4X was down most of yesterday and today, there were problems Friday and I was away Saturday! I've got a piece hardly started because of these major problems, that has to be done in 20 days! The program that works worst, that I'm totally dependent on, is the Roc program. It's really bad, the machine crashes constantly!"

HY replies angrily: "I've got half an unfinished tape, and a first performance on Friday! I've got to have more time this week!"

WOW adds: "We just need more time on the 4X.."

Later, over supper, tension drops and HY says half desperately, half jokingly: "Has anyone got a spare piece of tape music that I can use for the last half of my tape?!"

16.5.84: There are complaints about the VAX crashing and causing big problems from four tutors. They blame the System manager FA, who is away while the major changeover of UNIX from 4.1 to 4.1a is happening: bad planning.

WOW despairs that he has lost half a directory of important files that he is using.

AV says: "I deleted the 'People' directory (1) by mistake last night

because of the chaos of disks and disk space on the VAX; and XX deleted all my Roc files! Now I've got to start them all over again!" AV is furious that they're changing the basic operating system while he's working with the system under pressure. He thinks it's an insult. He says he feels like giving up: he hates working here, it's so unmusical.

NP (squatter-composer) has decided to stay at home to work every other day because it's so frustrating here, with the crashes and overload making the system so slow: two hours for just 10 seconds' sound!"

The constant breakdowns of the main computers had several causes, local and more general. Locally, due to the several new programs for AV's project, the new translations of Chant and Formes, and the constant re-writing of them all, there were many program bugs constantly appearing that needed to be smoothed out, which meanwhile caused the PDP11 or the VAX to crash. A new piece of software linking two machines, called the 'fast link', also caused many crashes; its design was not right. The new Roc program failed to work properly. The link between the PDP11 and 4X was poorly synchronised, which caused the 4X to crash. Then there was a lack of memory and disk space reserved for AV's big files; so that when he 'ran' a big file (launched it to compute samples) it caused the VAX or PDP11 to crash. This could have been avoided by better resource planning. AV summed up the situation thus:

"The VAX was coming down like a yoyo, or was down for a number of days, or came down every hour or two which meant your job crashes in mid stream. If the VAX comes down 5 or 6 times a day, the likelihood of your finishing one second of sound is.. small!"

So the scale of new software that it had been decided to create for AV was, in retrospect, over ambitious and made stabilisation of the configuration for productive use within the time allotted impossible.

But the wider causes of the VAX's constant crashes were, first, chronic overloading and congestion; and more importantly, the changeover from UNIX 4.1 to 4.1a. Overloading was exacerbated by the squatters who came in each evening to use the VAX: composers, but also computer

scientists from the University of Vincennes, amongst them a Professor with high status at IRCAM. The Administration occasionally spoke out against squatters, but most of the time tacitly condoned their unofficial presence. In fact, it was unclear who was responsible for managing access to the VAX, as the following illustrates.

Congestion reached extreme proportions in summer 1984, when the stage coincided with a production visit by composer BLr, and there was much crashing of the VAX. This led to the Systems team taking constant measures to 'clear space' on the system, by deleting various files, programs and directories that they judged to be using too much space and expendable. Their job was thus, within limits, to coercively manage the system. In this period, typical daily systems messages from the Systems team to all VAX users were concerned with managing space and resources as shown by Fig.8.1. A week later, the situation was worsening, and more drastic system messages appeared as shown by Fig.8.2. The top of this message reveals a telling problem: that the Systems team do not know to whom all the programs on the system belong, who has authored them (2). Congestion reached crisis point a week later, when Boulez called Systems manager FA in and told him to police the system more fiercely. FA reported him saying: "You're not doing your job properly! You should be removing these unofficial users who are blocking up the system!" FA was amazed, since he considered this a new degree of coercion in his job. Boulez insisted, so that FA sent out the message shown in Fig.8.3 which details exactly who are the heaviest users of the VAX, and threatens to forcibly remove their excess files. This list of users makes it clear that IRCAM's in house programmers and software developers are the heaviest system users and, against the official view which scapegoats the squatters, that squatters do not take up much space. At this point,

Figure 8.1 Systems' team system messages aimed at managing space on the overloaded VAX computer, June 1984

'Message 313:

From FA Thu Jun 28 10:13:29 1984

Subject: /people is full

Please start archiving your files onto tape using tar(1)'

'Message 314:

From YI Thu Jun 28 14:48:39 1984

Subject: Allotment of sound disk space

The stage is going to use the disk /snd.

The removable disk (/snd1 and /snd2) is exclusively reserved for BLr's production.

The disk /snd3 is reserved for the transfer and manipulation of files from one disk to another. Only certain authorised users have the right to use it (notably me, WOW and WUA during BLr's production). ABOVE ALL do not touch the removable disk without being authorised.'

Figure 8.2 More urgent Systems' team message a week later

(From FA, Systems manager:)

'SYSTEM CLEAN UP: the following programs disappear today unless someone identifies the author:

loadst queens quietst filt cref disp dx tab trucs'

A Poem by the VAX. Understand it and you may avoid Armageddon:

Where did all the disk space go,

Since last winter in the Paris snow?

It was a time when our problem had no Formes,

And our ways to analyse it had not been Born

Oh where did all our disk space go?

Does someone want to make me slow?

One cannot compose without a space,

So free some now; get rid of your waste.'

Figure 8.3 Final warning from the Systems manager about VAX resources, July 1984

'July 12th 1984: Pierre Boulez has told me personally to make sure that NO individual uses more than 2500 blocks of disk space. He said if it is not done by the end of the week, I am to do it for you, ie REMOVE files:

4773 JDK (Ex Chant/Formes, tutor)

4081 XU (Chant/Formes)

3572 AJ (4X signal processing)

3470 BUa (postgraduate)

3443 YI (systems team)

3246 NGF (programmer between IRCAM contracts, so a squatter)

3222 BX (programmer, 4X software) ... etc...

then, the VAX was overloaded and crashing due mainly to official research; and there was much talk of the need to get a second VAX.

The decision to upgrade from UNIX 4.1 to 4.1a was taken by the FA, who argued that it was necessary in order to link IRCAM up to a major new networking facility. Because this changeover involved re-writing the basic coding of all programs in use on the system, it was bound to throw up many bugs, so that it would take weeks to debug the system and get back to normal operating. At one level this was simply a poorly timed and badly communicated move. A week before the changeover, which was preceded by weeks of preparation by the American consultants doing it, many IRCAM tutors and major users of the system knew nothing of the impending chaos. FA decided arbitrarily to go ahead, without taking into consideration the urgent production needs and congestion of the system, and despite himself being absent from IRCAM the crucial week. (For this FA received an *avertissement* from Boulez, and within 2 months he had left IRCAM).

But at a deeper level, the decisions to upgrade and violently change the operating system to a new American standard (UNIX 4.1a had been developed at Berkeley), in order to link in to an American based international network, derive ultimately from IRCAM's dependence upon American technologies, related in turn to America's leading edge in computer science research and development. We have already seen another symptom: IRCAM's profound dependence on American skilled computer labour (Ch.2.3.1). During 1984, this was as acute as ever, and IRCAM searched the USA for its new Systems manager when FA left (3).

Similarly, the previous major change in the IRCAM system, the changeover in mid 1983 from the PDP10 mini to the VAX, was caused by another recurrent symptom of technological dependence. DEC, the

corporate American makers of both machines, gradually raised the service charges on the PDP10 until it became uneconomic to keep it and better to upgrade and buy their new 'standard', the VAX, with its lower service charges (4). DEC enjoyed a virtual international monopoly of the standard mini-computers at this time. IRCAM's System manager spoke of the functional irrationality of this move, since the PDP10 was working well and IRCAM's software was adapted to it; so the mini change had also involved a major crisis of re-writing software just as Chant and other programs had been stabilised for use.

Thus technological dependence and the chronic, cyclical instability of the computing environment that this causes, exacerbated by the retranslation of all software required each time a basic dimension of the overall system is changed, are major factors in the apparently 'local' technological problems of instability and unreliability. The extreme instability and rapid obsolescence are further expressed by the many bits of computer technology and peripherals strewn chaotically around IRCAM's corridors (see Photos 8.1-4) (5). But notably, of all IRCAM's technological problems, despite my raising this issue many times, informants had little to say and were uninterested in the subject. It seems that despite its profound effects (uncertainty, constant running to keep up, and economic pressure), for high level computer cultures the phenomenon of technological dependence on the USA is so self-evident as to be considered banal. There is, then, a determined blindness towards the threat of cumulative technological disadvantage that such dependence brings.

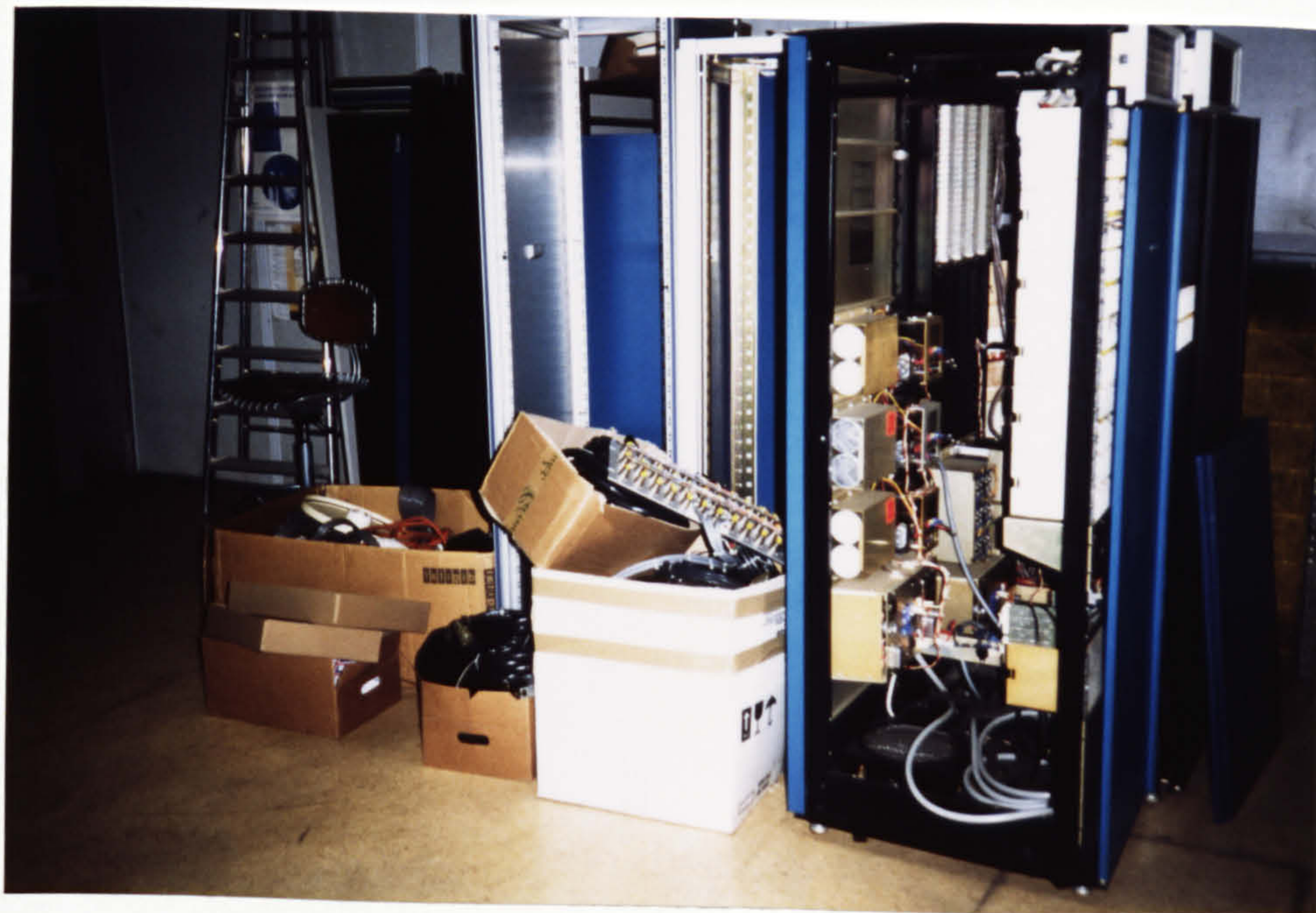
In summary, IRCAM's technological dependence is both enforced financially, through rising service charges imposed by the American multinationals; and induced by the seductive desire to keep abreast of

8.1



8.2

8.2



8.2

8.3



8.4



the latest, state-of-the-art research environments (eg the latest UNIX version), without which it is feared that IRCAM research will be outdated. There seems to be a continuing element of 'false consciousness' in IRCAM's dependency trap: a belief in the need to constantly 'keep up with the States' in terms of hardware and so associated software. These are effects, then, of American multinational control and leadership of standardisation in this high technology sector; which in turn imposes premature obsolescence upon technologies, such as the PDP10, that are still entirely functional. This is not 'built in' obsolescence, but imposed. Setting the standards, and constantly revising them upwards, gives American corporations the power internationally to force other national research outfits to upgrade and adopt their new standards (6). IRCAM was, in 1984, fully caught within the dependency trap.

The initial talks about IRCAM's computer music infrastructure, at a 'summit meeting' of IRCAM directors and consultants at Baden-Baden in 1976, resulted in the decision not to buy a copy of the 'Samson box': the Stanford CCRMA's machine, which would have provided a tried and tested hardware environment along with much already developed and used music software. Instead, Boulez and Berio pushed for IRCAM to put its resources behind developing its own new hardware, the designer PDG's project that became the 4X; and this meant also buying the DEC PDP10 as IRCAM's basic research computer (7). It thus appears that IRCAM's technological dependence derives from the politically fuelled decision to ignore the ready made Stanford facilities and develop IRCAM's own hardware prototype, to which end it was necessary to become linked in to the leading American multinational technologies. Ironically, then, IRCAM's technological dependence and instability have been stoked by its

desire to compete technologically with its rivals in the United States.

The second general IRCAM problem illustrated by both the chronic congestion and the UNIX 4.1a story is the weakness of IRCAM's resource planning, its lack of scientific and technological management. The problem of lack of scientific planning was commented on by both staff and visitors to IRCAM. It was picked up by Boulez in a Scientific Committee meeting attended by most production staff following AV's departure, at which he berated the staff for AV's problems and the failure to produce a piece from the visit. Ironically, the meeting began by Boulez announcing the departure of the incumbent Scientific Director, FOK, who had held the position for barely a year and had found it increasingly impossible to exercise authority and to control the quasi autonomous subcultures within the institute. Also ironically, given the major role played by technological renewal in AV's problems, Boulez welcomed FOK's and others' departures as an opportunity for another kind of '*renouvellement*': a renewal and turnover of personnel which, he said, would keep the institute lively. As the meeting discussed AV's visit, Boulez became increasingly angry with the lack of co-ordination between teams and the poor state of equipment. The teams' non-cooperation was demonstrated even in the meeting when the 4X designer, BU, blamed Formes for being a mess and so causing the 4X to crash. Finally, Boulez blew up and began a monologue in which he threatened to bring in a new '*autocrat*' manager (quoted above Ch.4.2.1).

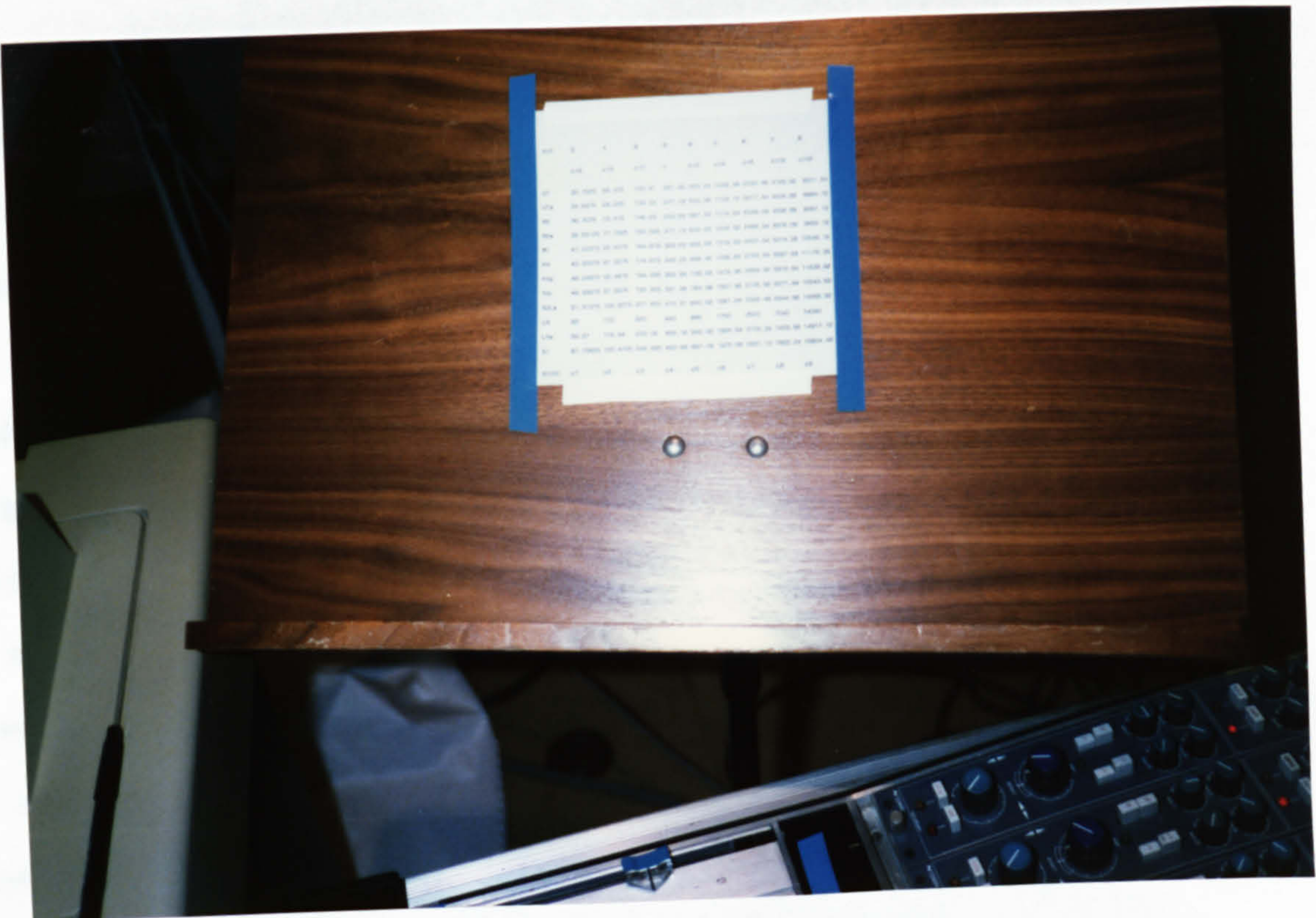
Despite Boulez's view of AV's visit as a debacle, stalwarts of the musicians vanguard continued to defend it as having been a risky but productive research project which had explored the possibilities and limits of the particular technological configuration. From this perspective, no high level research is without its pay-offs. Yet AV did

not return to use an improved version of that configuration; and it is doubtful whether the programs written for his project were preserved or documented in order to be re-used in another context. So beyond the general insights gained into the non-equivalence of Chant and additive synthesis, it is doubtful whether the research and soft development were used elsewhere; and the visit must go down as one of IRCAM's more expensive and megalomaniac, unproductive projects.

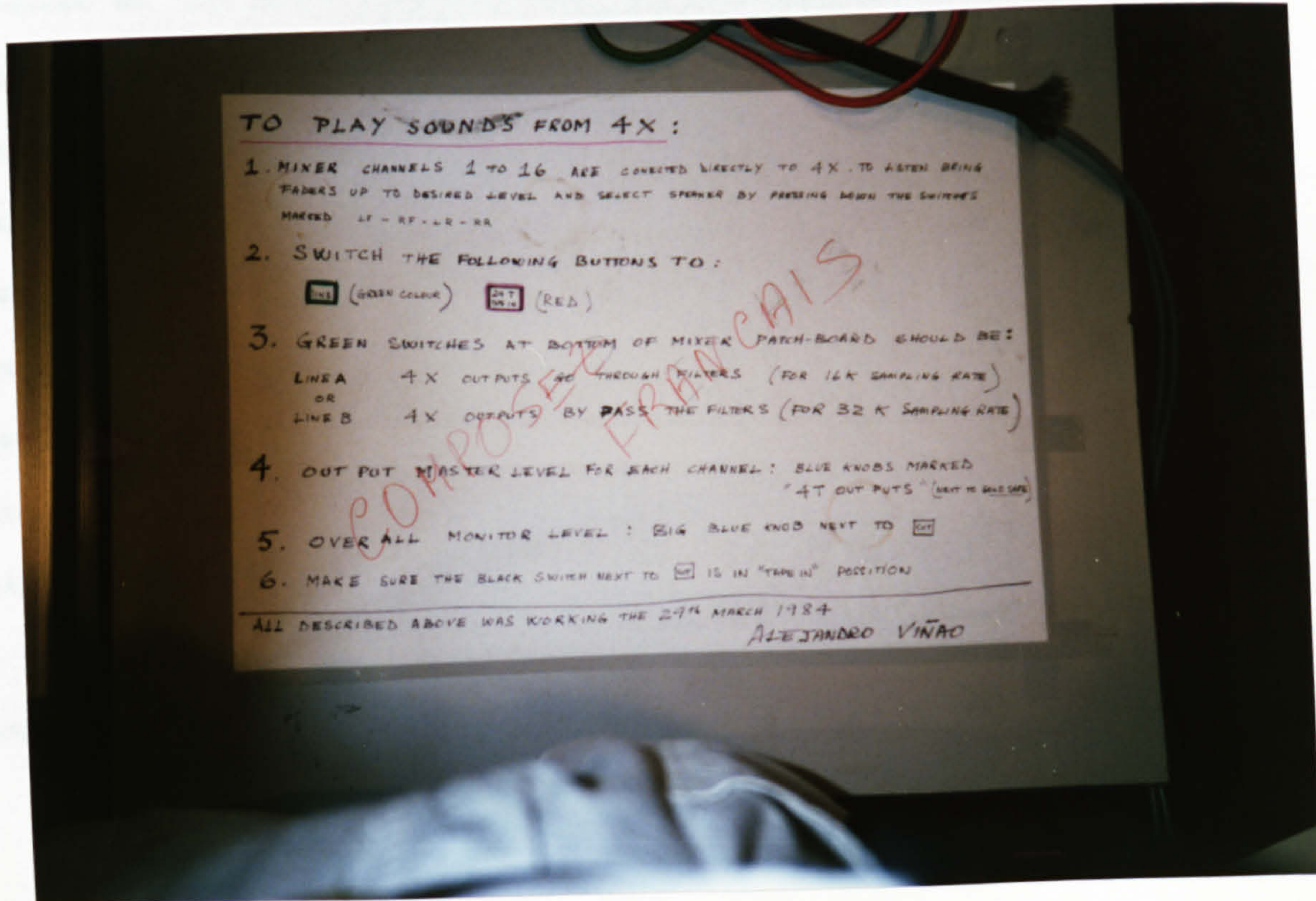
8.1.1 Technological chaos and 'irrationality': neglect of the analog tape medium

A final cause of AV's problems, deriving from broader problems within IRCAM, was the chaotic state of some of the machinery that he was using. In particular, he found the DAC's and the analog tape recording machinery in the 4X studio in very poor condition, both in terms of lack of maintenance and of their poor set up for work. AV found that the ways to link up the 4X, the DAC's and the mixing desks were complex and were not generally known, so that he had to reconstruct this information for himself. Photo 8.5 shows a sign that he wrote having done this: it describes step by step how to set up the machines in order to play back sounds from the 4X. Frustrated and amazed at the ignorance of the set up, AV wrote the sign in English and stuck it on the mixing console to inform people generally (8). The poor state of the machines was shown by the problem outlined above (Ch.7.2.3) of mysterious 'gremlins' in the mixer causing the amplitude meters to wave around, and many clicks and noises in both the mixer and the DAC's. At times, AV could not hear back his sounds without many clicks, and it was hard to know if they were being caused by the programs having bugs, or his files' improper use of them, or the DAC's, or the mixer; so they were impossible to trace and

7.25



8.5



TO PLAY SOUNDS FROM 4X :

1. MIXER CHANNELS 1 TO 16 ARE CONNECTED DIRECTLY TO 4X. TO LISTEN BRING FADERS UP TO DESIRED LEVEL AND SELECT SPEAKER BY PRESSING DOWN THE SWITCHES MARKED LF - RF - LR - RR
2. SWITCH THE FOLLOWING BUTTONS TO :
 (GREEN COLOR) (RED)
3. GREEN SWITCHES AT BOTTOM OF MIXER PATCH-BOARD SHOULD BE :
 LINE A 4X OUTPUTS ~~GO~~ THROUGH FILTERS (FOR 16K SAMPLING RATE)
 OR
 LINE B 4X OUTPUTS BY PASS THE FILTERS (FOR 32 K SAMPLING RATE)
4. OUT PUT MASTER LEVEL FOR EACH CHANNEL : BLUE KNOBS MARKED "4X OUT PUTS" (LEFT TO RIGHT)
5. OVER ALL MONITOR LEVEL : BIG BLUE KNOB NEXT TO
6. MAKE SURE THE BLACK SWITCH NEXT TO IS IN "TAPE IN" POSITION

ALL DESCRIBED ABOVE WAS WORKING THE 27th MARCH 1984
 ALEJANDRO VIÑAO

remove.

Thus, not all the technological crashing and bugs are caused by instability and technological dependence: they are also due to neglect. For the large hardware and the peripherals that have been bought, IRCAM has service contracts with the (mainly American) companies that sold them. But for hard and soft technologies made at IRCAM (the 4X, peripherals such as the ADC's and DAC's), and especially for IRCAM's analog audio technologies (tape recorders, mixers), there is no external and little systematic internal servicing or routine maintenance. In 1984 MIO, nominally responsible for Hardware and Lab Maintenance in addition to two other functions, left IRCAM and was not replaced for a period. Also in 1984, the one audio maintenance technician was relocated by Boulez to look after 4X Hardware, and again was not immediately replaced; while the Sound team do not consider maintenance to be their job. Thus the analog audio equipment was particularly neglected, its servicing erratic and a low priority, which explains its poor state.

Several further phenomena indicate an irrational neglect of, and uninterest in, the uses of analog tape technology within IRCAM that is deeper than the broader problem of technological neglect and chaos. First, neglect of the recording medium is shown simply by the fact that so little attention is paid within IRCAM to recording, compared with the quantity of live musical performance. This is suggested by IRCAM's slowness in starting its own record series (9). It is most glaringly illustrated by the neglect to record, even just for archives, the 1977 70-concert series *Passage du XXeme Siecle*, which contained many premieres, and performances of many pieces almost never heard, and was thus a unique opportunity to capture the music for posterity. The *Passage's* exclusive emphasis on unique, live, unrepeatable performances

highlights the ritual, prestige-oriented nature of the series (10).

Further, IRCAM was slow in moving over to digital audio technology in the recording studios, and appeared to give very low economic priority to digitalisation (11). Even without digitalisation, IRCAM lacked basic studio tools, so that AV reported with frustration "It's due to me making a fuss that there are even tape splicing blocks in the studios! There didn't use to be". IRCAM also lacked powerful recording equipment, although the facilities available were of high quality. This is conveyed by the following diary note from my first visit in 1983, when I was shown around IRCAM with several others by a music director.

"In the recording studios, I was surprised to learn that they (IRCAM) consider 8 or 16 track recording facilities sufficient for their needs; surprised, since in professional popular music production these days, less than 16 tracks is considered ridiculous, and the norm would be 24, 32 tracks or even more. Listening to the director discuss this with another visitor on the tour, a middle aged, senior American classical music producer who recorded orchestras, their consensus was that the push towards more tracks in recording was an unnecessary commercial conspiracy, fetishising the technology. Their reasons: the American orchestra producer because he wanted an 'ambient', live, room-acoustic sound (common in classical music recording because of the expense, complexity and fear of single-instrument recording, or of many 'takes', where a live recording is hopefully complete in one); the IRCAM director because, he said, with their computer and digital sound synthesising facilities, more than 8 tracks is unnecessary since so much of the sound processing is done before recording".

The orchestra producer here exhibits an ideology of recording and electronic transformation that is also characteristic of IRCAM's Sound team, who record and master most IRCAM commissions, and so of IRCAM's dominant aesthetic. This ideology, common among musicians inexperienced or uninterested in the recording or electronic media but also propagated by classical music record producers, holds that the proper approach to recording and amplifying acoustically based or similarly subtle musics is to aim to faithfully reproduce the acoustic or ambient (live) sound as exactly as possible. The IRCAM sound engineers, for example, when

setting up the amplification of my cello for a concert in which I played, talked of "...simply keeping the controls flat... We're not doing anything to the sound! It's just as you play it!" The notion is that by keeping the electronic controls 'flat', the acoustic sound remains essentially unaltered apart from greater loudness. In the same way, classical recording engineers tend to use the electronic controls of the mixing desk minimally in recording, believing that this leaves the acoustic sound of instruments 'authentic' and undistorted by electronic intervention.

However, this ideology misperceives the nature of these media; since even with the controls 'flat', sounds are completely transformed by live amplification or by recording and play back. This occurs simply by virtue of sounds being 'captured' by microphones, with their inherent acoustical biases, and by increased loudness, both of which alter the relationship between the sounds' component frequencies, boosting some and 'cutting' others and so necessarily altering the timbre. In fact, amplifying or recording acoustic instruments such as strings without altering their frequency spectrum often produces distorted sounds. In short, sounds cannot remain untransformed by recording and amplification: there is no way of retaining the 'natural' or 'authentic' acoustic sound using electronic mediation.

The dominant IRCAM / classical music ideology of recording is, then, naively purist and ignores the profound transformation of sound inherent in all electronic or taped reproduction: another naivety concerning the phenomenology of the technological representation of sound that is surprising in a culture such as IRCAM (12). By striking contrast with the purist classical music ideology, popular music producers have since the 1950's embraced the aesthetic possibilities

inherent in electronic and tape based transformation of sound. Popular music aesthetics have employed amplification effects, changing the timbre of sounds through recording, and since the mid 1960's the layering of sounds through multitrack recording. IRCAM's absence of aesthetic awareness of recording studio techniques and multitracking was remarked upon by AV, who had pop music production experience and was thus greatly frustrated by the poor state of IRCAM's analog tape facilities. AV said: "If there's one thing I'd do if I had the power at IRCAM, it would be to get a top (pop) record producer in here for a year to teach good studio techniques!" It was also discussed by KF, a junior tutor with positive experience of commercial pop studio work that he kept hidden from IRCAM (see App.9).

There are two further observations to be made on this material. First, in the context of high quality digital sound synthesis, it is quite irrational to neglect digital recording since unwanted noise eliminated by great effort during the synthesis phase is likely to be reintroduced by lower quality analog recording equipment - exactly as happened to AV. Second, the director's view cited above in the diary, and widely articulated within IRCAM, that more powerful recording technology is unnecessary ignores the fact that, whatever the quality and complexity of synthesised sound inputs, multitrack recording gives a different level of flexibility through empirical, realtime aesthetic experiment with those input sounds, by mixing them together and so allowing mutual modification. The director's uninterest in the aesthetics of multitracking links logically to another view expressed by some from IRCAM's vanguard: a disdain for polyphony, music constructed from the movement of several 'voices' or lines against one another. In

this view, polyphony is outdated since it is aesthetically irrelevant to the unique potential of computer music (13).

In the face of all this, we must ask why IRCAM shows such a strong neglect of, and uninterest in, analog electronic and tape media. We can now perceive how these phenomena express at a deeper level IRCAM's attempt to define itself through the construction of difference, in several ways. First, locally, some of the vanguard differentiate themselves aesthetically from the embrace of polyphony, central even to Boulez's non-computer works (Griffiths 1986:140-1). Then, IRCAM differentiates itself technologically from the 'empirical', tape based tradition of *musique concrete* at the GRM, its close but dominated rival. Less consciously, this character of IRCAM expresses its absolute difference from the techniques and aesthetics of popular music. Finally, the contempt for analog technologies also embodies IRCAM's rejection of and attempt to transcend the previous generation of music technology, which is therefore seen as useless to IRCAM compared with digital technology. Hence also IRCAM's purist taboo on mixed analog and digital technologies, which would defy the boundary and confuse the assertion of difference - a phenomenon raised by two of IRCAM's technological 'dissidents', PL and NI (see Chs.4 and 9), who both saw mixed technologies as yielding more power and flexibility for less resources. IRCAM's musical and technological culture is defined, then, by a complex and often unconscious, overlapping set of assertions of difference.

8.2 The character of collaborative labour: hierarchy, exploitation, and tensions over authorship

Finally, I will outline a group of interrelated social and technological phenomena affecting both musical and programming work.

They relate to the collaborative nature of this work, and provide a non idealised view of tensions and problems arising from collaborative labour. We have seen that there is much collaborative work in IRCAM's intellectual culture, and that for the musicians vanguard collaboration is a utopian principle. However, the tutor-composer collaboration is founded upon differences of status; and we will see that it is experienced by tutors as exploitative, and is riddled with patronage and mystification. While more generally, the surface spirit of collaboration covers a great deal of competition, secrecy and rivalry within and between IRCAM projects.

The tutor-composer division of labour depends upon and embodies the classification described earlier whereby tutors are defined as not themselves legitimate composers. This view is acceptable to those tutors who are primarily scientists, but is clearly irksome to tutors who do consider themselves composers. Sensitive visiting composers decry the classification, and talk of their tutors as also composers in their own right (14). Nonetheless, as we saw earlier the classification is promoted by IRCAM artistic management, so that tutoring has enshrined a status distinction against which musician-tutors rebel (15). The formal copyright agreement on musical works that have been produced by visiting composers at IRCAM, with a tutor's assistance, specifies that rights are divided between the composer and IRCAM. The tutor is assumed to be recompensed for his labour by his salary: he is paid as a salaried IRCAM official, for the part of his waged time that has been spent on the work. This represents, then, wages for technical labour rather than a share in the market value of the creative intellectual goods.

However, the actual nature of tutoring labour is often even more exploitative, and in a different way. As we have seen, much tutoring

work is done not by the four official, salaried tutors but by the exploited and self-exploiting junior tutors, whose tutoring is entwined with seeking patronage. They are commonly first invited into IRCAM having been spotted by a director on the stage, and are then asked to work on a director's project. During this 'trial period' of establishing patronage, junior tutors are given recurrent contracts of one, two or three months, with pay sometimes as low as 2,500 fr.gr.p.m. (eg WOW), or they may be entirely unpaid. One example of the process is conveyed by the following interview with NR, a foreign junior worker who later became one of the favoured 'heirs elect'.

NR: "After 2 years studying computer music very hard (in a European country) I felt prepared enough to come to IRCAM... It turned out that I was right because I took the stage in summer 1982, and I was the best one (on it) - not because of gifts but because I'd studied two years more than anybody else!... I had a very good knowledge of these programs (Music X, Chant), so I made examples that were for me interesting".

Q: "And people found them interesting?.."

NR: "Ya, and then I was asked by XX to work with him on his piece 'YY', (mumbled cynically) like everybody..."

Q: "So he asked you then, right after the stage, to come and work with him on 'YY'?"

NR: "To keep on working with him, like an assistant, right. That was frustrating because I didn't want anything that (fades)... I had a crazy idea: I worked, I dunno, 18 hours a day for him; but I knew that it was my only chance to stay here."

Q: "How long did you do that?"

NR: "One and a half months."

Q: "What money did you have for that?"

NR: "Nothing. He just shared with me, he promised me some.. Oh I was very badly treated at IRCAM from the point of view of money. If you do something that you like, sometimes at the beginning at least you accept that. And he promised me 5,000 francs for the work of one and a half months, because I had to stay here, to live, to pay rent; and he couldn't do that."

Q: "He couldn't, after he promised you?"

NR: "No, no. He shared his commission with me. But it was very very little, something like 1,500 francs... At the same time I had to pay for my (composition) diploma, had to get it... That's a terrible period in which for 3 months I studied an average of 16-18 hours a day, including weekends."

Q: "So you must have been going mad at this time, working for that and for XX?.."

NR: "Yes, really. That nearly drove me mad."

Q: "What money were you living on at the time?"

NR: "A little money from home, a little from the teaching that I'd

saved; I can live on very little money... Then it was thanks to XX, and I owe him that at least very much, he was the first who had confidence in me, who invited me. We discussed the many problems in his piece, just computer problems, because of the mentality (of the piece). It was not.. it was very well thought out, but since he doesn't know how to program, all the practical man-machine interface was terrible, terribly bad. So I told him 'You have to do it like this and that, there must be some kinds of improvement'... (Later) I came here permanently... That was a vacation for 11 months, very little salary compared to other people.. I had 4,400 francs net a month, more or less half as much as the other people... I was silly, that was also my fault: but for me it was so important to come to IRCAM that I didn't want to negotiate anything. XX promised me a good salary, and I had confidence in him; and I was wrong!!"

This man is quite aware of his exploitation. But ultimately, as he conveys, there were no hard feelings since despite the director's poor reputation for exploiting juniors he became NR's patron, negotiated further short contracts for NR, and eventually helped to get him a plum postgraduate position at a prestigious American university.

Some tutoring relationships are more mystified. One example is Boulez's own permanent in-house tutor BYV, officially employed not as Boulez's tutor but as 4X Software director, who spoke of his unpaid work for Boulez as follows.

"My main motivation for working with Pierre is not at all because that's what I'm paid to do; as a matter of fact on my contract there's no mention at all of my work with Pierre. That's simply some kind of agreement between him and myself. My main motivation is basically that Piere is a composer who I believe in very deeply. I feel that he has the key to a lot of problems in contemporary music that no one else has; I find it stimulating to work with him for that reason".

BYV's indirect rewards for tutoring Boulez were, however, substantial: his cumulative promotion up to a high director.

The attitude of willing and pleasurable labour shown by BYV is expressed whenever tutors work with composers that they respect musically and intellectually; it was, for example, the attitude of tutors MC, HM and XH to working with AV. But sadly, the majority of visiting composers are not so respected, since they are not skilled and

may be quite inept at computer music; and indeed the tutors may not like their music at all. Rather than pleasurable, tutors find working with these composers frustrating since they need to be nursed through an experience which they will also find trying, the results of which will inevitably be musically and scientifically disappointing. This kind of 'collaboration' with inept composers raises, then, other major issues: first, the question of authorship of a piece which is the result of collaboration, and especially of such unequal collaboration. Often, working with inept composers, tutors joke cynically that the sonic and musical results come out uncannily similar to the tutor's own sounds and music. Thus, one afternoon in the main corridor, several tutors were chatting together and one said jokingly to WOW, then assisting a visiting composer considered to be unskilled and uninterested in the medium: "Hey, I heard BLr's piece this morning. Amazing how much it sounds like your work!!", and everyone laughed. WOW was renowned for having a very individual, rich and expressive use of the medium; he himself considered that pieces that emerged from his tutoring work often bore signs of his own musical personality.

Another difficult issue for tutors is that of 'guilt by association'. Being employed to help composers who are inept with the medium can mean becoming identified with an end result, a piece, that may be disappointing and far below the tutor's own standards, with the fear of damaging one's reputation. These veiled tensions underlie the tutor CX's article criticising the work of the composer Holler, whose tutor he had been (see Ch.6). CX thought that Holler had not used the medium successfully, and was over dependent on his tutor's (CX's) help.

The ultimate question of authorship centres on the fact that, whatever the form in which composers give their input, it is often the

tutors who do most of the actual hands on work: arranging the technological configuration, writing the dedicated software, writing the files within the programs that produce the computer musical output, controlling the recording process etc. Composers' input comes in a variety of forms: from carefully prepared scores and technological ideas, to extremely vague and unprepared ideas. Two examples from 1984 can illustrate. The composer NO, tutored by JIG, arrived to do his computer tape with well developed ideas, but left the completion of the full instrumental and vocal score for his mixed ensemble and tape piece until after leaving IRCAM. Whereas the composer BLr, whom WOW tutored, arrived with very loose, fanciful ideas for his piece, conveyed by a few rapidly prepared graphic texts. The piece was to be based upon sound materials drawn from recordings of the phrase 'I love you' spoken in many languages. In these cases, but even when composers arrive with fully developed scores, the tutor has to translate the composer's ideas into IRCAM's technological terms, to communicate that to the composer, and then to realise the ideas technically with the available 'tools'. The tutor thus intervenes conceptually, technically and physically in the composer's plans, and does much of the practical realisation. One major question here is the creative centrality of this 'technical' realisation in musics such as IRCAM computer music that are based essentially around new sound materials as much as new forms of organisation. Tutors, in manipulating the technology, are directly responsible for producing the new sound materials, so that their contribution is central to this music and their part in the overall creative authorship of the piece considerable.

However certain visiting composers have some knowledge of, at the least, electronic music and recording techniques, so they are less

totally dependent on the tutor's mediation. The visiting composer NO, for example, considered that although he owed a lot to his tutor JIG - for which he was determined to see that JIG's name would always be credited on the program note - ultimately the overall authorship of the piece was his. NO had much experience of electronic music and was therefore not completely dependent on JIG's help.

The deeper issues raised by the question of authorship of musical works developed through collaboration are aired in the following exchange with Boulez's long-standing tutor BYV. Boulez is known to refrain from hands-on work with computers and to delegate the whole practical-technological dimension to BYV. Despite this, BYV firmly places ultimate authorship with Boulez and colludes with an ideology whereby he is simply the technical aide who realises Boulez's musical vision.

BYV: "During the *College de France* (Boulez's seminars) I actually ran a psychoacoustical experiment... From then on I was working on Pierre's seminars, at first in a kind of light collaboration, and then more intensely."

Q: "Is some of this down to.. do you actually get on well with Pierre?"

BYV: "Oh yeah."

Q: "Regarding your experimental work with Pierre,.. do you have an ongoing regular work period with him?"

BYV: "Yeah. It's a little bit difficult with Pierre because he has his commitments outside and so our work is irregular. But it's.. ongoing; and for a number of things we're on the same wavelength and so we understand each other pretty well."

Q: "So you'll discuss things and try things out, and then do you continue working on things while he's away?"

BYV: "That's right. Sometimes he gives me.. a small task or a big task, and when he comes back he listens to the result."

Q: "Do you feel that your role is in a way translating Pierre's ideas into actual (practice), working on the machine? I mean, does Pierre himself have much contact with sitting at the machine and working?"

BYV: "No, no... When we first started working together I made him work on the machine. But you know, it's like an instrument, you have to keep at it regularly. And Pierre was basically too irregular.. so his progress really wasn't that (good)... It's basically out of a positive feeling that I work for him. Otherwise I would not work with other composers, I would not be.. a tutor... (That would involve) going from one musical universe to another, of varying quality. What I find satisfying in the work with Pierre is the sense of continuity in time. Because on the one hand there's an ongoing project, which is 'Repons', and there are other projects coming over the horizon, and there's

working on problems which go beyond particular pieces. So the particular pieces are.. a kind of detail. So it's the ongoing work over time...

But (as to) whether (composers) should ultimately work independently: I don't know. I think that's a little bit idealistic. I think that a lot of people will work by themselves, simply because the kids who are growing up nowadays will become familiar with computers, and so on. But of course in.. the last analysis, the computer is just a tool; in the end what is more important obviously is the intelligence of the musician, the composer. So there's a certain going beyond the fact that we use the computer or don't use it."

Q: "But how about that argument that since you're actually working not just with structure and form, the conceptual imagination of the composer, but actually with the production of sound material itself? There's the point about: when you hear people saying here 'Oh that piece, that's all so-and-so's...' ie the tutor's, because it's got his characteristic sound. I wonder what you feel about the question of how much the other tutors' or your own contribution to the final result is recognised or not? With Pierre maybe you don't feel that your contribution is terribly high profile in the final result?.."

BYV: "It's hard to say. I've been working with Pierre certainly longer than any tutor here has been working with any other composer.. almost 5 years. What you're.. raising is, in a collaboration of that kind, the question of authorship. My attitude to that is that the unquestioned author, let's say the 'deep' author, of 'Repons' or any piece that I work on with Pierre, is Pierre himself: there's no question about that... The solutions that I work on with him will obviously to a certain extent bear certain parts of my personality... But in the deepest sense of authorship, there's no question that Pierre is by far the main author. And that's not necessarily something that bothers me. The only thing that did for a time.. when I first started working for him, I didn't always feel that I got enough recognition for the work that I did for him. But that's changed."

Q: "For example with the publicity, having you clearly on it?.."

BYV: "Yes, things like that - a small gesture but it's important" (16).

In the exchange above BYV expresses his view of the tutor-composer division of labour as almost a manual-mental one, with 'deep' musical authorship firmly Boulez's, although he is sensitive to being properly credited in publicity. Regarding the future of computer music, BYV remains uncertain as to whether the tutor's role of technical translation will wither away, and sees that as 'idealistic'. Other IRCAM music intellectuals did believe that tutoring was simply a transient stage in the evolution of the field that would become obsolete with the growth of computing expertise among the young: a view that helped to numb their ambivalence towards their tutoring roles in the present. But

in the interview above BYV evades the basic issue: that is, if the highest aims of computer music at IRCAM, those centred on the unique musical possibilities of the computer (as with AV's project), involve the unification of sound materials and form, it becomes problematic to retain the distinction between simple 'manual', technical realisation of materials (tutor) and prior, higher conceptual and formal work (composer).

Thus according to the logic of IRCAM's own vanguard, we can see that the hierarchical ideology surrounding the tutor-composer division of labour is largely a left-over from earlier forms of music making, a hierarchical mystification obfuscating and devaluing the creative centrality of the tutor or whoever does the intimate conceptual and hands-on work with the technology.

8.2.1 Failure of documentation and communication: IRCAM's oral culture, security, secrecy, and intellectual property

Within the research and production sphere, we have seen that there is an ethos of collaboration, openness and co-operative knowledge sharing linked to IRCAM's image of itself as an oral culture; and together these imbue the culture with a utopian and libertarian spirit. But I show here that beneath this veneer workers are preoccupied with security and secrecy, and that 'knowledge sharing' is structured by patronage. I relate these phenomena to IRCAM's chronic problem of lack of documentation of its research, and to tensions over intellectual property. Lack of documentation is perceived as a problem both internally and externally; and many IRCAM researchers admit that there is a failure within IRCAM to fully develop much of the research and programming to a stage whereby it can be diffused more widely and used

by others. Yet some of those researchers, as we saw, hotly defend the need for longer term basic research cycles untrammelled by the need to stabilise and document. Below, I outline other factors exacerbating the documentation problem, some specific to IRCAM, while others are general phenomena related to the character of IRCAM's technologies and particularly software as a medium.

The notion of IRCAM as an oral culture, as mentioned Ch.7, was initially decreed by Berio. RIG recalled it thus:

"Berio made the famous statement, which became law, that he would have no documentation in his studio, because 'music is an oral culture' he said. This was crazy; but it became the standard in here, so that BU (4X Hardware designer) for example has never bothered to document his work".

We have seen that 'openness' and knowledge sharing are embodied and encouraged architecturally and technologically, by the glass walled offices and open-plan lab spaces, the interconnected loudspeaker system and computer networking. They are also embodied in the many formal and informal research meetings at which staff discuss ongoing projects and try out new ideas. Ideally in these meetings, intellectual workers act as each others' first, internal consumers or critics, so providing a first, experimental completion of the production-consumption cycle.

But above all, knowledge sharing and collaboration occur in the longer term collaborations between researchers or with composers; and in the constant informal consultations and mutual help exchanged between workers about understanding and using new bits of hardware and especially new software. Over the working week, researchers drop in and visit one another to ask for help with problems that have arisen, or to enquire about possible new resources (17). All of this informal consultation is by word of mouth. It is, therefore, largely an oral

culture of mutual help unaided by documentation, as the technologies in question are either still work in progress and so not yet 'stabilised', or they are custom-built one-off programming solutions. In either case, it appears that documenting the 'tools' in question has not seemed a priority or necessary to the researchers who are knowledgeable about them. Most intellectual staff are amused by the epithet 'oral culture' for IRCAM, with its egalitarian and collectivist overtones. These aspects of IRCAM culture, then, appear to express a healthy disregard for individual authorship in favour of collective endeavour and authorship, and a disdain for the fixing of research in textual form that would enable it to become realised as intellectual property. The oral, collaborative ethos appears also to counter the many rivalrous and ideological divisions within IRCAM's intellectual sphere outlined in previous chapters.

However things are not so simple. For one thing, visitors do not perceive the culture in this way. An American computer science consultant, for example, questioned the collaborative ethos, commenting that "The major contrast for me between Lucas Film and IRCAM is that there's no co-operation here, no one works together!". More seriously, IRCAM's educational licence legally enjoins the institute to maintain security on the commercial software, such as UNIX, that it receives. This involves protecting the source code, the basic level of the software, from being spied upon, copied or tampered with. Thus commercial interests and legal structures are supposed to prevent all levels of this technology from being openly accessible to all.

The Systems team say that it was as an initial condition of obtaining UNIX that they had to set up IRCAM's first computer security system: a system whereby access to working on the VAX is limited to

those who have been allocated an individual secret password that they must use when they first log on. Before UNIX came, there had been no such security system limiting use of the mainframe, so that in principle anyone could log on; and this had been a basic tenet of IRCAM's anarcho-libertarian computer subculture, led by a few internal programmers and the computer science squatters from Vincennes including the Professor, GB. The anarchists are proponents of an ideology widespread in international computer cultures, and supported by the technical difficulty of protecting computer data, that computer technology is inherently democratic and an anathema to notions of private property in knowledge. For example, several of the Chant/Formes group hold this perspective, which links to their advocacy of software that evolves due to a process of gradual cumulative input from their users, of communal authorship. The System manager FA reported that when he had first introduced the password system, several of the computer anarchists had refused to comply and took no password. They vowed to subvert the security, considering it to be ineffective window dressing in any case. This had set the scene for a half-serious ongoing game of ideological, pseudo-guerilla warfare between the anarchists and FA's Systems team, perceived as the system establishment or 'police', around the issue of security.

Ironically, the Systems team are sympathetic to the anarchist view and ambivalent towards security and their managerial role, so they oscillate between 'policing' and themselves subverting the security controls. Central to the password system are 'superusers': privileged users of the system who, for management purposes, have a common 'superuser' password which allows them access to all levels of the

system and its secret code. By contrast, users with ordinary passwords only gain access to restricted areas of the system. Only Systems team members are supposed to be superusers, and to know the superuser password. During mid 1984, however, it became apparent to me that knowledge of the superuser password was more widespread, and that the Systems team would let it be known to those with whom they were friendly or who were pragmatically useful. Thus, several of the scientific directors knew it, and a few senior programmers; once I had become a friend and intimate with the team I was let in on it; and a visiting systems consultant programmer, BWr (a close friend of the System manager FA) also knew it. FA admitted that even his supposed 'ideological opponent', the squatter-Professor GB from Vincennes, knew the superuser password. Rather than a guarantor of security, the password was therefore a currency with restricted access structured by the exercise of patronage, and one which by virtue of its over diffusion had currently become debased. Indeed its content was a meaningful joke: in 1984 the superuser password was 'Men at Work', the name of a then highly successful Australian pop group. The System manager FA and his friend BWr were Australian; and the name, invented by FA, was a poke in the eye for both IRCAM's high musical pretensions and those of the security system since it vested the ultimate technological power of IRCAM in a fizzy 'Aussie' pop group.

On the other hand, the anarchic 'openness' of access to information at IRCAM also creates ambivalence among IRCAM intellectuals since, as I showed earlier (Ch.7), it becomes akin to constant surveillance and denies them privacy for their work in progress. So workers invent various informal means of protecting their privacy and retaining secrecy for their work: they put up posters to prevent others seeing into their

offices through the glass walls; they adhere to IRCAM's night work culture, so as to avoid others knowing what they are doing, or even whether they are working at all. Two incidents gave me first hand experience of the fear of surveillance and intrusion. First, several months into fieldwork I was writing an early paper about IRCAM on a wordprocessor on the VAX, being careful to work only at night and weekends to avoid informants' curiosity. One Sunday the following incident happened, as recorded in my diary.

"I'm sitting typing a few pages, almost no one about, when RIG (Pedagogy director) comes in and stumbles about in the office, glancing at what I'm doing. He says: "You're not still using 'vi'? You should use the 'emacs' editor - it's much better, I only use that nowadays". I say: "I don't know emacs, I only know vi because that's what I learnt on the stage" (which he taught us!)... He goes next door. About half an hour later he comes in and says: "Excuse me for looking over your shoulder but..." and continues that I should learn some simple formatting rules that will automatically lay out my text... Comment: this 'looking over my shoulder' means that RIG had been checking me out, spying on what I was working on at my terminal by getting into my directory and files from his terminal! I must be very careful of what I write, mustn't leave any critical or confidential stuff in my files, because it seems that they can be examined any time... Later, I get scared that RIG will tell HM, HY and others about my article, that they'll all look and laugh at what I'm doing, turn against me".

My evident paranoia that anyone could look at my work stored on the VAX was less technologically misguided than socially. Weeks later I asked the visiting systems consultant BWr, who had become my friend, for help with making my files more secure; and he wrote me a little program whereby I could cryptically encode my files - scramble them up and make them unreadable except by using a secret decoding device that only I (and he) knew. Later BWr enlightened me about another area lacking privacy on the system: a file which stored all the past computer mail that I had sent. Ill.8.1 is the computer message, called 'On privacy', by which he told me. BWr's telling me was ambiguous, since it indicated that he may have been reading my past mail: another sensitive area,

since I had thought my mail confidential. These discoveries gave me a sensation of others having access to my hidden inner thoughts. The ease of access to files and data, even protected data, is confirmed by the *stageaire* VT, an iconoclast with a basic flair for programming, who confided to me a few weeks into the course at IRCAM that he had found a way to see inside many confidential institute files on the VAX.

Researchers' desire to keep their work in progress secret and private from rivals and critics relates also to tensions over differential access to research, and over intellectual property. The 'oral culture' of research means that to understand the technology one is dependent upon the oral help of the informed, and like the security system this help is socially structured by patronage since it can be withdrawn or withheld as well as granted. Both the 4X and Chant/Formes groups are informally notorious for the exercise of patronage; and this creates much ambivalence and frustration. For example, we saw above how the 4X designer BU took his compatriot Berio at his word by refusing to document his hardware designs and so retaining an oral research culture. RIG described his own encounter with this as follows:

"I used to work on BU's machine - I did a piece on the 4A, for example, I wrote a lot of the 4A's basic software. But I gave up and moved over to the PDP10 because it was impossible to work on BU's stuff! You always had to go to him to ask what was going on, what was wrong, how things worked.. there was never any free information. BU has always been totally secretive and not let people in on his stuff. That makes it hell to work with ".

This view of BU as withholding information about his machines is widely held, so that even a 4X Software researcher complained: "An oral culture! There's no documentation for the 4X, so one must go to BU or AJ (BU's sideman) for any knowledge about it" [WRY]. A consultant said: "BU will only talk to some people, not others. CA (an ex-IRCAM American

researcher who wrote basic software for the 4A machine) couldn't work with him, because BU wouldn't tell him what was in the relevant part of the machine!" [NRD]. BU is therefore known for bestowing information about his hardware orally on those he wants to patronise, and withholding from others.

Similar views of motivated inclusion and exclusion are held about the Chant/Formes group. Thus, the programmer JDK was a founding member of the project, central to early research, who left and took another IRCAM post to gain a salary rise in order to support his four children. Despite his inhabiting the next door office, he reported that the group would now no longer confide in him about research; and he was bitter and sad at this exclusion from the group's confidence. Chant/Formes are also rivalrous with the System manager FA and engage in conflicts over secrecy and control. FA's job of disinterested policing of the mainframe environment involves knowing the location and identity of each bit of programming going on in the computer. But FA has an ongoing tussle with the Chant/Formes group, who hide parts of their work in the bowels of the computer, refusing to tell him. "They hide their source code from me!" he complained. This atmosphere breeds retaliation: there was an angry system message on the VAX from Chant/Formes director MC one day, demanding to know who had stolen or deleted some of their essential source code. Chant/Formes is, then, a highly bounded group, despite its intellectual advocacy of the libertarian, 'open' computer philosophy, and selective about bringing in new researchers; in 1984 new attachments to the group were limited to MC's own postgraduates.

We can see now that IRCAM culture shows an oscillation or tension between its self-image as a collaborative and open oral culture, and the security imperative which, buttressed by informal competition and

rivalry and researchers' desire to retain privacy for their developing work, encourages patronage and tends towards secrecy and closure. We have seen that IRCAM's utopian principles of openness and collaboration do not simply flow from its technologies, from the inherent collaborative or democratic nature of tape media or of the computer. They are equally ideological or discursive principles derived from aspects of Boulez's founding vision and from broader currents within computer culture. We have also seen how, as well as official security sanctions, subjects can and do invent mischievous ways of restricting access to, and so guarding the privacy and secrecy of, their work. Ironically, then, IRCAM's 'oral culture' and lack of documentation favour secrecy and patronage; and the exercise of patronage, we saw in earlier chapters, is in itself a strategy for accruing power and a source of gratification (18).

8.3 Conclusions

The tensions that I have outlined throw a different light on the problem of IRCAM's lack of both stabilisation and documentation of research. We can see first that the notion of an 'oral culture' is in part a utopian rationalisation of the chronic lack of documentation, and one that allows patronage to flower in the realm of research. But underlying this, we can discern two sets of forces working against stabilisation and documentation: one concerning intellectual property, the other concerning the phenomenology of software as a medium. The material above has shown that tutoring relationships and technological research projects are imbued with tensions and conflicts over intellectual property: both over the principle of intellectual

authorship, itself confused by ideological and moral tensions over the relative merit of individual and collaborative labour; and over 'real' interests of property and ownership. Rather than simply expressing researchers' utopian and libertarian impulses, the lack of stabilisation and documentation also reveal subjects' insecurity as to whether their authorship will be respected, which generates ambivalence towards documenting their research. By neglecting documentation, researchers protect their work from others and appear to retain greater control over it, both intellectual and material. Of course, they also fail fully to develop or communicate their work. Further, given IRCAM's problems with industrially or commercially developing its research, and compared to the vanguardist prestige of constant open-ended research and the stimulation of continuing collaborative *bricolage* (eg as suggested by AV's project), researchers' material incentives for completing a product by stabilising and communicating their work are unclear at IRCAM.

Two phenomenological factors compound this. First, we have seen how the context of IRCAM's software and programming research in particular is extremely unstable, due to technological dependence and the enforced revision of standards and constant premature obsolescence of the technological infrastructure that this brings. Since programs are being constantly adapted to new contexts, re-written and re-translated, and also constantly written and then discarded, the task of documentation appears massive and, ironically, unproductive; its value becomes debased, since a program documented this month may well be transcended or obsolete by next month.

Second, we saw earlier how programs are often developed over time through a collaborative *bricolage*, with several authors contributing to the whole. This in turn has two implications. First, it means that the

resultant complex, baroque totality is extremely difficult for any one programmer to decode in toto, and thus opaque to the reconstruction of its total logic - the necessary prerequisite for documenting. This throws new light on the security 'battles' mentioned earlier; since according to a senior programmer, even with access to a program's full source code, this code is so complex and resistant to intuitive decoding that programmers cannot reconstruct the program's higher logical meaning without the exegesis or help of the writer, or someone else who already understands it - ie without the patronage of the knowledgeable. Thus 'spying' on the code of complex programs is unhelpful and does not in itself allow one to understand or use the program: the hiding of source code is more a game simulating issues of control than the real locus of the issue. The second implication of the gradual collaborative *bricolage* of software is that it renders authorship problematic, since it is hard to reconstruct afterwards who contributed what to the program. It becomes unclear both who is, in principle, the intellectual author, and so creatively responsible and responsible for documentation; and who should gain which material rights in the product if it were to be documented and fully developed - a strong disincentive. Thus tensions of intellectual property are made particularly acute by the character of software as a medium.

It seems that in relation to IRCAM's technologies and particularly software, the combination of an ideology centred on the values of vanguard research and utopian collaboration, the lack of prestige, protection or material incentives for either individual authorship or the completion of products, the divisive ideological disputes outlined in this and earlier chapters (19), compounded by the phenomenological

problems outlined, all create a particularly self-absorbed research culture: one that is highly diffident about communicating research both internally and to the outside world.

In summary, beneath IRCAM's surface of apparent openness and knowledge sharing lies a nexus of rivalry and competition over research, fuelled by workers' concerns over intellectual property; so that the sharing of knowledge is in reality strongly structured by patronage. Chronic tensions over intellectual property and the principle of authorship are found both in the tutoring relationship, at the heart of music production at IRCAM, and within and between technology research groups; and they are exacerbated by the character of software and its centrality to all IRCAM's work. These tensions fuel tutors' and researchers' ambivalence to their work, and may contribute to low productivity. For junior and official tutors, the tensions are compounded by a sense of exploitation and by devaluation of their collaborative labour, a major creative contribution to the resulting work, which is considered simply technical. Finally, we can note that the coexistence within IRCAM of the overproduction of technical codes and texts, described at the start of Ch.7, with the institute's oral culture of mutual help is far from contradictory. Rather, the oral culture is necessitated by the hypercomplexity of those codes and texts given the failure of documentation, and by the instability of the environment.

Chapter 9 Modernism and post modernism, aesthetics and technology

in IRCAM culture

Introduction

The previous chapters have provided a portrait of IRCAM as an institution, and of its intellectual culture: its ideologies, practices and conflicts. However, a fuller understanding of IRCAM's intellectual culture requires an historical analysis of the main aesthetic and philosophical traditions by which it is informed and which, in turn, it aims to inform. The clearest indications of IRCAM's dominant aesthetic came from the analyses of Boulez's aesthetic discourse (Ch.2, App.5) and of the IRCAM canon (Ch.5), both of which, I suggested, centre on the modernist tradition in music: a tradition spanning most of this century. The first half of this chapter, then, centres on an analysis, drawn from secondary sources, of the key discursive characteristics of modernism and post modernism, in general and in music, as they develop during the century. This sketches out the dominant features of those traditions which can then be related back to aspects of IRCAM culture.

I begin with a characterisation of modernism and post modernism in general, since this provides a framework for the specific developments within music. Turning to musical modernism, I trace its increasing legitimation through the past decades; and I show that it is not a unified tradition. I analyse a historical divergence within the musical avant garde between two main post-War movements: the post serialist modernists, and the experimental post modernists. The characterisation of these antagonistic avant garde traditions throws light on how post modernism asserts its difference from modernism, and so on the relationship between modernism and post modernism. From the historical

material I draw a hypothesis of their interrelation which I then bring to the analysis of conflict and differences within IRCAM culture.

In the second part of the chapter I focus closely on the differentiation of IRCAM intellectual culture in relation to its two main areas of work: the musical-aesthetic, and the technological. I provide an account of inter-subjective and intra-subjective differentiation of IRCAM intellectuals in regard to both areas. I then draw out factors underlying subjects' positions, and so analyse mechanisms in the social construction of aesthetics and technology at IRCAM. In the light of the hypothesis above, this in turn generates insight into the representation of modernism and post modernism within IRCAM.

9.1 Characterising modernism and post modernism

In this section I draw upon research from art, cultural and music history and criticism to characterise the traditions of modernism and post modernism in general. From them I have distilled a set of dominant, recurrent characteristics at the heart of these discourses. This provides a backdrop against which to analyse musical modernism and post modernism in the next section. The point is to demonstrate that certain dominant characteristics of Boulez's ideology and IRCAM culture are prefigured not only by musical modernism, but by major features of modernist art in general: so that musical modernism must itself be understood within the context of broader cultural historical forces.

I characterise modernism under five themes: negation; new media, technology and scientism; theoreticism; radical interventionism, vanguardism, and the political dimension of modernism; and finally, difference from and antagonism towards commercial popular culture (1).

Modernism refers to the cultural era that follows late romanticism. It is a generic term referring to the new aesthetic movements across the arts that date from the late 19th and early 20th centuries, amongst them in the visual and literary arts symbolism, expressionism, cubism, futurism, constructivism, dada, surrealism (2). The first common, defining feature of modernism is its basis in a reaction by artists against aspects of the prior aesthetic and philosophical forms of romanticism and classicism. It is this general feature of modernist art that is often referred to as the negative aesthetic or simply negation, since the prime motive is a negation of the principles of the previous tradition: in painting, a rejection of realist representation and the primacy of subject matter in favour of abstraction and an emphasis on formal and perceptual experiment; and in music, the deconstructing and rejection of the earlier harmonic, melodic and sonata forms of tonality in favour of the extension of dissonance and ambiguity. In all the modernist arts there thus arose a self-conscious experimentation with form founded on a sense of the necessity of revolutionising the 'language' of art itself (3).

The second modernist characteristic, linked to the desire for formal experiment, is a concern and fascination with new media, technology, and science (4). Modernist scientism arose as early as the 1880's, as shown in the work of Seurat and Cezanne. Both were centrally concerned with changing the basis of art perception, influenced by its scientific study (5). The celebration of technology is clearest in early 20th century movements such as Soviet constructivism and Italian futurism, both of which advocated new media and drew analogies between industrial production and cultural work (6). Technologies affected not only the artistic means of production and reproduction. They were also a

new aesthetic stimulus in terms of subject matter, for example in the way that cubist and futurist abstractions recall the forms and movement of machines. Futurists were especially ardent and iconoclastic proponents of the aesthetics of technology and of science, as in the work of the futurist theorist Severini who wrote that art should evolve hand in hand with science. His was an eclectic scientism: on the one hand theorising the interdependence of perception, psychology and aesthetics, on the other proposing an aesthetics of numbers (Apollonio 1973:10-11). Futurist visual art was strongly influenced by the new technologies of film and photography. While Russolo, the key futurist theorist of music, argued in his infamous 1913 manifesto The Art of Noises that "musical evolution is paralleled by the multiplication of machines" and called for music to become an 'art of noises' embracing the new urban and industrial soundscape (7). Futurist music theory became a major influence in composers' turn to technology and their search for new sound materials over the century, as for example in *musique concrete*. The futurists' predominantly polemical and aesthetic concern with technology and science, however, suggests that this early modernist reference to science and technology was largely symbolic and rhetorical, embedded in a cultish fascination: a view supported by both Poggioli (1982:131-147) and Anderson (1984:105) (8).

A third modernist characteristic, implicit above, is theoreticism. Modernist art invests an unprecedented power in exegetical texts. Examples are the polemical manifestos and writings that accompany many of the early 20th century movements: constructivism and futurism, dada and surrealism. Huxtable writes of modernist architecture: "Nor is it unusual in architecture for theorist and practitioner to be the same person - a notable phenomenon in 'modern' times from Serlio to Le

Corbusier" (1983:31). Art theory and practice were of course linked in earlier periods; but modernist artists attempted to solve the crisis in traditions and 'language' which they faced by foregrounding theory to construct and determine their practice. This is, then, a more profound change of relationship between theoretical text and artistic practice: "The normal point of intersection between the creative process and its recording and analysis has been speeded up and even reversed" (ibid:29), so that theoretical text precedes creative process. Further, theoretical texts take on the ambiguous role of exegesis and criticism, proselytising and publicity: both expounding and legitimising practice. Theoreticism, then, becomes central to the legitimation of modernist art practices, and closely implicated in the avant garde's pedagogic and prescriptive mission.

The fourth characteristic concerns the politics and political rhetoric of modernism, its vanguard and interventionist aims. Overall, most cultural historians now see the politics of the artistic avant garde as primarily rhetorical and metaphorical, confined to formal critique and terroristic attacks on extant tradition (Poggioli 1982, Haskell 1983, Hughes 1980, Williams 1988). The majority of modernist movements centred on purely formal experiments designed to subvert and shock the avant garde's dual enemies, the academic art establishment and the bourgeois audience; they sought no broader social engagement or political effect. In this sense, they can be characterised as formalist: ignoring or disdaining an involvement with the broader social or political dimensions of culture, preferring critique to be confined within the artwork itself. The phenomenon of aesthetic critique being read as social or political critique relates to the close association between modernism and the avant garde, and to the radical political

connotations of the concept of an avant garde. The reasons behind these radical political connotations are complex, and both historical and discursive.

They can initially be traced through three aspects of the historical context of the avant garde. First, the origins of the concept in early French socialism (discussed in Ch.2, App.4) and the shifting relations between artistic and political radicalism in 19th century France (9). Second, the wider political climate of late 19th and early 20th century Europe - as Anderson puts it, the "imaginative proximity of social revolution.." (Anderson 1984:104-5) and its influence on artists; although, as Anderson notes, modernist art was objectively trans-political - capable of affiliation with both Left and Right (10). And finally, the total suppression of modernist art from the 1930's in Nazi Germany and Stalinist Russia, which led after the War to the perception of modernism as inherently anti-totalitarian and anti-fascist (11).

Several discursive aspects of the avant garde fill out its radical and 'critical' connotations. First, allied to the interest in technology and science, modernist artists expounded a rhetoric of progress, constant innovation and change, and saw their role as leading this process through a radical intervention in art and culture. Poggioli calls this general characteristic 'futurism': the notion that the present must be subordinated to the future. Artists saw themselves as a vanguard charged with pursuing uncompromising progress, by definition ahead of current tastes, and so with a pedagogic mission to educate and convert the unenlightened audience. Haskell (1983) and Poggioli are at pains to show that, while such attitudes had existed in earlier times, they became systematic and intensified to an unprecedented degree with the rise of the concept of the avant garde from the late 19th century.

In addition, modernist experiments in formal negation - expressed in new aesthetics of fragmentation (collage, montage in cubism, dada), abstraction, the revealing of underlying structures (cubism, constructivism, futurism) - took on more than purely formal meanings: they were read as oppositional, subversive, as politicised critiques of the extant moral and social order. The language of art criticism became politically metaphorical to an unprecedented degree. Discussions of 'continuity, tradition' versus 'change, progress' appeared to be at the same time aesthetic and political, both 'real' and metaphoric.

Finally, Haskell relates the perception of the avant garde as 'critical' to artists' gradual internalisation of an ideology in which their art must attempt to subvert the (aesthetic) status quo, since artistic value depends on being 'ahead' of current tastes, which implies that it must necessarily be incomprehensible to the present audience. He traces the institutionalisation of the belief, still strong today, that "an instinctive hostility toward contemporary art..(is) the necessary breeding ground for true art" (1982:25) (12). Thus avant garde artists seek to alienate the general audience as proof of the value of their work.

Against these analyses, as we saw in Ch.1, Burger (1984) argues that a few movements - Russian constructivism, Italian futurism, dada, surrealism - did present broader critiques of the social and institutional forms of art. He reserves the term 'avant garde' for these politically engaged movements, opposing them to formalist modernism, and so retains a political reading of the notion of an avant garde. With other critics (T.J.Clark 1983), Burger sees this as the basis for a renewal of modernism in a politicised, contemporary post modern art.

The fifth feature of modernism, a significantly 'unconscious'

dimension only recently remarked upon by analysts (as mentioned in Ch.1), is its ambivalent relations with the 'other' of commercial popular culture. The development of modernism occurred simultaneously with the rise, from the mid 19th century, of urban popular culture and the new entertainment industries. The two - modernism and 'mass' culture - coexisted thereafter, in discreet domains. The early modernist period was also the height of French and British Empire, and witnessed the importation of non-western art. So modernist artists confronted a variety of 'popular cultural' forms: from the mass culture of the metropolis to 'primitive' and folk cultures. Recent analysts have traced the often hidden interrelations between modernism and mass culture (Crow 1983, Huyssen 1986), while exploration of the influence of non-western cultural forms is more established (13). Overall, with the coexistence of modernism and mass culture in mind, and the decline of reference to mass culture with the rise of formalist visual abstraction as analysed by Crow (a process paralleled in music as I later show), it becomes apparent that an implicit, defining characteristic of modernism is the assertion, under the guise of pure, formal autonomy, of its absolute difference from popular culture; whilst, crucially, reference to non-western forms has remained more acceptable. Modernist 'uninterest' in mass culture is revealed as a more active antagonism and repudiation in the writings of major modernist critics such as Greenberg (on painting) and Adorno (on music) (14). Popular culture has thus been the 'other' of modernism, with 'authentic' folk and primitive exotic forms more acceptable and enduring as influences than urban and commercial forms, as I show later in relation to music (15).

In conclusion, from this analysis we can see how many dominant aspects of IRCAM culture and of Boulez's ideology - the founding

principle, the 'necessity' of bringing technology and science into music, the concern with new media, sound materials and forms, the theoreticism, self-conscious vanguardism and preoccupation with constant innovation, the formalism linked to an absence of critical concern with the social and political dimensions of culture, the Boulezian ideology of a necessary alienation from the general public, and the antagonism towards commerce and towards popular music and culture - all of these are prefigured by the general historical character of artistic modernism.

Turning to post modernism, in Ch.1 I sketched two areas of recent debate concerning the key developments that are often taken to mark the break with modernism. The concept of post modernism first arose in architectural debates (Jencks 1977); but it has been generalised to refer to new forms of cultural theory and practice from the 1960's and '70's. Like modernism, post modernism subsumes different developments, and its character is still being fought out in cultural theory and practice. However, post modernism is unified by common origins in the attempts by artists and intellectuals to supercede the impasse of modernism, and motivated by a common dissatisfaction with modernism.

There are two main ways that proponents of post modernism claim that it marks a radical departure from modernism. First, post modernism reacts against modernism's hostility towards, or non-recognition of, popular culture; or against the modernist negation of the earlier 'languages' of art - realism and representation (in visual art), narrative (in literature), and tonality (in music). Thus some post modern works see a re-appropriation of earlier forms: hence neo-classicism, neo-romanticism and so on. Post modernism is thus defined by negation of a (modernist) negation, thereby reproducing a modernist

mechanism and revealing, ironically, an essential kinship with modernism. Unlike many analysts of post modernism, who stress the discontinuities with modernism, I suggest that analysis of the relation between the two must therefore trace discursive continuities as well as divergences. Significant continuities include negation, as we have seen, and the embrace of new media and technologies.

The second major divergence claimed by some advocates of post modernism, to some extent linked with the first, is a rejection of the pre-dominantly a-social and formalist, pedagogic and elitist cultural politics of modernism. Foster calls this the 'anti-aesthetic' (1985b), by which he means a rejection of modernist belief in the autonomy of the aesthetic. This, and the turn to popular culture and earlier cultural forms, characterise two tendencies within post modern-ism which I call, respectively, the 'vanguardist' and the 'populist'.

The 'vanguardist' position, like Burger above, hangs on to the modernist notion of a critical avant garde, now allied to or rooted in the 'new social movements' around race and ethnicity, gender and sexuality. Hence the prominence of feminist post modern art (eg Owens 1985). Lyotard depicts post modernism as the end of the grand modernist narratives (of humanism, marxism) and as a celebration of heterogeneity, dissent, the proliferation of '*petits recits*' (1984:60). Foster's view is similar: post modernism as sensitivity to difference, linked with an interrogation of the social affiliations of art (1985b). But rather than this politicised 'vanguard' post modernism, the populist stream is more visible. In terms of cultural theory this involves an optimistic pluralism and populism, a celebration of consumption and desire. In cultural practice, it involves one of two strategies: either an aesthetic reference to commercial popular culture with the intention to

overcome the separation between 'high' and 'low' culture and to appeal to the popular audience (as theorised by Huyssen 1986 and analysed by Crane 1987 (see Ch.1)); or an aesthetic reference, or return, to pre-modernist cultural forms - tonality, realism and so on.

The claims made for post modernism thus raise questions. Does post modern practice effect an engagement or '*rapprochement*' with popular culture? And how politicised or socially engaged is 'vanguardist' post modern culture? This, in particular, needs to be addressed given the fact, summarised but not interpreted by Jameson (1984b:62), of the trans-political character of post modern debate - a further continuity with modernism. This analysis also suggests two important dimensions for empirical investigation in relation to IRCAM culture, which provide clues to its placing in relation to modernism and post modernism: its political character; and its relations with the 'other' of mass and popular culture and music. I address these questions below, first in relation to recent music history, and then to IRCAM.

9.2 Modernism and post modernism in music

9.2.1 Musical modernism: serialism and post serialism

In the following account of the main historical developments in musical modernism, I show how it can also be characterised by negation, vanguardism, concern with technology, scientism, theoreticism, and by increasing rationalism; and how, after some early modernist reference to non-western and folk musics, this becomes submerged with the rising mid-century dominance of the abstract, rationalist method of serialism. In this way, musical modernism asserts its absolute difference from popular music. I also chart the rising legitimacy of musical modernism.

In music, modernism is usually timed from the breakdown of the underlying musical system of tonality which had lasted for over 300 years, and upon which baroque, classical and romantic music had been based. The late romantic composers, such as Wagner, had expanded that system so much that it was under great strain, its basic principles in question; and composers began a search for new organising principles, a new basic system. First, around the turn of the century, came a period of atonality - the suspension and avoidance of all tonal reference and of thematic form. But in the early 1920's, a new compositional technique and philosophy called serialism was created by Schoenberg and his pupils Webern and Berg (the Second Viennese School). Serialism, a stylistic revolution, became the most powerful development out of the crisis of tonality and was for some decades the organising force of musical modernism.

Serialism involves the construction of a 12 note series or row, using all 12 chromatic notes of the scale in a fixed order, each of which must be used once before the series can be started again. To generate material for a piece, four basic structural transformations of the series are produced: the original form, backwards (retrograde), upside-down (inversion) and retrograde-inversion. The four transformations can then be transposed to start on each of the 12 chromatic notes, so giving 48 permutations which provide the seeds of the composition. Serialism starts from the principle of the homogeneity of chromatic space (16), while by contrast tonality centres on the functional and symbolic hierarchy of the tonic or key note, its dominant and sub-dominant. In this sense, serialism negates the hierarchical ordering of pitch space in tonality. Compared to the negational character of abstract visual art, serialism - a highly rationalist and

structural system that aspires to the status of a new musical 'language' - can appear a positive and 'non-negational' development. But as I have described, serialist principles nonetheless prescribe an aesthetic that is completely antithetical to, and so a negation of, major aspects of tonality. We have seen that Boulez also conceives of the mid-century serialist aesthetic as negational (App.6), as did his mentor Adorno (17).

Given that tonal harmony is one of the aesthetic bases of the history of commercial popular music, the absence of tonal reference is a key marker of the way that modernism asserts aesthetic difference from popular musics; and this difference is systematised and rationalised in serialism. But early century musical modernism, before the ascent of serialism, was more eclectic; and composers drew on popular musics as influences, for their modes, rhythmic or structural forms. Significantly, the early modernists drew overwhelmingly on non-western and folk influences, as in the music of Debussy, Satie, Stravinsky, Bartok, Kodaly (and other nationalist modernists). Thus with few exceptions - such as Ives' use of popular band music and song, Weill's loving parody of cabaret, the influence of jazz in Krenek, Milhaud, Ansermet etc - modernist composers, where they made reference to popular musics at all, disdained urban and commercial popular forms in favour of exotic and 'authentic' popular musics. In most cases (except Weill - see note 20 below), popular musics were treated as an 'other' to be drawn upon as an influence; or to be played in 'other', less serious contexts. The serialist tradition in general disdained reference to these musics. Thus, in accord with the earlier analysis, popular music can be seen as the 'other' of musical modernism.

The early century musical avant garde also exemplified the

phenomena of vanguardism, radical interventionism, and a defensive disdain for immediate audiences. Like the other avant gardes of the early century, it aroused public scandal and moral outrage. An infamous occasion was the first performance of Berg's '*Altenberglieder*' in Vienna in 1913, which provoked such a riot that the police were called out; as did the Parisian premiere of Stravinsky's '*Rite of Spring*' soon after. This extreme public hostility caused defensive attempts by composers to get their music played. Schoenberg and his circle founded the '*Society for the Private Performance of Music*' in 1918. Private performances were by invitation and unpublicised, and critics and the public were debarred. They thus created a closed, elite group by which their music was judged, against the ravages of commercialism and of the mass public. As we saw in Ch.2 (App.4), Boulez took the '*Society*' as a model for his *Domaine Musical* in the 1950's. These early modernist composers supported themselves mainly by private teaching and occasional conducting jobs. They held the marginal, ostracised position typical of an avant garde.

Schoenberg was an ambivalent revolutionary, believing his work to lay the basis for continuing tradition, while acknowledging that he was instigating an irrevocable break with the past. He felt himself impelled by a force greater than himself, necessary for the future of music. He wrote in 1910: "I am conscious of having broken through every restriction of a bygone aesthetic... I am obeying an inner compulsion which is stronger than any upbringing" (quoted in Rosen 1975:14-5). This illustrates Schoenberg's self-conscious view of his vanguard mission, which he supported by a number of important teaching texts. Adorno later elaborated upon Schoenberg's view of his work, seeing Schoenberg's uncompromising pursuit of the immanent laws of aesthetic development as the only progressive direction for modern music (see note 17 above).

Adorno's is the most eloquent philosophical defence of the critical potential of modernist aesthetics (Adorno 1948 (1973)).

Thus, aided by Schoenberg's pedagogic writings, and by the serialist and aesthetic teachings of Adorno, composers Leibowitz and Messiaen, serialism as a method of composition became the ideological rallying point of the new post-War European avant garde at their meeting place, the Darmstadt summer school, from the late 1940's on. The generation of composers who came to the forefront from the 1950's on - led in Europe by Boulez and Stockhausen, in the USA by Babbitt - elected Schoenberg's Second Viennese School as pioneering forefathers. I will call this post-War tradition 'post serialism'. Boulez and Stockhausen at Darmstadt, and Babbitt at Princeton, soon themselves became leading teachers; and through their extensive influence, serialism has been the main training technique for composers up until the present. However, since the War there have been two main lines of development within the musical avant garde: one this post-serialist group, who extended the modernist tradition and became dominant; the other, the experimental composers who, after their founding figure John Cage, developed what is now often considered the post modern position in music. I return to this later.

As we saw earlier in relation to Boulez (Ch.2.3.4, App.6), the post serialist composers tried in different ways in the '50's to generalise serialism in order to produce a new, universal musical 'language'. Following their reading of Webern's late technique, they extended serialism to the rationalist and determinist control not only of pitch but all other parameters of composition: rhythm or duration, timbre and dynamics. This became known as 'total' or 'generalised serialism'. It was accompanied by polemical writings against the aesthetic compromises

of much inter-War composition and, adopting the pedagogic and prescriptive vanguard mission, attempted to purify the correct, rigorous direction of the avant garde.

The '50's generation added further layers of rationalism to that inherent in serialism. They were scientific, and explored the acoustics and physics of music. They also began to scientise the conceptual basis of composition, drawing on maths, statistics, information theory, logic, linguistics, as revealed by the character of conflicts between them at that time (18). In parallel, drawn by the new post War electronic media, composers turned to technology for the analysis and generation of sound. Both the scientism and the technological bent were legacies of early modernism, both in general (as we have seen), and of two specific and important musical influences. The first were the sound experiments and philosophy of the Italian futurists, discussed above. The second influence was that of the French-American composer Varese who, from the 1920's on, called like the futurists for new sound materials, for the progress of music to be allied to the development of new instruments, and pioneered a new concern with timbre. His earlier works explored percussion sounds, and later works the new "liberating medium" of electronics (Middleton 1978:70). Varese was perhaps more responsible than any other individual for the importation of scientific terms and rhetoric - 'research', 'experimentation', 'laboratory' - into theorising music. He wrote of music as an "Art-Science", and in 1936 condoned the view, prophetic of IRCAM, that "there should be at least one laboratory in the world where the fundamental facts of music could be investigated" (ibid:68) (20). Thus Varese's discourse was an important precursor both of the tenor of the post War avant garde, and later of IRCAM itself.

By the 1950's tape recording technology and electronic wave

generators became available to composers with access to radio stations or university labs; so that access was limited in this period to those affiliated to large institutions, while less credentialled composers had no such access. The leading Europeans, Boulez and Stockhausen, both worked in radio stations, Babbitt in university laboratories. Babbitt's combination of electronics with total serialism, extended particularly to rhythm, aimed to produce accurate performances of extremely complex serial scores. His work made use of an early pioneering large synthesiser made by RCA and based at the Columbia-Princeton studio.

Stockhausen's work brought together serialism, scientism and electronics with the aim of total control of timbre, at that time the most elusive and unanalysable element of music. As I mentioned in App.8, Stockhausen wanted to create a systematic repertoire of artificially-generated timbres, analytically ordered and so suited to serial manipulation. He aimed at achieving a combination of perfect sound material (pure sine tones) with a perfect theory (total serialism). But in fact the theoretical, scientific and technological bases of Stockhausen's electronic music proved reductive and inadequate, and reveal the limits of the rationalism and determinism of the time. It was thought that, through Fourier analysis, any timbre could be synthesised simply by setting up a series of oscillators to produce each component partial frequency in the timbral spectrum as a steady state sine wave. But this produced woefully poor results, since it omitted several other crucial and idiosyncratic elements of timbre: above all, the interrelated evolution of each partial in time, and variable degrees of noise, both of which are now known to contribute to the organic quality of timbres. Stockhausen's notion of total serialisation of timbre was, then, an extreme expression of the scientific musical rationalism of

the time; and, as we saw in Ch.7, the scientific analysis and simulation of timbre, even in computer music, are still far from perfected.

Another characteristic of these composers was their theoreticism. Boulez and Babbitt are among the foremost theoreticians of contemporary composition. Both have produced powerful theoretical writings and have been very influential teachers. Boulez's writings, as we have seen, are formidable and draw on structuralism, linguistics, set theory. These composers followed Schoenberg's example, then, in uniting theory and practice. The post-War period also saw the consolidation of the new academic music disciplines of musicology, music theory and analysis in the universities, and a proliferation of textual and theoretical analyses of music. Journals appeared as mouthpieces of the new theories, led by Perspectives of New Music (on the American east coast) and Die Reihe (in Europe). The theoreticist post-serialists were at home in such a context; so that Babbitt's 'total serialism' soon became the dominant school of composition in the powerful American east coast universities such as Princeton and Yale. While Boulez, as we have seen, after stormy earlier relations with official culture, returned to France in 1970 at President Pompidou's personal request to direct the planning of IRCAM: a large institution dedicated to technological and scientific research around music.

Kerman (1985), describing the bewildering specialisation within musicology since the War, says that the new disciplines of music theory and analysis, as well as studying modernist texts, took on a more complicit role in their construction. Thus music theory became not just descriptive but prescriptive: "Much of the power and prestige of theory derives from its alignment.. with the actual sources of creativity on the contemporary musical scene" (ibid:15). This incestuous union of

theory and composition was cemented by the post War academicisation of post serialism in the elite American east coast universities. Kerman comments:

"Babbitt at Princeton was pointing out that avant garde music could find its niche after all - though only by retreating from one bastion of middle-class culture, the concert hall, to another, the university. Like pure science, he argued, musical composition has a claim on the university as a protector of abstract thought... So Princeton.. set up an academic programme for the PhD degree in musical composition in which the final exercise consisted of a musical composition plus a theory dissertation or essay. The marriage of theory and composition was legitimised by graduate councils around the country; the avant garde was house-broken into the academy" (ibid:101).

We can see, then, a process of increasing legitimation of post serialism, which the character of the discourse - rationalist, scientific, determinist, theoreticist, formalist, concerned with high technology - was particular suited to, and which enabled this tradition to become acceptable to state cultural institutions and to the academy. Central to this process was the fact of composers themselves becoming theorists, providing a metalanguage (science) to rationalise and assess composition - a metalanguage that was itself extremely powerful and legitimate. It is, then, the post-serialists who best exemplify mid-century musical modernism; and who became established internationally from the 1950's as the dominant tradition of the musical avant garde, a hegemony in which the Europeans and east coast Americans, despite their rivalries, were ultimately collusive (20).

9.2.2 The counterpoint of modernism: post modernism and experimental music

The main alternative avant garde development to the dominance of post-serialism from the 1950's on was the tradition of experimental music that centred on the American composer and guru John Cage and his

followers. As I have mentioned, this is often considered the foundation of musical post modernism; and we will see that it provides a counterpoint to the post serialist tradition. These composers were less well known, less powerful and legitimate than the post-serialists; they became the 'unserious' dissidents of the avant garde.

Cage had been a pupil of Schoenberg's; but by the 1940's he was developing his own compositional philosophy, opposed to the legacy of serialist rationalism. In reaction to serialist determinism and the hyper-control of all parameters of sound, Cage and followers wanted to liberate them by introducing aleatoric and chance procedures: non-control. His watchword was indeterminacy. Nonetheless, experimental composers sought different theoretical determinants for their composition. Cage turned to anti-rationalist cosmologies - Zen and eastern mysticism; while other experimentalists became involved in alternative belief systems, for example marxist-leninist politics. Paradoxically, then, the experimentalists remained theoreticist and determinist, while searching for alternative philosophies - non-scientific and more social and spiritual - to legitimise and prescribe compositional practice. The music was still constructed in discursive texts; Cage, like Boulez, is also known as a writer-philosopher.

Against the often unperformed and unperformable complex scores and text-centred composition of the post-serialists, experimentalists wrote simplistic scores that broke away from traditional music notation, often just a short written description or graphic diagram aimed at live performance that intended to give the performer maximum interpretative play. In opposition to the primacy of pitch logics in serialism, Cage proposed instead that time should take the central position in music since it was materially central to both sound and silence (21). Against

the post serialist view of time as linear, 'duration' as mathematically quantifiable, experimental composers viewed time as non-cumulative, non-directional, static, and rhythm as cyclical, repetitive and processual. Cage called for 'non-intention' and (after Satie) 'purposeless music', in rebellion against the teleology of serialist, and before that classical, form. This approach is well expressed in the minimalist, process or systems music of composers such as Riley, Glass and Reich, which developed out of the experimental tradition. Influenced by non-western musics, for example Javanese Gamelan, this music sets up repetitive and cyclic rhythmic structures that permutate as the performance unfolds: a ritual process set in motion. Performances sometimes lasted for 24 hours; and music was stripped to a minimal simplicity.

The mention of non-western music and ritual raises two key aspects of the experimental tradition and its post modern legacy that are significant by their absence from modernist post serialism: that is, they mark the difference between the two avant gardes.

9.2.3 The experimental break with post serialism: popular music, and the social

First, experimentalists had an interest in, and made reference to, non-western and popular musics. Compared to post serialism and its genealogy centred on the Schoenberg school, the experimentalists elected a more eclectic range of musical ancestors including Debussy, Satie, Varese, and the Americans Ives and Cowell. Amongst them were some, Debussy and the Americans in particular, who had drawn on the influence of non-western and popular urban musics. Like their eclectic forefathers, experimental composers drew on popular musics as

influences, for their modes, their rhythmic, repetitive or structural forms; or treated them as pastiche or parody; or created music montage by overlaying one music upon another (as with Ives). These techniques are now considered central to post modern aesthetics; yet, as I have shown, they go back to the eclectic early modernists, while they are largely absent from serialist modernism.

Second, and influenced by ethnomusicological studies of the ritual and participatory nature of non-western musics, the experimentalists were centrally concerned with the social and live, performative aspects of music. Often themselves performer-composers, experimentalists gestured towards effacing the composer's authoritative and hierarchical role, and wanted to lessen the hierarchical musical division of labour between composer-as-creative-authority, performer as constrained interpreter, and passive audience (22). The emphasis was on the performance process, music as an unfolding and participatory ritual event structured above all by time; but in fact, the composer remained the author of these events so that the division of labour remained basically intact.

There was a pervasive two-way influence between experimental music and the new American visual art movements of Abstract Expressionism and then Pop Art; so that Cage and followers cited the influence of Duchamp, Pollock, Johns and Calder, and vice versa. Music, in its pure abstraction, became seen as the paradigmatic medium in the heyday of American abstract art (23). Events were often multi-media, as with Fluxus performances in which the visual and ritual were as important as the sonic/aural; or Cage's long collaborations with dancer Cunningham and painter Rauschenberg. Performances were, then, often less than serious events; and a dada-esque iconoclasm linked experimental music to

the wider radical art movements of the 1950's and '60's, including performance and conceptual art.

From the later 1960's there emerged out of this a clearer set of frankly politicised experimental composers than in the post serialist camp, including the composers Rzewski, Wolff, Cardew and their followers. Inspired in part by marxist-leninism and maoism, these developments were of two kinds. The first were attempts to produce political effects through the use of, or reference to, revolutionary popular musical material or lyrics (24). The second kind of political experimentalism, developed by some of the same composers but more widely influential, extended the critique of the musical division of labour. Composers such as Cardew, Wolff, and groups such as the Italian-American MEV (*Musica Elettronica Viva*), the British Scratch Orchestra and AMM, emphasised changes in the social relations of music production and performance through attempts at a new interactive, collective and non-hierarchical group practice. The social dimension of music was seen as a crucible for experiment in collective and democratic social relations (25).

Other politicised experimental groups centred on live, free electronic music improvisation, as with MEV and AMM. Free improvisation was both a logical extension of indeterminism, and also in accord with a stress on group relations as determining musical output (26). Some of the politicised experimental groups, then, had a practice centred on the use of electronics, but not all. If we examine the experimentalist attitude to technology, we can see that while it accommodated these more socio-political experiments, it was autonomous from them and important in its own right, and bore its own softer political connotations.

9.2.4 Experimental music technologies: the small, the empirical, and the pragmatic

Like the post serialists, and after their common ancestor Varese, the experimentalists also believed strongly in the necessity of technology as a source of new sounds; and, as their name implies, in the need for constant experimentation and 'research'. But beyond this their relation to technology was polemically opposed to the post-serialists'. Experimental composers used technology artisanally and pragmatically, in contrast with the scientific and analytical post serialist applications. Experimentalists rejected both the implicit elitism of the post serialist adherence to inaccessible and expensive high technologies found only in large and official institutions, and the universalising high rationalism and scientism with which these technologies were deployed. They countered determinism and formalism with technological empiricism and with live, social, improvised and performance-based use. Above all they countered 'high tech domination' with a practice centred on the celebration of small and low tech. Ch.2 (and App.4) described one expression of this technological antagonism: how the opposition of post serialist determinism versus experimental empiricism was played out in the major conflict in the '50's and '60's within French electro-acoustic music between the pioneers of *musique concrete* - Schaeffer, Henri - and Boulez, which began a lasting tension between the GRM (home of *musique concrete*) and IRCAM, devoted to anti-empiricist technological and scientific research and development.

More typical of American and British experimentalism than this French conflict, given that experimental composers were usually unaffiliated to major institutions and so lacked access to high

technology, was a commitment to small technologies, either commercial or self-made. This linked to the politics of musical performance. Nyman describes it thus: "Composers began introducing electronics into experimental music in the early sixties, not by taking into concert halls the equipment from the electronic studios which had proliferated in the '50's, but by inventing and adapting a portable electronic technology which was easily accepted into the.. open world of performance indeterminacy. Live electronics were used in two related ways. First, electronic versions were made of scores whose instrumentation was unspecified.. which could now draw freely on the new range of sound sources opened up by electronics. Secondly, the way was prepared for pieces which specify a particular electronic system, which may in itself be inherently indeterminate and may or may not include a score" (Nyman 1974:75). Paradoxically, given the commitment to indeterminacy, this last development indicates a kind of technological determinism in music, in that the technologies themselves become the composition. Thus in contrast with the post serialist use of high technologies in the university lab, aimed at the concert hall, experimental composers sought flexible and portable small technologies for live performance, multi-media events and 'installations', for use in everyday situations or on the street. Above all, composers themselves became electronics bricoleurs, artisanal designers of small technologies, tampering with the sources of sounds - a direction initiated by Cage's early works for 'prepared' piano.

The 'experimental-composer-as-technological-bricoleur' is exemplified by several Americans, notably Mumma, Behrman (members of another live electronics group, the Sonic Arts Union), Teitelbaum (of MEV) and Neuhaus, and in Britain Hugh Davies. All saw their

'composition' work as centred on technological invention, and designed and built portable electronic instruments and systems for use in live performance. Mumma has said: "My decisions about electronic..circuitry and configurations are strongly influenced by the requirements of my profession as a music maker. This is..why I consider that my designing and building of circuits is really 'composing'" (ibid:77). Writing of Behrman, Rockwell describes his strong commitment to homemade circuitry as a demystification of technology: "Behrman is not a trained engineer. He learned what he needed to know mostly by reading and by corresponding with Mumma" (Rockwell 1983:139). Neuhaus, like Behrman, began as an auto-didact designing his own circuitry, and developed a new populist form of environmental electronic sound installation, which put space at the centre of musical experience (27). Rockwell notes that the 'real revolution in electronic music' for these experimental auto-didacts was the access to small and cheap electronic synthesisers that followed the progressive miniaturisation of the technology, which in turn followed the broadening of the electronic instrument market through their use in rock music. It was this small, commercial technology revolution that allowed Berhman and others to "liberate themselves from deadening institutional associations" (ibid:135).

In conclusion, ideological differences over technology between the two avant gardes fed into continuing debates within computer music over small versus large system development, and over the role or necessity of theory - which, as we see later this chapter, also surface within IRCAM.

9.2.5 Post modernism as the negation of modernism

The crucial differences outlined above between the experimental and post serialist traditions, then, define the break between musical post

modernism and modernism. However, it is necessary to scrutinise them and to perceive their limits. First, although a reference to popular and non-western musics is largely absent from post-serialism, the experimentalists' relation with these musics is limited to using them as a source - for quotation, for transformation, for use as an influence. A certain distance is thereby maintained: popular and non-western musics retain the status of an 'other' - a quality, as we have seen, going right back to their eclectic forebears such as Ives, Debussy. As important, the popular music drawn on by both early modernists and post modern composers has mainly been limited to non-commercial forms: to folk, ethnic and non-western musics rather than the commercial stuff of the capitalist music industry and the tastes of the 'mass'. In this sense, much musical post modernism has continued to reference an untainted and idealised notion of non-commercial, authentic people's music, and to disdain the aesthetics and circuits of commercial popular music. Very recently, a few experimentalists - Glass, Reich, Nyman - have embraced commercial populism, using formats closer to rock and attempting to reach a large popular music audience. However, even this work remains aesthetically, ideologically and socio-economically distinct from commercial popular music (28).

Second, although the politicisation of experimental music is more developed than in post serialism, it is confined mainly to critiques of the immediate social context and social relations of musical practice, as in the neo-dada performance events. Only rarely, or implicitly, does this become a broader cultural politics attacking the elite institutional forms of serious music. We saw also that experimentalists' technological discourse was in accord with these critiques, yet the technologies were just as often employed devoid of any political

connotations. Finally, it is worth noting that many politicised and practical elements of experimental discourse are redolent of the influence of popular music, including the advanced black jazz of the '60's - influences that are commonly unacknowledged (29).

Placing the two traditions geographically and socio-economically, the split between the post-serialists and experimentalists was also one between the east and west coast of the USA, with Babbitt and followers based in the east, Cage and followers in the west. They were associated with different institutions: rather than tenured professorships in the WASP universities, experimental composers taught in liberal arts colleges, untenured, and performed for a living. The Cageian post moderns were thus susceptible to the Pacific and oriental cultural sympathies of the American west coast, and to the influence of Californian rock music in the '60's; while the east coasters looked towards and identified with Europe, birthplace of the modernist avant garde. A polemical 1958 article by Cage epitomises the tensions between experimental music and the European (and east coast) post serial modernists. It reveals his active rivalry with, and desire to supercede, the European tradition. In his subtle rhetoric, Cage describes experimental music as 'the' American movement, and then equates 'America' with 'the world' in describing the necessity of America taking the lead from the old European discourse (30). Given such a blatant bid for hegemony, nationalist feeling at IRCAM and among the French avant garde against American incursion becomes more understandable (31).

In conclusion, we have seen that the musical avant garde is not unitary. The antagonism between the two main movements - post serialist modernism and experimental post modernism - can be summarised at three levels. First, by their different relations to popular music and

culture; second, by the absence or presence of a supra-formalist concern with the social and political dimensions of culture; and third, and related to this, by conflicting technological discourses and different technologies. The differentiation between the two factions involves a continuous counterpoint, an unfolding antagonistic dialogue at times explicit, at others implicit. The post modern experimental tradition is defined against the post serialist modernists through a series of negations, as summarised in Fig.9.1. But since the post modern tendency to negation itself repeats a defining characteristic of modernism, this also expresses a basic discursive continuity. Thus the history of the two avant gardes shows an internal structuration (Giddens 1979) of simultaneous negation or opposition, and continuity. We can describe the relation between the two factions abstractly as 'A to not A': a relation of antagonistic or oppositional kinship. Whereas the relationship between these two traditions and popular commercial culture and music has been one of absolute difference, in abstract terms 'A to B' - the other basic form of difference (Laclau 1980). Popular music is either unaddressed (by modernists), or treated as an 'other' to be represented, drawn upon as a source or influence (by post modernists).

Further, we have seen that the 'innovations' often attributed to post modernism have earlier precedents. Neither reference to nor representation of the musical 'other', nor a concern with the social functions of art, are new; they are also evident in some early modernism. The evidence of this analysis is, then, that post modernism is defined in the first instance through a negation of modernism, that it remains locked into implicit dialogue with modernism; and that throughout the century, this has been the basis of its turning to the 'other'.

Figure 9.1 The antagonistic counterpoint of musical modernism
(post serialism) and post modernism (experimental music)

Modernism / post serialism	:	Post modernism / experimental music
Determinism	:	Indeterminism, non-determinism
Rationalism	:	Irrationalism, mysticism
Scientism, universalism	:	Socio-politicisation
Cerebral, complex	:	Physical, performative, simple
Text-centred	:	Practice-centred
Linear, cumulative, teleological	:	Cyclical, repetitive, static
Within a unity on technology -		
Scientistic, theoreticist	:	Empiricist, artisanal
High tech, institutional	:	Low tech <i>bricolage</i> , entrepreneurial
Within a unity of difference to popular (and commercial) music -		
Non-reference	:	Reference, transformation
Institutional base -		
Tenured, east coast universities	:	Untenured, west coast, art colleges
Institutionally and state backed	:	Self-employed, performance backed

9.3 Aesthetics and technology, modernism and post modernism,

within IRCAM culture

The remainder of the chapter provides a closer analysis of the differentiation of IRCAM intellectuals in relation to the institute's two main areas of work: the musical-aesthetic, and the technological. The analysis is summarised by Chart 2 in Fig.9.2 - a heuristic guide to the key differences and their interrelations; and I address that directly below. Subjects' positions are mapped according to their aesthetic and technological ideologies and practices in the intersecting space between two axes: a technological axis, and a musical-aesthetic axis. This allows us to focus on the two fundamental domains of IRCAM's work, as they link to broader cultural and technological developments. The analysis is based on observation and interview, and includes material on subjects' broader cultural allegiances - such as their cultural activities and musical tastes beyond work, or biographically prior to coming to IRCAM.

Through the analysis represented by the chart I introduce the relationship between IRCAM culture and modernism and post modernism, the longer term and broader discourses that underlie IRCAM culture. IRCAM subjects' positions can be seen as informed by, and yet as particular expressions of, those broader discourses. The chart represents, then, an analysis of IRCAM subjects as interpreted through the lens of the earlier characterisations of modernism and post modernism, in order to trace and make sense of significant differences. It does not aim to be a representative sample, but rather to indicate the range and significance of subjects' differences and strategies.

The previous section ended with a summary of three major ways by

FIGURE 9.2: CHART 2 - DIFFERENTIATION OF IRCAM SUBJECTS ON AESTHETICS AND TECHNOLOGY

1) HIGH TECH, high capital, big machines eg VAX, 4X
 2) NEUTRAL, inclusive: both big and small machines
 3) LOW TECH, COMMERCIAL: small machines eg Apple Macs, Yamaha DX7

TECHNOLOGICAL

<p>BOULEZ - Director WV - Artistic Dir (Area 1)</p>		
<p>*BYV - Boulez's tutor 4X Soft Dir WOW - junior tutor, Chant/Formes, (Mus Res Dir), composer GB - Prof Comp Sci Chant / Formes team (Area 2)</p>	<p>*HY - Mus Res Dir, composer *HM - junior tutor, psychoacoust AV - composer KF - junior tutors, HU - composers (Area 3)</p>	<p>*PL - composer, Apple II proj *RIG - Pedagogy Dir *WLe - composer, previous Dir (Area 4)</p>
<p>BU - 4X Hard Dir (Area 5)</p>	<p>VO - 4X Industrial- isation Dir 4X team - eg: AJ - Signal Proc Dir VRn - tech Systems team - FA NGF - programmer (Area 6)</p>	<p>*NI - visitor, Casio - bricoleur Flu - squatter, junior tutor, composer, DX7 expert (Area 7)</p>

- 1) MODERNIST:
 serialist,
 post-serialist
 canon -
 high cultural,
 elitist
- 2) POST-MODERNIST:
 modernism plus
 'best' of
 popular culture -
 evaluative,
 objectivist,
 discriminatory
- 3) POPULIST:
 pro popular
 culture -
 subjectivist,
 non-evaluative,
 consumption-
 oriented

MUSICAL/AESTHETIC

which post modernism is often claimed to be distinguished from modernism, and so to effect a radical break. First, a new recognition of, or '*rapprochement*' with, commercial popular music and culture, and the 'mass' audience. However, this 'recognition' still perceives popular music and culture as an 'other', to be used as a source, or infiltrated. Second, an awareness of and engagement with the social (and sometimes political) dimensions of music and culture. Both are associated with pluralist and democratic leanings, against the elitist and hierarchical character of modernism. And third, these are associated with a different attitude towards, and use of, technologies. By examining how IRCAM culture relates to this characterisation, we will see that it both exemplifies and yet also in some ways modifies it. The ethnographic material therefore provides a more complex understanding of modernism and post modernism as expressed within IRCAM culture.

9.3.1 Mapping the differentiation of IRCAM subjects on aesthetics and technology

The chart identifies three major and distinct positions along each axis. The technological (horizontal) axis contains three positions ranged between two extremes: proponents of high technology, and those of small technology. Position 1, on the left, represents those who are pro-high technology, who consider large machines (such as the 4X and VAX) necessary for interesting music and software production and far superior to small, commercial machines, which are denigrated as worthless toys. By contrast, position 3 on the right involves a strong advocacy of the creative power and possibilities of low-tech, small, commercial music technologies and computers; and indifference or active hostility to big machines. Position 2, in the middle, is a neutral, pragmatic, inclusive

space in which subjects appreciate the possibilities of both. The two poles - pro-big machines and pro-small machines - are thus analogous to the opposition between the high tech modernist and low tech post modernist technological discourses.

The musical-aesthetic (vertical) axis involves the following three positions. At the top, position 1, is the high modernist and elitist position. In the centre, position 2, is IRCAM's post modern position, a perspective that embraces and appreciates the 'best' of both modernism and popular music and culture. Most important, this is still an evaluative, discerning, and discriminating perspective (as is the modernist), ambivalent towards commercial interests. At the bottom, position 3, is a populist perspective, pro popular and commercial culture, subjectivist and less evaluative, and embedded in a commitment to the experience of consumption. There are thus two kinds of difference along the aesthetic axis. First, that dividing position 1 from 2 and 3, revolving around a relation or non-relation to popular music and culture. In position 1, the modernist, popular music is an ignored and unrecognised, absolute 'other'; whereas in both positions 2 and 3 there is some kind of positive relationship with, and recognition of, popular music and culture. The second kind of difference is that dividing positions 1 and 2 from 3, revolving around the presence (in 1 and 2) or absence (in 3) of an evaluative disposition, of investment in objectivist cultural discrimination.

The analysis in Chart 2, then, links IRCAM subjects' technological and aesthetic allegiances with the broader, coexistent technological and musical fields, and in particular with commercial popular music and small technologies; and beyond that, with the earlier characterisation

of modernism and post modernism, and the key aesthetic and technological differences between the two. We can thus begin to see how IRCAM subjects relate to 'other' forms of music and technology that are absent from IRCAM's dominant and official discourse. We have seen that small technologies do find a place, as part of dissident subcultures such as PL's small system project or the musicians group vanguard program for future research (Chs.5, 6). Yet these gained only very limited support, so that in 1984 IRCAM remained largely devoted to big system development. Thus we have already glimpsed a tension between proponents of large and small systems; and in fact the issue was a widespread preoccupation of IRCAM intellectuals, the most overt and highly charged broader ideological conflict within IRCAM (32). Above all, the analysis above provides insight into the particular post modern ideological connotations of small system, as opposed to large system, development within IRCAM. We have also seen how popular musics make very occasional appearances in dissident and marginal IRCAM concert series such as the *Espace Libre*, and the free jazz events organised by RIG (Ch.5). But we see below that despite these, the presence or influence of popular musics within IRCAM is quite severely repressed, and covert.

I now outline the seven major areas in which subjects cluster on the chart, and illustrate with examples. The illustrations draw earlier material together with new material. (Note that the Americans at IRCAM are starred on the chart).

Area 1, at the intersection of aesthetic and technological modernism, is the most elitist position. It contains Boulez and the Artistic Director WV. WV programs the concert seasons and so defines the canon: he is IRCAM's 'aesthetic guardian'. We saw earlier (Ch.3) the

cultural privilege of his earlier life. He had been an agent and manager for several avant garde composers. Before that he worked as an apprentice impresario at Glyndebourne opera, and co-founded and managed a major British contemporary music ensemble. His elitism is revealed in the interview cited earlier in which he reacts against a pluralist policy quote by Fleuret (the current *Directeur de la Musique* in the Ministry of Culture):

"All '*les musiques*'...no, they're not equal, I don't agree. I believe in fine art, I believe in aristocracy, I believe in elite".

Boulez's aesthetic allegiance has clearly been modernist and against the softening of post modernism (Ch.2 and App.5). In a recent interview Boulez restated his adherence to serialism and rejection of post modernism, as embodied in the work of American composer George Rochberg. Rochberg is well known for turning away from serialism to a post modern neo-romantic aesthetic.

"I wouldn't follow, say, George Rochberg's lead in giving up twelve-tone music and composing like Gustav Mahler because I think Mahler has done it much better than Mr. Rochberg will ever do. It seems really stupid to me that to avoid a present danger, you adopt the dangers of the previous generation... I can already see that our 'new' post modernist buildings are dead.. even deader than the ones they wanted to replace" (Boulez 1984:14).

However recent signs appear to indicate a moderation of Boulez's polemical rejection of popular music, shown for example by him conducting the rock musician Zappa's orchestral works in an evening of American music. But in the same interview, touching on the Zappa event, Boulez revealed his modernist distance from even this 'avant garde' popular music, speaking of "worthwhile exchange" with "another culture", seen as completely distinct and strange (33). The distance between Boulez and IRCAM, and Zappa, was satirised in an article in the CGP monthly magazine publicising the Zappa concert (see Ill.9.1). It

consists of a 'purely imaginary' dialogue between Boulez and Zappa, which shows profound mutual respect - Boulez likening Zappa to Wagner - and ends with Zappa asking to come and work at IRCAM: "Frank Zappa moves off. He dreams of his future stay at IRCAM" (CNAC Jan. 1984:33, my transl.). The ending is clearly an ironic and teasing comment on the unlikelihood of such a visit ever happening.

Regarding technology, not only does Boulez's music use the 4X and VAX, 'Repons' having first call on the 4X; but he actively despises small machines. The key conflict over small technologies during 1984 blew up between Boulez and American Pedagogy director RIG over whether RIG could bring into IRCAM two new, innovative, small commercial digital technologies: Apple Macintosh personal computers, and Yamaha DX7 synthesisers (and linked to this the MIDI interface). RIG had nurtured links with both companies, travelling to Japan in 1983 to make contacts with the major Japanese music technology manufacturers. On his return he reported enthusiastically on the development of the DX7 and MIDI. By summer 1984, with the help of a visiting Lucas Film contact who was a friend of a member of the Mac development team, RIG had set up a deal with Apple in which IRCAM would receive six Mac's free in return for Apple retaining some rights over software developed on and for it. RIG reported Boulez saying to him that Mac's would come into IRCAM 'over my dead body' (34).

We see below that as well as Boulez, some major IRCAM scientists were implacably hostile to small machines. By October, the Mac's had arrived; and an AC meeting noted this with a cool word of caution: "Care must be taken that the (music and software) language used is not too limited by the Macintosh's specifications" [AC 3.10.84, my transl.]. With his flair for deals and favours, RIG organised for a young Bell

Labs researcher to come over to Paris and work for two weeks unpaid installing the Mac software and linking them up to the VAX. The story shows, then, RIG's role as IRCAM's key small system dissident; and how, despite great opposition, he managed 'illicitly' in 1984 to bring in small machines, ironically on terms very favourable for IRCAM.

Area 2 is the 'serious' post modern position, containing Boulez's tutor BYV and the young junior tutor and composer WOW. WOW's piece 'Chreode 1' had the effect of gaining him promotion to the 'heir elect', while by 1985 BYV had been promoted by Boulez to be a quasi-Scientific Director, the 'Technical Co-ordinator'. Thus both men have risen fast in the IRCAM hierarchy. Both are also involved in the music research meetings of the self-styled intellectual vanguard. And in those meetings, both express a pro big machine bias. BYV works the 4X for Boulez, and he sees IRCAM's role as developing the 'Rolls Royces' of computer music. WOW works in the Chant/Formes group (also mapped in this area on the chart), who program on the VAX and are strong proponents of big machines as a framework for advanced software research. Similarly, WOW believes that sophisticated software can only be developed on big machines. He dismissed the work done by composer-bricoleur PL on small Apple II computers because, in his view, their memory is too limited for complex musical results.

In terms of their aesthetic allegiance, both men show a similar mechanism. BYV was, like all IRCAM Americans, brought up on popular culture and music, and his father is a commercial film art director. He was heavily involved in jazz as a student and professional wind player; but he says "I also rather quickly came to the conclusion that jazz was too limited.. that if I was to be really satisfied..I should really get

into..serious music. Because of my jazz background I was naturally interested in contemporary music, almost automatically". BYV here speaks a logic particularly common in the post modern ideology of IRCAM Americans, that an interest in jazz and in avant garde 'serious' contemporary music are somehow naturally allied - an attitude that wishfully ignores their objective differences. Yet in fact BYV later repudiated his earlier jazz work for 'serious music', as at IRCAM. WOW started out as an auto-didact avant garde rock synthesiser player, and made several records; but he now renounces that past and keeps it quite hidden. In discussion of some ambitious 'avant garde' rock that he and I commonly knew, WOW invited me to agree that they had lost their way and compromised with a misguided populism. We can see, then, that both men repudiate and suppress a previous involvement in popular music.

However, the ghost of WOW's involvement in rock can be heard in the centrality of a strong repetitive rhythmic pulse in his aesthetic (Tape 1). In this way, and more than most IRCAM music, WOW's contains a hint of reference to the rhythmic aesthetic of popular music: one of the main historical aesthetic differences between modernism and popular music, and one that some post modernists want to overcome. WOW's music marks him, then, as a key IRCAM post modern. Confirmation of this view of WOW, and of his status as an IRCAM philosopher, comes in a joke bibliography entry from an internal document written by his friend HM, as follows:

"WOW (1986) - Les Presuppositions Spirituelles du Symbolisme Musical dans la Post-Modernite), Editions de la Nuit: Paris" ('The Spiritual Presuppositions of Musical Symbolism in Post Modernism').

(The joke publisher is itself a satire on the leading avant garde French publisher *Editions de Minuit*).

GB, also in this area, is professor of computer science at a Paris university; and he developed the French version of one of the leading

(American) artificial intelligence languages. GB is one of IRCAM's leading squatters and, as we have seen, has an informal arrangement to bring in his students as squatters on the VAX, since their own computing resources are scarce. Earlier in his life, GB had toured playing jazz piano in a group; and he much enjoys good jazz. But he also respects Boulez's music, and personally taught Boulez the fundamentals of A.I.. In our interview, he ridiculed one of the Apple Mac computers that had just arrived, mocking it as just "*une boite de bons bons*" (a box of sweets), so revealing his antagonism to small (American) machines.

Area 4 contains three American composers who are the most active ideologues and promoters of small machine power. It includes RIG and PL, IRCAM's black American composer. PL, as we saw in Ch.5, was engaged in 1984 on IRCAM's only small machine project, working exclusively with Apple II's and Yamaha synthesisers linked up by MIDI. We saw that he wrote interactive improvising software, so that a player improvises and the computer analyses that input and 'improvises' along. As well as his programming in assembler and Basic, PL had built his own MIDI units from scratch, according to instructions from an electronics magazine, since they were not yet available in Europe. Tape 1 has part of a live concert in which his Apple/DX7 system 'played with' his friend the jazz saxophonist Steve Lacy.

PL had no training whatsoever in computing, and his abilities as a small machine bricoleur were, he said, due to the help of another friend: the experimental technologist Behrman (see Ch.9.3.4). PL was asked in 1984 to submit a project on small, interactive music technologies for a major CGP exhibition called '*Les Immatériaux*' directed by the post modern philosopher Lyotard. PL put forward a joint

project with Behrman in recognition of his debt to the man. PL's commitment to small technologies therefore has direct and personal links with the philosophy and practice of the post modern, experimental tradition. And like that tradition, his small machine philosophy is back to back with hostility towards big systems. Talking in a bar one day, PL said cynically: "What's the 4X? It's the French Flagship, just a big prestige object - that's how the media treat it, that's what it's really about: a major nationalist cultural prestige project...Sure, the 4X is the biggest realtime synth at the mo; but it'll be superceded! So what else is new?... I'll never be allowed to do a piece on the 4X because its function is for the big guys, high power and prestige composers, the pecking order people. 'If you do a piece on the 4X, then it must be good!' - that's the rationality now" [BD:22].

PL is also, as we saw earlier, a well known brass player working in jazz, improvisation, avant garde rock and funk; and he continues that work outside and unrelated to IRCAM. During 1984, for example, he toured intermittently with a major French jazz group, and went to Japan with a leading American big band. However, PL is also a serious composer, backed by studies in philosophy at Yale. He ran a New York avant garde showcase for some years; and as a player and composer, he is situated mainly within the American and European experimental music scenes. On listening, his written composition is far from popular music, the aesthetic modernist; while his (performance-based) improvisations involve both 'modernist' moments, and pastiche and parody of popular music genres. PL himself would reject these statements, since he is strongly against the classification of musics. He believes instead that all musics should be judged - but judged in themselves, and not in terms of rigid genres and predetermined categories. This strategy, combining

pluralism with a distrust of naive relativism and a desire to retain judgement and evaluation, appears to be common among IRCAM's American post modern intellectuals. Nonetheless, as we have seen, PL sees himself as a dissident and 'token black' at IRCAM.

The director of Pedagogy RIG, as we have seen, is the most powerful 'dissident' at IRCAM, and a close friend of PL's. RIG is like Boulez's bane. He is responsible for letting in and encouraging many squatters. Yet he is also indispensable and irreplaceable to IRCAM and Boulez since it is he who negotiates IRCAM's software licences and the deals for free Apple Macs and DX7's; and he is also responsible for some of IRCAM's most important links with the American computer companies and computer music scene. In 1984 RIG was smitten with Japanese technology, and had a Japanese girlfriend. He is totally committed to 'small is beautiful'. As the new Mac's settled in, RIG's and PL's infatuation with them soon spread to others; and the machines became invested with a semi-joking fantastic, mythical status (35). Like PL, RIG's technological philosophy links closely to the experimental tradition, for example in his proponent of live group and improvised performance uses of small machines (as in his dissident concert series at the CGP, and the ICMC 'Off Festival'). And like PL he also has close personal contacts with American experimentalists: for example, the bricoleur Max Neuhaus visited during 1984 and, through RIG, offered IRCAM a project. The bid was unsuccessful.

Musically, RIG also has close and ongoing ties with popular music and with black American musicians. As we have seen, his first musical memory was hearing his mother's record of Tex Ritter; and as a student he played jazz drums with the Art Ensemble of Chicago - a leading black

jazz improvisation group. In the past he worked with the pop star Stevie Wonder, famous as the major innovator in the use of synthesisers in pop music. Wonder had offered RIG a job, which he declined. Wonder came to Paris one week in 1984, and although all his shows were sold out some complementary tickets were specially delivered to the IRCAM reception for RIG. After the concert, RIG told me how he had been taken by Stevie to a wild all night recording session. The entourage ended up in the early hours (when few are around and subcultures thrive) back at IRCAM, where RIG demonstrated the 4X. Wonder's sound engineer drooled over the machine and asked when they could get to come and use it. RIG confessed that he thought it unlikely that they would ever be officially invited to IRCAM. Another time, the black free jazz pianist Cecil Taylor passed through IRCAM one evening to see his friends RIG and PL. RIG still occasionally himself plays drums, and during 1984 was often lamenting not being able to play more. His main training, however, is as a psychoacoustician; and he occasionally composes computer music pieces. These tape pieces are, again, not at all popular music.

Thus both PL and RIG exemplify a position of advocating small commercial machines, of being actively involved in popular music outside IRCAM, or in earlier days; but of producing non-popular and modernist music at IRCAM. This *split* between different spheres of their production I will identify as another IRCAM post modernist strategy.

Area 3 introduces a different split characteristic of post modernism: between subjects' production and their consumption. It also illustrates the evaluative or discriminating aesthetic impulse which I suggest is characteristic of IRCAM's post modernism.

This might be called the 'opportunist' position, ie central on both axes. Technologically, subjects in this area are pragmatists, prepared

to use both big and small machines according to context and need. The composer HY, Music Research director, works with the 4X but likes to use his DX7 at home for compositional 'sketching'. He is very excited by small machines, and talked enthusiastically of his visits to Attari and Xerox PARC in the USA where this technology was being developed. But he is also plugged into big institutions, working at MIT as well as IRCAM, and happily uses their big machines. Musically, HY illustrates a split between production and consumption. His own musical aesthetic is non-popular and more modernist. Yet he organised the infamous showing of Michael Jackson's 'Thriller' video at an *Espace Libre* - (in 1984 this dominated the pop charts); and at home he lazily follows popular music and enthuses over it as a consumer. Although HY listens to a variety of pop, it is limited to the very well-known: whether Jackson (from the chart mainstream) or the avant garde pop of Laurie Anderson, both high profile in 1984. Discussing 'Thriller' with me informally, HY repeatedly stressed how "great" it was, "really strong"; but he couldn't elaborate. When I pushed him to speculate on the way 'Thriller' worked, or its politics, he was uncomfortable. He saw no point in thinking that way about it, and could not. Thus it seemed very important to HY to make a judgement, but there was no language behind that to develop an exegesis. There was an impulse to judgement, but the content was empty.

Also in Area 3 is the visiting composer AV, whose production visit I described in Ch.7. AV works with the 4X and VAX at IRCAM, but prefers to use his own Yamaha DX and CX equipment at home, or the Fairlight based in his British university. He finds these small and commercial machines more efficient, productive and empirically responsive. After the IRCAM debacle he was invited to MIT to produce a piece; but by then

he was so sceptical of large institutions and their chaotic high technology that, to avoid a similar experience, he told me he had prepared most of the computer tape before going to MIT on his Yamaha set up at home.

AV is deeply interested in popular music and listens to a broad range. He links this to his musical roots in Argentinian tango, and to his non-'first world' identification. He wants his composition to successfully unite what he sees as popular music's strengths - its rhythmic power and sophisticated production techniques - with the stronger aspects of the modernist legacy. He sees this as enabling him to learn from popular music, but also to intervene in it. So AV produces different kinds of music for different spheres of circulation. His own 'serious' composition is more dynamic and rhythmic than much, yet I suggest that it remains framed within a modernist aesthetic. AV distinguishes that composition, which is for IRCAM, MIT, the world of high institutions, festivals and prizes, from the film and TV music which he churns out on the Fairlight or Yamaha machines and 'sells by the minute': the music which makes his living. He thus keeps his commercial work quite separate from IRCAM. With a friend, AV once produced a pop demo tape, which he played me late one night at IRCAM. It was a credible, but over-produced and over-polished track. Occasionally, AV produces a piece which he thinks is a successful synthesis of the serious and popular (eg Tape 1 **); but he feels such pieces cannot be played at highly serious events, and so operates a careful aesthetic self-censorship, playing his different musics in different contexts to 'appropriate' audiences.

IRCAM's psychoacoustician, HM, is AV's friend and admires his music. Like AV, he strongly appreciates popular music: he grew up

playing in high school bands, and, being a west coast American, identifies with the experimental tradition and its oriental leanings. Technologically, HM uses big machines for his own research (the 4X, VAX), but also - non-ideologically - advocates the uses of small machines.

Two other junior tutors and composers, KF and HU, are also located here. Both are pragmatic, non-ideological users of whatever technologies are available. KF is a junior tutor still on irregular short contracts who is very anxious to become better established at IRCAM. His musical activities are subject to two kinds of self-imposed suppression. First, before IRCAM he had produced soundtracks for theatre and dance groups. But he considered that this would be seen by IRCAM as 'unserious' and inappropriate; so, with ambivalence, he made a conscious decision to keep quiet about and drop that kind of work, and to change musical orientation in order to get on at IRCAM. However, this 'suppression' of his past work was incomplete. I walked into a recording studio late one Sunday night - a very 'dead' time at IRCAM - and found KF secretly at work producing an 'illicit' soundtrack for some film-maker friends. The room was booming with a heavy funk rhythm track, revealing KF's skills in pop. This was the only time I heard this kind of sound being produced in an IRCAM studio. Like AV, then, KF's strategy embodies a splitting between different spheres of production, as well as a suppression and hiding of his musical past. And, like AV, he also keeps his commercial and popular musical work well hidden from IRCAM. Appendix 9 is a full transcript of part of my interview with KF, illustrating these issues; it hints at his ambivalence about the situation, and his struggles to integrate his different musical selves.

HU, considered one of IRCAM's most promising young composers and music theorists, was on poorly paid short contracts in 1984. His music remains, once again, strongly embedded in the modernist aesthetic. However HU lived and taught in South America for some years and married there; and as a legacy, he is known informally as a fine tango player on the piano. For HU, playing tangos is a form of leisure activity for parties, and rarely, when pressed, for late night, marginal IRCAM events. HU sees popular music, then, as a mode of leisure and consumption, quite distinct from his serious compositional work; so that, like HY above, HU's musical self is divided between that involved in serious production, and in consumption.

Area 5 contains BU, the 4X Hardware designer, who is committed to large machines; and, beneath a veneer of indifference to small machines, he is in fact rivalrous and antagonistic. In an interview he said of the DX7: "It's a good instrument, I've got nothing against small systems - but it's so limited! Once you've played it a few times, you know it all". The following incident between BU and visiting American technological bricoleur NI (Area 7 on the chart, discussed below) betrays BU's underlying hostility to small machines. NI brought to IRCAM a souped up small machine, his modified Casio VL Tone - then one of the cheapest high street digital synthesisers. NI belongs to what he calls the 'Casio Underground': fanatic Casio owners who get inside their machines and alter them with analog devices to achieve far better effects. This knowledge is circulated internationally by an 'underground' magazine. NI had modified his VL Tone so that it had eight octaves, could bend notes, and produced sounds ranging from the Albert Hall organ to a harpsichord to Jimi Hendrix's guitar. On the afternoon in question, NI sat playing his VL Tone to PL in the reception area,

just as BU, the Scientific Director FOK and others were going into a 4X seminar. NI showed it proudly to BU, expecting interest from a fellow designer. But BU's reaction was disdain and complete uninterest. As NI recalled, BU shot him a nasty look, as if to say 'get this guy out of here'. While FOK said sarcastically to PL: "This is your department, isn't it PL?" - implying, for small machine enthusiasts. Thus BU (and FOK) revealed their disdain for small system *bricolage*. Musically, we saw above (Ch.6) that BU is actively hostile to IRCAM music and avant garde music in general, while he enjoys classical, easy listening and popular musics. Hence his desire to make a popular record similar to William Carlos' 'Switched On Bach' to show off the 'real' possibilities of the 4X.

Area 6 contains computer technicians and service staff, the 4X Industrialisation director VO, and American programmer NGF. These people are keen on, and professionally involved with, both big and small machines. They are computer enthusiasts and populists, and mostly non-ideological in their attitudes to the technology. VO, however, is more ideological. We saw earlier (Chs.2, 6) that he finally left IRCAM over the issue of developing a small, commercial version of the 4X for the broader market of musicians, including those from popular music. (He then set up his own company to do so). VO is, then, firmly committed to the view that small machines open up potentially different musical markets to the big systems supported by elite institutions such as IRCAM, that only give access to avant garde composers. Like BU, VO is scathing about most IRCAM music, so that in his philosophy small machine development links logically to his dislike of avant garde music, and of Boulez (see the end of Ch.6).

FA, the Systems manager, is more even about small and big systems. He installed computer graphics software on both the big VAX and the Macs, and encouraged people to play with both. Musically, the Systems team and their technician friends are the most visibly active and enthusiastic consumers of popular music within IRCAM. They go often to low brow MOR and rock concerts, following the scene closely, loose with their praise and not concerned with serious judgements. The Systems manager confesses to being a blues fanatic and has a big record collection. These workers are, then, keenly interested popular music consumers, who perceive IRCAM music as simply another sound, and nothing special. The Systems team's use of the name of the Australian pop group 'Men at Work' as the confidential super-user password, mentioned earlier, betrays their teasing, 'unserious' iconoclasm towards IRCAM's dominant aesthetic.

VRn, employed as a 4X cable technician, is secretly a professional sound engineer outside IRCAM. He built, and now runs, his own professional recording studio working in 'variete': French MOR pop. One of his singles had gone high up the charts. Thus, strangely, the most experienced recording engineer within IRCAM is officially known only as a lowly technician. Our interview was stilted and VRn was not articulate. But after the tape was off, hearing that I play bass guitar, he sprang up and took a Lynn Drum synthesiser (a drum synthesiser much used in pop recordings) from a locked cupboard. He plugged it into a studio console and started to enthuse, inviting me to bring my bass to play along. I learned about VRn's 'other life' some months in from other technicians, and was only confided in as word began to spread among them that I played rock bass guitar. Soon after, another interview, with the 4X Signal Processing director AJ, ended with him enthusiastically

inviting me to bring my bass in one day so as to put its sound into the 4X. On the quiet, for their own use and amusement, these 4X engineers were recording a range of sounds and instrumentation drawn from rock and pop into the 4X's data base. These sounds were, for them, more interesting than the official musical uses of the 4X.

Area 7, finally, contains two people marginal to IRCAM, who are also strong proponents of a populist and pluralist approach to technology and music. Both men were treated as a bit of a joke, and humoured, during 1984. FLu, the son of a famous East European composer, works sporadically for IRCAM as a junior tutor and studio assistant. During 1984 he was either altogether without a contract (a squatter) or on intermittent short, low paid ones. Since he was treated as a part time technician and bricoleur, it took months for me to realise that he was a composer and wished to be properly employed as a tutor. FLu was unabashed about his involvement in and commitment to popular music and jazz, and experimental performance. He was also in 1984 more deeply immersed and expert in the new Yamaha DX7's than any other IRCAM worker. The DX7's arrived in Paris from Japan with notoriously poor documentation, so that musicians found them extremely difficult to understand and use. With some friends from the pop scene, FLu set up a series of commercial courses on how to use the DX7, which they ran for Parisian pop musicians. This sphere of his activities was completely outside, and unacknowledged by, IRCAM.

The American computer musician NI, whose encounter with 4X designer BU over his Casio VL Tone was described above, is a technological bricoleur. His modifications of the VL Tone involved putting a few simple analog electronic devices in with the digital ones. NI talked at

length about the enormous potential of such mixed digital/analog technologies, which could at low cost massively enhance even the cheapest small commercial system (36). He derided what he saw as an irrational purism within the dominant discourse of computer music which ignored the uses of analog technology - (a phenomenon discussed in relation to IRCAM in Ch.8). Although, as we saw in Ch.4.3.2, not in principle against big systems, NI is hostile to the militarist links of machines such as the 4X. NI's own music, composed for films and advertising, is like synthesised systems music (sometimes known as 'New Age' music): tonal, and based on endless repetitive sequences of phrases. He was not keen on IRCAM music, which he found alienating and hard. NI had a slightly paranoid air, so that his exclusion from IRCAM's scientific and musical company was unsurprising to him. His VL Tone innovations had been shunned by the Japanese Casio company (37), and other potential manufacturing deals had also fallen through; and NI came across as a broken and disillusioned man. No one, it seems, wanted to know about his tiny, cheap machine that could sound so powerful that it might put larger digital synthesisers to shame.

9.4 Mechanisms in the social construction of aesthetics and technology at IRCAM

The material above suggests some common mechanisms at work in the social construction of aesthetics and technology in IRCAM culture. The mechanisms structure the differences between subjects; but also differences within individual subjects - ie intra-subjective differentiation, and specifically the fragmentation of subjects' musical identities.

We saw in the material three forms of fragmentation. The first is

the splitting by a subject of one sphere of their musical production from another, as we saw in the examples of PL and RIG from Area 4, and AV and KF from Area 3. The second involves a subject splitting their production from their consumption, as we saw in the examples of HY, HU and AV from Area 3. These splits manage to retain a modernist aesthetic orientation in subjects' musical production, especially in the part of their production that takes place at IRCAM. At the same time these composers may enjoy and have deep sympathy for popular music and culture as consumers; or they may consume popular culture because it's 'de rigueur' and not have much understanding of it. Or again, they may be active producers of popular music in other spheres, outside IRCAM (or at night within IRCAM as with KF), and accept the split pragmatically.

The third mechanism is a splitting between aesthetic past and present, involving the repudiation or suppression of a past musical self. We saw this in the examples of BYV and WOW from Area 2 (and KF from Area 3). This is a more verbally articulated and ideological position than the largely tacit splitting mechanisms above. BYV and WOW had arguments as to why popular music had not been sufficient to hold them, rather than just assuming it as self-evident. This articulated aesthetic certainty may link with their rapid promotion within IRCAM, and indeed their closeness to Boulez. By contrast, when he spoke to me of his conscious musical re-orientation, KF had the air of an apprentice, ambivalently learning a new discursive position; unlike BYV and WOW, he remained as yet very junior within IRCAM.

Central to this analysis, then, is the concept of 'splitting', as a way of examining several kinds of fragmentation of subjects' musical selves. I am using the concept of 'splitting' by analogy with its

psychoanalytic meaning, to gain insight into what might be called mechanisms of the cultural unconscious. In psychoanalysis it refers to a defence mechanism involving the dissociation of different parts of the personality and an overall failure to integrate thinking. In particular the splitting between different parts of the self, and/or between different 'objects' in the external world, leads to an extreme form of binary thinking. On one side things are perceived as totally 'good', idealised and legitimate, while on the other they are perceived as 'bad', worthless and illegitimate (38). Thus for KF and AV, while they are identifying with IRCAM, certain areas of their musical practice are considered legitimate, 'good' in IRCAM's terms, and other areas are considered illegitimate, certainly not for IRCAM. The splitting therefore also involves an introjection of the values of the dominant institution, which may be in conflict with other areas of the self.

A sympathetic view is to see these cultural defence mechanisms - subjects' splitting between areas or periods of their practice, or between their production and consumption - as characteristic of the anomalous position of post modern intellectuals; and as a way of dealing with the problems and contradictions that arise in trying to integrate two worlds of discourse, or cosmologies, (modernism, the popular) defined - as we have seen - by their absolute aesthetic and socio-economic difference. A sceptical view is to see them as pragmatic strategies derived from the need to retain aesthetic credibility as young composers within the world of serious contemporary music, which appears still to mean retaining a distance from popular music, so guarding the 'high seriousness' and autonomy of the avant garde. The splitting shows, then, awareness of the continuing illegitimacy of popular music: a judgement which IRCAM subjects must consciously (as

with KF) or unconsciously have internalised. (On this, see App.9, the discussion with KF).

A fourth mechanism concerns the basic distinction drawn between positions 1 and 2 as against position 3 on the aesthetic axis: ie the existence of an evaluative and objectivising aesthetic disposition, shared by IRCAM modernists and post modernists, and applied by the latter to both 'serious' and popular musics. This contrasts with the subjectivist, less evaluative and non-generalising aesthetic disposition of IRCAM populists. The evaluative disposition is a thought habit embedded in the pedagogic, prescriptive and interventionist character of modernism; so that its existence in IRCAM's post modernists indicates a basic continuity in the form of aesthetic discourse between modernism and post modernism within IRCAM. Post modern IRCAM subjects seem caught up in this modernist thought habit, in the necessity for 'serious judgement'. The nakedness and fragility of the habit was revealed above in the composer HY's judgement about Michael Jackson which he could not, however, develop: an impulse to judgement without a language of exegesis. This is not to suggest that IRCAM populists and popular culture consumers do not evaluate, and do not choose between alternative experiences. The distinction is more to do with the weight attached to this process and the need for subjects to objectify their cultural judgement (39).

Other forces behind positioning in the chart are discursive negation, generation, and professional interests. First, the aesthetic position of IRCAM post modernists confirms the earlier historical hypothesis in showing a negation of the modernist negation of popular music and culture, by subjects recognising and in some ways engaging

with those forms. However, as we have seen, the evaluative attitude helps to retain distance and ambivalence, so that popular culture is still considered 'other': a form of leisure, a source of influence, or 'another' (hidden) kind of work to be infiltrated.

Second, the shift from aesthetic position 1 to 2, from modernist to post modernist, is also a generational shift: from Boulez's 1950's generation, the elder avant garde, to the young IRCAM composers of the 1970's and '80's, almost all of whom are under thirty-five. It seems that none of this younger generation could take an unabashed elitist, modernist position; but they could take forward the evaluative disposition and bring that to bear, as though meritocratically, on the broader musical field, and so discriminate between different musics - including popular musics.

The populist aesthetic position, beyond the modernist-post modernist oscillation, appears a more naive cultural position, simpler, less intellectually mediated (hence the inarticulacy of VRn and AJ). This position is typically held by those with no professional interest in music. And conversely, whereas there are no official IRCAM musicians in the populist position (pos.3), they are all (except Boulez) in the post modern position (pos.2): the respectable place for a serious young composer. The power of this professional positioning is revealed by the fate of musical dissidents: those IRCAM-associated musicians who have fiercely asserted a more populist than post modernist view, who tend to remain in marginal employment and are not officially defined as musicians within IRCAM (40), or who leave altogether (41).

Regarding technological positions, there are two basic mechanisms: discursive negation, and professional interest. On the left in position 1, pro-high tech, are those subjects - almost exclusively European -

most professionally involved in big machines (the 4X, VAX etc), who also show an ideological commitment to them. On the right in position 3, pro-low tech, are those - almost exclusively American - composers who promote an ideology of the benefits of competitive market pluralism, the potential for progressive decentralisation and miniaturisation of computer power, the view that small is beautiful and portable, etc; and who, by contrast, believe that big systems involve an unacceptable centralisation of power. The opposition between positions 1 and 3 therefore involves mutual negation, and rehearses the opposition described earlier between the technological philosophies of musical modernism and post modernism at large. This big system-small system tension also exists within the wider computer music community (42); just as its ideological connotations relate to the polarisation in broader debates on the 'information society' between a utopian view of progressive decentralisation, and the dystopian fear of increasing elite and multinational centralisation and control (43).

Position 2 - pragmatic, inclusive, less ideological - is usually held by those with a professional interest in both kinds of machine, either composers, or lower level and younger computer workers. All the professional computer scientists and technicians, then, occupy positions 1 and 2 on the technology axis: ie pro large systems, or neutral regarding the scale of technology. However this is divided so that high-level computer scientists and most European computer staff tend to be pro high tech; while lower technicians and American computer scientists tend to be neutral, in position 2.

Overall, it is the people with the strongest professional and highest career interests in either music or technology that feel

compelled to hold a more articulated and evaluative ideological disposition (the post modern aesthetic, or the pro high tech). The lower computer staff feel less compelled to take a polemical position, and can be laid back both about machines and music. Only technological bricoleurs and auto-didacts - IRCAM's marginal, dissident and ideological technological post modernists - occupy position 3.

In summary, we have seen some simple motivations - generational rivalry, professional prestige and interest - at work in subjects' allegiances; but also strong discursive negation, aesthetic and technological, in accord with the analyses of modernism and post modernism earlier this chapter. While technological dissent is overt and explicitly ideological within IRCAM, aesthetic 'dissent' is repressed, covert, and does not surface. Thus, as we saw in earlier chapters, there is an absence of open aesthetic debate or discussion, so that any aesthetic disagreements that arise are experienced fragmentedly, as individualised and private doubts. Above all, this analysis has revealed another level at which aesthetic conflict is 'managed' and difference averted: through intra-subjective mechanisms of splitting and repression which have the effect of censoring areas of music that are not deemed legitimate within IRCAM.

9.5 IRCAM's 'post modernism': experimental music as dissident subculture, and the exclusion of popular music

The above analysis assumes that we can make sense of subjects' aesthetic and technological allegiances by reference to characteristic differences between modernism and post modernism, and, aesthetically, between them and popular music. There are in fact few explicit references to post modernism around IRCAM. Two were mentioned earlier:

one the joke reference to junior tutor and 'heir elect' WOW as a post modernist philosopher; the second, the editorial to the first issue of a new music journal devoted to 'musical thought at IRCAM' by the editor NO, an IRCAM commissioned composer (see Ch.1). NO writes of "our post modern pluralism" in the serious musical world of the 1970's and '80's: a period of "fragmentation and diversity..(of) the demise of the composer-scribe". He continues by celebrating the "spontaneity, immediacy..(which is) a far cry from the rigorous intellectual control and pompous strictures of the 1950's". The period, says NO, has witnessed a "massive and exhilarating expansion of the musical world-view, from a questioning of the very bases of human musical experience, through a weakening of ethnocentricity, and an accommodation with popular culture" (all Osborne 1984:i-ii).

NO's utopian articulation of post modernism, then, centres on cultural diversity, equated with a weakening of 'ethnocentricity' and a new receptivity to non-western and popular music and culture. By the following page, an introductory piece about IRCAM by a young director, this broad pluralism is already moderated. He addresses primarily whether IRCAM has developed a house style; and concludes that "musical diversity is, in fact, much more common at IRCAM than standardisation". This diversity reflects the fact, he says, that in contemporary serious music "no single ideology is predominant and.. in the best of cases at least, talent and message are valued more highly than adherence to this week's latest stylistic fashion" (all Osborne ed. 1984:1). We see, between the two articles, a semantic shift away from positive reference to anti-ethnocentrism and popular culture (NO) to a view of IRCAM's post modernism as to do with narrower concepts of 'diversity', 'talent' and

'message' by the young director.

Yet I have suggested that, even if unarticulated, IRCAM has an incipient post modernism, revealed by elements shared between IRCAM subjects and post modernism at large: ie some positive relation with popular culture; and a technological discourse of small machine power that is related to that of experimental music.

We have seen that the conflict between technological modernism and post modernism is overt and ideologically charged within IRCAM. But the aesthetic differences analysed have subtler implications. We have also seen that the rhetoric of aesthetic post modernism has a place within IRCAM, as with the views of NO above, or those of AV, PL, RIG, who assert that their music is beyond modernism and has transcended any antagonism to popular music. But I have suggested that, in fact, the music produced for IRCAM, even by those (such as AV, PL, RIG) who produce other kinds of commercial or popular musics elsewhere, remains primarily modernist in character and is less influenced by the aesthetics of popular music than other, non-IRCAM post modern music. (For a discussion of this, and illustrations, see note 44 and Tape 1). Thus, I suggest, IRCAM post modernism remains closer to the modernist aesthetic.

This is shown equally by other levels of mediation commonly sought by young IRCAM composers that are more characteristic of post serialism than experimental music: the large scale of resources and hyper complex physical and technological forms (eg combinations of orchestra or ensemble, soloists, electronic amplification, computer tape, realtime computer transformations); the traditional hierarchical division of labour embodied in the work (composer-theorist, constrained interpreter, passive audience); and, of course, the highly (scientifically and

technologically) theorised conceptual basis of the music. In summary, the rhetoric of aesthetic post modernism, and the appearance of a 'rapprochement' with popular music, are superficial within IRCAM. They are not matched in practice by marked aesthetic changes; so that, aided by the splitting mechanisms, IRCAM's 'post modernism' stays aesthetically modernist, while popular music remains an aesthetic 'other' kept absent from IRCAM.

Other signs confirm the near total exclusion of popular music from IRCAM. For example, although as we saw in Ch.6 IRCAM apparently had one small temporary research project in 1984 related to popular music (jazz), its status was very low and its legitimacy continually in question. We saw also in the material above how even world famous American pop, avant garde jazz and rock musicians (Stevie Wonder, Cecil Taylor, Frank Zappa) are made aware, by 'dissidents' such as RIG, that it is not appropriate that they should work at IRCAM. It cannot be assumed that this situation is accepted as 'self-evident' by these musicians. For example Anthony Braxton, the leading black American avant garde jazz musician, in a recent general interview specifically mentioned his resentment at his certain exclusion from IRCAM (45).

By contrast, the experimental tradition has a presence within IRCAM as a small dissident subculture, aided by its representatives RIG and PL - IRCAM's key American post modernists and small system fanatics. As we saw, RIG and PL have personal links with two well-known composers-cum-technological-bricoleurs from the experimental tradition: Berhman and Neuhaus. The latter were both part of proposed IRCAM projects, but neither took place; which suggests that experimental music remains antithetical to the dominant discourse of IRCAM. That the experimental

tradition is at least acknowledged by IRCAM is shown by the fact that three other major experimental composers have had commissions: Cage himself (1981), Rzewski (1977), and Riley (1986) - a modest showing.

Finally, all of this throws light on the technological 'irrationalities' at IRCAM discussed in Ch.8: above all the neglect of the analog tape medium and of recording production techniques, as well as the purist aversion to mixed analog and digital technologies mentioned by NI above. We can now confirm that these technological characteristics are overdetermined by IRCAM's broader assertion of difference from popular music and from the post modern, experimental tradition, both of which are associated with empirical use of the tape medium and with analog studio production. While IRCAM completely disdains the techniques of popular music production, it also attempts to transcend and supercede the mixed technologies and analog *bricolage* of the experimentalists, and of their French counterpart in *musique concrete*. Thus, the disdain within IRCAM for these processes expresses the broader exclusion of these other musical discourses, so that IRCAM's technological culture itself expresses the broader discursive differentiation.

In summary, we can ask how the above analysis of IRCAM culture compares with my earlier historical hypothesis of the relationship between modernism, post modernism, and popular culture. We can now see that the analysis in Chart 2 confirms aspects of that hypothesis, and modifies it in relation to IRCAM. Post modernism at IRCAM appears to involve a negation of the modernist negation of popular culture. But aesthetically, despite the signs of '*rapprochement*', the music produced at IRCAM remains primarily modernist, different to other extant post modern musics, and without aesthetic reference to popular music; so that

popular music remains a distanced 'other', kept largely beyond IRCAM. However the technological discourse of experimental music does infiltrate IRCAM as a dissident ideology, its proponents IRCAM's American intellectuals. The analysis shows further how, without the need for overt aesthetic censorship, these discursive interrelations are managed through fragmented aesthetic subjectivities: through the mechanisms of splitting production and consumption, splitting production in one sphere from that in another, and repudiation or suppression of another (past) cultural self. These mechanisms achieve the externalisation of commercial popular culture from IRCAM - particularly the music, less so the technology. They also therefore maintain a conflictual balance within IRCAM of a dominant modernism under 'attack' by a dissident, youthful and 'vanguard' post modern culture: the conflict expressed through both generational and European-American rivalries. But this is largely a pseudo-conflict, a negotiation between charismatic leader and would-be heirs: a passing on of power. And I suggest in the next chapter that while the technologies are allowed to change, IRCAM's dominant aesthetic cannot.

At another level the analysis raises the role that Americans play in spreading the post modern message. It is striking that Americans are the most sincerely optimistic, active and populist proponents of post modernism within IRCAM, shown by their pro-low tech and populist consumption behaviour. They cluster on the right and bottom of Chart 2, ie towards low tech and towards the populist aesthetic (46). From qualitative interview data, it is possible to speculate that post modernism derives its subjective origination and power from a specific American experience of cultural pluralism: in simple terms, nearly all

the Americans at IRCAM had been brought up with black and white popular musical forms, as well as with 'serious' music, and saw both as deep in their own cultural heritage. This cultural pluralism - the deep subjective basis of their cultural experience - becomes easily linked to the pervasive American ideology of the achievement of a classless society, and to a view of the progressive potential of competitive capitalism. It becomes 'natural' both to ignore the objective institutional differences, and differences of status and legitimacy, of different musics; and to view culture, and music, as themselves autonomous and effective forces for overcoming socio-economic difference. Thus aesthetic difference is divorced from extant socio-economic arrangements and becomes read as itself a 'progressive' social force. This perspective is lived out in the American cultural condition, and it has much emotion and nostalgia invested in it precisely because of the weight of social and economic contradiction, and the hopes, that it bears. Hence its subjective power and apparent truth for my American IRCAM informants - (and hence perhaps the nostalgia of American writers such as Jameson 1984a and Berman 1984). Yet as we have seen, none of this prevents IRCAM Americans from also submitting to IRCAM's musical ideology - by fragmenting their production and consumption, and by implicitly agreeing to censor certain musics from IRCAM.

This material may, then, begin to provide insight into subjective dimensions of the phenomenon of post modernism: how, for example, American intellectuals experience it imaginatively as progressive while they continue to conform to extant institutional arrangements. This might complement the macro political-economic analyses of post modernism such as Jameson's (1984a) and that sketched in Ch.8 above. Jameson (1984a:78) outlines a periodisation in which modernism and post

modernism correspond to the eras of monopoly and multinational capital. In his view post modernism is the cultural manifestation corresponding to the post-War establishment of American multinational economic dominance, so that post modernism is precisely the form of American cultural hegemony.

Finally, it must be noted that the element of anti-formalist critique of the social institutions and functions of art that is supposed to inhere in 'vanguard' post modernism is more or less absent from IRCAM's post modernism; even - despite their utopian reflections on certain social dimensions of IRCAM's work - from the discourse of the musicians group vanguard (Ch.6). The analysis of IRCAM's post modernism, then, also confounds this broader view of the potential character of post modernism, as proposed by writers such as Burger (1984) and Foster (1985b). But as we saw earlier this chapter, the loss of this 'critical' dimension of modernism, itself always historically unstable, predates IRCAM and was accomplished with the rising formalist rationalism of the mid-century musical avant garde.

Chapter 10 Conclusions: IRCAM's musical discourse, history, and legitimation

In the first part of this chapter I outline some major developments at IRCAM in the two year period after fieldwork. I then return to the central problem of the thesis as raised in Chapter 1: the question of IRCAM's legitimation. I discuss this in relation to the preceding analyses of IRCAM's institutional and ideological forms, and explore in greater depth the legitimising force of IRCAM's advanced computer music discourse. Finally, I examine the implications of the thesis for analysing cultural reproduction and change, and how this contributes to understanding and theorising IRCAM's legitimation.

10.1 Developments at IRCAM in the period following 1984

During 1985 and 1986, IRCAM underwent some major changes, particularly in its technology policy. It also welcomed some new directors: the new Artistic Director GG, and the new Administrator VN. The Scientific Director job was suspended after FOK left in late 1984 and, as we saw in Ch.4, BYV - Boulez's tutor and 4X Soft director - became the stand-in, the 'Technical Co-ordinator'. Several junior tutors were promoted: WOW to director of Music Research, HM to that of Pedagogy. VN decided to make her mark by planning a large new IRCAM building; while the computing infrastructure grew and diversified with the arrival of a second VAX and several SUN computers.

Under BYV's scientific direction, there was by late 1985 a new and explicit awareness of the need to valorise IRCAM's scientific and technological research, or, more accurately, of the need to be seen to be conscious of valorising the research in terms of the external

community beyond IRCAM. Thus, BYV presented a short paper on this issue at a conference in September 1985 (see Ill.10.1). Interestingly, the aim of the paper is both to define how IRCAM's research should be valorised, and to summarise the progress of various areas of research that, it is assumed, will legitimise the institute's scientific activities. We thus see again (as at the end of Ch.6) a combined emphasis on the legitimation, and on formulating the framework or terms of legitimation, of research.

But the most significant change in the institute was a sudden decline in objections to, and a rapid increase in work on and with, commercial microcomputers. The main developments related to two technologies: the new, more powerful Apple Macintosh general microcomputers; and the range of Yamaha DX, CX and KX digital synthesisers and music technologies. The change was signalled by several other phenomena, for example by BYV's inclusion of '*petits systemes*' as the last category in his valorisation paper, and his commentary that the aim is, through this technology, to disseminate IRCAM's tools and knowledge as widely as possible. RIG, previously Pedagogy director and as we have seen IRCAM's key proponent of small machines, moved over to the new position of director of '*Microinformatique*': his own invention. And a course of evening public lectures on *microinformatique* and music took place in early 1986. This was, then, an ideological victory for the small machine ideologues, including those from the musicians group.

The Chant/Formes group worked enthusiastically on re-writing their software for the Macs, so that a Mac version of Formes was ready by the end of 1985 (as well as versions of Formes and Chant to run on the 4X). The overcoming of the team's objections to small systems, they explained, was due to the much increased power of the machines. IRCAM's

ex-Systems manager, FA, returned to develop a program called 'Macmix' which linked up many of IRCAM's technologies with the Macs. The Macs were interfaced to both the VAX's and the 4X's; and all of these in turn could be linked via MIDI connections to a virtually unlimited range of other peripherals - small synthesisers, digital effects etc.

During 1985, the Japanese Yamaha corporation successfully negotiated, via RIG, to equip IRCAM, for free, with a studio containing exclusively Yamaha digital music technologies. Thus by 1986, the studio at the top of the old building had become the 'Yamaha studio', and was manned by the (British) Yamaha representative WI, well-known in the computer music community as the man who 'voiced' (designed the timbres of) a major Yamaha synthesiser. However, WI's relations with the institute were uneasy, and musically he felt especially distant from IRCAM (1). WI expressed his technological rivalry and disdain for IRCAM's supposedly unique and advanced computer music tools by boasting to me that, in five minutes, and using a network of several of the Yamaha machines, he could make an imitation of the timbral transitions possible with Chant. And indeed, he rapidly produced a passable bell-to-voice timbral transition - and unlike Chant, one that he could then use polyphonically, ie use in realtime to drive a keyboard and so build up into several voices or chords. In his view, anything Chant could do he could also do, faster and with more versatility, with the Yamahas. Thus, despite apparently closer relations between IRCAM and commercial industry, tensions and rivalry remained.

It should not be assumed that these developments signalled an embrace of empiricism or too great a change in IRCAM culture. The public lecture course on musical microcomputing, for example, attended by external musicians keen to understand the latest developments, remained

highly theoretical and technical, and had no practical work nor any sound examples at all.

These technological changes contrast markedly with developments in IRCAM's music policy. The new Artistic Director GG came from being the director of an innovative regional contemporary music festival, which included a broad contemporary music programme including elements of 'advanced' jazz; and where he had managed to build up a sufficiently large audience that, for the first time in France, ticket sales provided 20% of the festival's funds. GG spoke of bringing fresh perspectives to IRCAM, despite resistance, and also of increased pressure from the Ministry for better audience figures - basically, for evidence of greater public interest in IRCAM. However, despite his broader musical perspective, GG was firm that this required no change of artistic policy. IRCAM should continue to invite the same kind of composers as previously (he called them '*les IRCAM-iens*' implying that this was now a well-recognised category of composers), since the character of the institute was already fixed and its parameters set.

"To continue to exist, it's imperative that what IRCAM has defined as its project must succeed strongly... Because if I now bring in Joachim Kuhn, Frank Zappa - all these names that I hear around (fades out)... the more people here are weak, sectarian, the weaker they'll get. I think we must first prove that the research here is important, can find a public, can make commercial and industrial links, can have a strong image.. first we must establish all this; and after the public perceives IRCAM differently, we can discuss again" (GG int., my transl.).

GG here mentions Kuhn, a modern jazz improvising pianist, and Zappa, the leading American avant garde rock musician. He implies that names such as these are being heard around IRCAM, ie that some people advocate them as potential candidates for invitation. But although GG had invited Kuhn to play in one of his festivals, he was adamant that this would not be appropriate for IRCAM: "Personally, I'd not integrate

Joachim Kuhn into IRCAM, no". GG expressed his conviction that IRCAM must stick to its founding musical identity by making an interesting analogy with political parties: he said that if the Socialists were to come too close to the Communists, they would inevitably lose their identity, cease to exist, disappear.

Instead of a changed musical policy to revivify IRCAM's flagging public image and counter its lack of wider cultural appeal, GG proposed increased attention and resources to the marketing of IRCAM and its music. He said that the aim of his festival had been to answer one major question: whether the lack of a public for contemporary music was due to the "problem of (musical) language", ie the aesthetic problem of modernism, or due to a problem with how the music is presented to the public: what he called its "*insertion sociale*". While conceding that there may perhaps be a problem of language, GG stressed how his festival had obtained good results by new strategies of presentation. "My festival had an image, colour, vivacity.. the aim of marketing is to project contemporary music with these qualities" (my transl.). He proposed to take the same approach and attempt to project a good image for IRCAM. And indeed, by 1987 IRCAM's publicity had been re-worked and was more colourful and more informative. In addition, GG seems to have been responsible for the exclusive emphasis on young IRCAM composers in the important IRCAM 10th anniversary concerts in 1987 at the CGP.

In summary, these developments show that while change in IRCAM's technological culture is possible, here in response to changing external conditions (the rising importance of small systems), aesthetic and musical change is not - a view articulated quite consciously by the new Artistic Director. Thus, of the two main domains of discursive struggle within IRCAM, as shown in the last chapter, technological conflict -

which was explicit and overtly ideological - in conjunction with external pressures could produce cultural change; while aesthetic dissent - which was largely hidden, fragmented, dealt with by intra-subjective mechanisms - could not. IRCAM's aesthetic character is therefore central to the definition and maintenance of its identity, and is, it appears, unchanging.

10.2 IRCAM and legitimation

10.2.1 Institutional and ideological forms

In Ch.1 I outlined the central problem of the thesis, founded on a double contradiction: how IRCAM legitimises itself in order to reproduce its current privileged and dominant position, despite its lack of a large audience or public for its works; and in addition, how it can reconcile its existence as a hegemonic institution with its enunciation of avant garde ideology.

If IRCAM does not gain external legitimacy by successfully finding large markets for its main musical and technological products, it may by other means. Because of the complexity of its work, we have seen that the institute touches on a number of overlapping specialist domains - scientific, technological, artistic; so that, rather than great success in one or two domains, it relates to, and exchanges with, several disparate constituencies. Added up, this composite 'public' for its work is not so small, and is international, highly legitimate and powerful.

However, in the absence of significant external legitimation through either large audiences or high regard for IRCAM music, or through commercial or industrial interest in its research and technologies, we have seen throughout the thesis an emphasis on internal

legitimation within the institute. We saw also that, despite their criticisms, officials from the Ministry of Culture acceded this as an appropriate state of affairs for such a highly privileged and unique institution: that IRCAM should be subject to a process of self-monitoring and assessment (Ch.2.3.2, App.5). Thus IRCAM has to legitimise its work, but it does so through a constant reflexive search to formulate the terms of its own legitimation: an analysis that accords, as we saw in Ch.6, with that of Lyotard (1986:38). Where Lyotard depicts this process as characteristic of scientific discourse, we have seen - through both the historical analysis, including Boulez's own career, and the ethnography - that it is equally characteristic of artistic discourse, in which production is linked to and legitimised by reproduction, while the latter is itself accomplished through the production of a discursive genealogy - a canon. The thesis has given insight into various forms and dimensions of IRCAM's internal legitimation, and I want now to summarise and discuss them.

First, we have seen that in its very institutional form, IRCAM supports its own internal, unofficial intellectual vanguard - the musicians group (Ch.6). Nestling within this very stratified and hierarchical institution and with its highest cultural status, but - appropriately for a vanguard - on the defensive, suffering exploitation and insecurity, and willingly engaged in self-exploitation, the vanguard proves its integrity through charismatic asceticism (Ch.3). The institute thus contains within itself, microcosmically, its own avant garde, devoted to utopian speculation, to critique of the dominant ideology and the extant state of things, and to anticipation of the long term future. This 'avant garde', however, is also a domestic garden for cultivating IRCAM's young 'heir elects', since many of them eventually gain

promotion and power. We saw also that the vanguard flirts with consideration of social dimensions of the institute's work; but, as with Boulez's own sociological leanings, this is weak and undeveloped. Thus, as I argued in the last chapter, IRCAM's vanguard comes nowhere near developing the politicised critique of the social functions of art proposed as the foundation of a new 'vanguard' post modernism by theorists such as Burger (1984), Foster (1985b) or Clarke (1983). Its main functions are, then, the formulation of potential directions for IRCAM; and, as importantly, the symbolic expression of utopian discontent within the hegemonic institution and, in this way, to mitigate the second contradiction outlined above.

Second, we have seen that the institute also contains - more generally than the controversies surrounding the vanguard - various levels of internal conflict. These concern the orientation of its internal work (Ch.6), but also broader aesthetic and technological questions (Ch.9). Further, we saw in Charts 1 and 2 (Figs.6.2 and 9.2) that this internal conflict commonly takes the form of binary oppositions, (in Chart 2 with an intermediary position between the two technological poles, while the aesthetic axis is structured by two distinct, overlapping oppositions).

Rather than seeing binary oppositions as 'innocent' deep structures of the cultural unconscious, as Levi-Strauss depicts them, recent work in literary criticism has stressed their peculiarly ideological character. In binary oppositions, the two poles are inextricably bound by a mutual antithesis in which one pole asserts its superiority and transcendence of the other: one is systematically idealised, the other denigrated, while, crucially, 'other' positions are just as systematically ignored. Binaries, constituted by each pole

antagonistically 'preferring' the other, appear as 'natural' forms of thought; they are normative, very stable, and inhibit the perception of what is absent or 'not being said' (Eagleton 1983, Macherey 1978). Thus, for example, the 'opposition' of hardware (4X) to software (Chant/Formes) in IRCAM culture in 1984 concealed an underlying consensus over large system and digital development, and so worked to exclude consideration of small systems and of 'mixed' technologies; just as, at a higher level, scientific and technological controversies within IRCAM worked, as a whole, to evade and exclude open aesthetic controversy or debate (Ch.5).

The positive view of these phenomena is that they demonstrate IRCAM's ability to contain and rehearse dissent, a lack of repression of alternative viewpoints; and indeed, real issues of legitimation are informally fought out within the institute, as we saw in Ch.6. The sceptical view is that this containing of apparent 'dissent', 'opposition' and 'difference' is simply a show, a display by which IRCAM seeks to demonstrate an absence of imposed hegemony, and its responsiveness to criticism and new ideas. As I mentioned in Ch.1, Bourdieu notes how the preoccupation with opposition internal to the 'cultural field' acts to effectively exclude other potential positions, differences that may not be entertained within that field (a view analogous to that on binaries described above). Both Bourdieu and Williams analyse this as a mechanism which ultimately reinforces authority and power. In this view, then, IRCAM's internal dissent serves to support rather than undermine its legitimacy. In fact, we have seen that while technological 'dissent', in conjunction with external pressures, can produce change, aesthetic dissent is tacit and change avoided; so that in the area most central to IRCAM's identity, dissent,

or even open debate, cannot be tolerated. This suggests a fragility at the centre of the IRCAM project.

At a deeper level, we saw in the last chapter (Ch.9.3.1, 9.4) how the most difficult kinds of difference and dissent - the musical-aesthetic - are 'managed' through (sometimes unconscious) intra-subjective mechanisms of repression and splitting. Superficially, subjects may espouse an ideology of cultural pluralism and appear to value musics external to IRCAM, for example popular musics; yet, through these tacit and hidden mechanisms, they systematically exclude from IRCAM any musics that conflict with IRCAM's dominant modernist discourse. The result of these forms of subjective fragmentation, then, is to evade any challenge to the legitimacy of IRCAM's dominant aesthetic and to produce compliant subjectivities within IRCAM.

10.2.2 IRCAM's computer musical discourse: non-aesthetic universalism

I now want to return to the substantive character of IRCAM's musical discourse and of its intertextual theoretical domains, to show their role in IRCAM's legitimation.

We have seen that the scientism, concern with technology, theoreticism and a-social formalism of IRCAM's musical discourse are no spontaneous conjuncture or innovative development, but are legacies of the continuous and dominant character of modernism through the century. However, at IRCAM and within high level computer music these general elements are reinvigorated and obtain a new force. It is now proposed that areas of 'music research', psychoacoustics and the cognitive psychology of music, and their application particularly in advanced, artificial-intelligence influenced software - such as, at IRCAM, the

Chant and Formes programs, PL's interactive improvisation project, or the musical expert system - will provide new constructive or generative bases for composition, through analysing and then modelling the fundamental structures and 'rules' of musical process.

Roads, in his article 'Artificial intelligence and music' (1980), provides an overview of these developments, and epitomises the rhetorical flavour of the argument:

"The germ idea of organising musical compositions around a set of systematic procedures contains within it the implication that these procedures could be made automatic. The inverse notion, gaining ever more significance, is that these procedures and syntactic structures can be recognised automatically. Indeed, one of the fundamental notions of any A.I. application is that it can be characterised as rule-structured. Certainly one of the major tasks of composition is creating a rule system.. for a piece" (Roads 1980:14).

He continues with a rhetorical device classic in this discourse:

"Clearly, creative composers do not simply execute a fixed set of instructions... Of course music is not just rules; but rule specification is one component of composition" (ibid).

This qualification appears to make the prior claims quite reasonable; and yet throughout the rest of the discussion its implication - that there is more to creative composition and aesthetic innovation than the following or extending of formal musical structures - is never developed. Roads' piece consists of enthusiastic discussion of various formalist A.I. approaches and concludes with a list of applications of A.I. techniques in computer music. These include: "intelligent instruments,..intelligent musical data bases;..a better understanding of human musical cognition and musical universals; new musical machines with capabilities beyond those of a single performer;" but it ends, inevitably, by returning to composition: "..and new and interesting compositional rule structures" (ibid:23).

Similar rhetoric is also characteristic of IRCAM. Thus, a 1985

paper by the director of Music Research begins:

"Musical Research at IRCAM considers that the key problems in the area that need to be resolved today are not so much technological, but principally cognitive. These problems relate to what has been called Artificial Intelligence, the explicit control of reasoning: ie making explicit and formalising the whole of musical knowledge" (WOW).

These areas represent, then, new attempts to transcend and transform the basic negational character of musical modernism: a desire we saw articulated in Boulez's founding writings on IRCAM (Ch.2, App.6) in his call for 'synthesis'. At one level these areas of research are continuous with the earlier attempts to make sciences (previously maths, information theory, acoustics) the basis for musical composition. But at another level, through attempting to derive scientific models specifically from music, they appear less arbitrary in their relation, and closer, to music. However, despite this concern to develop metalanguages for music that derive from the 'nature' of music itself, the same logic is at work: the view that domains of knowledge purportedly analogous to, or derived from the analysis of, music can become the basis of new music. Thus, in texts from this perspective (as Roads above) one finds a constant elision, or movement, between computer-aided music analysis and computer-aided composition, based on the assumption that refined analysis can be used to generate compositional ideas or material. Or, and continuous with modernism in general, there is simply the assumption that the 'aesthetics' of science will also translate into, and provide, an aesthetics for music: the notion underlying the many instances that we saw within IRCAM of more arbitrary conceptual foraging from science (eg genetic biology, fractal geometry) as a basis for composition (Chs.5, 6, 7).

While apparently providing more 'appropriate' metalanguages for music, there are several problems with the A.I. approaches. They derive

either from very general physical, perceptual or structural characteristics of musical sound (as in acoustic and psychoacoustic research), or from very particular aesthetic characteristics (as with computer analysis of the aesthetic patterns or 'rules' of specific, extant musical forms (2)). In the first case, it is questionable to assume that an aesthetic can be deduced from such general laws, which may be necessary for composition but, crucially, are not sufficient. A good example of this kind of implicit strategy - ie the move from the general and scientific to the aesthetically particular - is an article by Lerdahl (1988), (an American researcher who has worked at IRCAM). He begins by proposing various cognitive constraints on musical comprehensibility, moves from this through a critique of serialism, and ends by putting forward two aesthetic principles for good music, which accommodate the cognitive constraints, with the clear implication that these can prescribe compositional guidelines. Lerdahl thus moves from cognitive 'laws' to aesthetic critique, and from this to 'aesthetic propositions' framed, still, in very general cognitive terms.

As regards the second case above, it is questionable to depict the 'rules' derived from analysis of one musical aesthetic as either musically universal or generative of new aesthetic forms. In fact, the likely effect of applying 'rules' derived from one musical genre to composition is to inhibit any possibility of profound aesthetic innovation and to encourage just slight transformations or variants of the extant genre. In this sense, A.I. influenced composition represents its ultimate rationalisation, the scientific, high cultural version of what Adorno (1978) accused the cultural industries of bringing about: the standardisation of music.

Yet, within IRCAM, such areas of research and analysis are applied in technologies that, it is claimed or implied, are both universal and aesthetically valuable in a general sense. We saw this, for example, in PL's reluctance to discuss the aesthetic specificity of his improvising software (Ch.5). But the strongest example is the Formes program which, based on the A.I. language Lisp, provides a set of hierarchical and recursive principles for structuring musical 'objects' into compositions (Ch.5). The program is proposed, then, as a general or universal compositional environment; its basis is a deductive hypothesis of musical structure or grammar. It is seen as an aid to composition - implying that its syntactic character can be transformed into specific compositional, or aesthetic, semantics. Yet at the same time as the designers encourage this move from the general to the musically particular, they are also tempted in the opposite direction, beyond music, towards even broader and more universal uses of the program: they suggest that Formes can find equally valid applications in computer graphics, video and robotics (3).

There is, then, a constant desire to universalise: either by moving from the scientifically (for example cognitively or perceptually) 'universal' to the aesthetic (and therefore particular), or to universalise what are specific aesthetic characteristics. This universalising tendency, and the claims that the models derive from the underlying 'nature' of musical processes, are legitimising strategies, and ideological. They are ideological in attempting to evade and cover up what is most difficult and appears to be most missing: particular, innovative aesthetic developments - interesting new musical compositions. No less than with the other arbitrary, scientific intertextual references in musical modernism, then, the discourse of

A.I. in computer music is used to overdetermine the music rather than, as it presents itself, to 'reflect' (or 'explicitly model') the 'nature' of music. It is an attempt to provide an a-historical, a-cultural and (paradoxically) non-aesthetic basis for musical aesthetics.

Once again, something of the fragility of this evasion of the modernist aesthetic impasse through the elaboration of a vast superstructure of scientific theory can be glimpsed through a few significant doubts expressed privately by key IRCAM subjects. Thus, we saw in Ch.6 how both Boulez, and the director of Music Research himself, expressed scepticism about the theoretical project of music research and its usefulness for composing. While, as mentioned earlier (Ch.5.1.1), IRCAM's main psychoacoustician, HM, whose research was often cited by well-known IRCAM composers as the basis of their pieces, said with frustration and scepticism that he really could not see how his work was applied in their music. HM dismissed the supposed psychoacoustic bases of the music of four well-known IRCAM composers as pure rhetoric; he exempted just one other whose music, he believed, really made some musical use of the theory. These private doubts, then, focused on the contradiction between public theoretical rhetoric and actual musical practice, signal these individuals' own sense of the arbitrary and mystifying relation between theory and practice.

Finally and more simply, the thesis has uncovered phenomena that question the rational, scientific basis of computer music at the level of synthesis and analysis of sound materials. We saw this in the lack of predictability of digital synthesis of rich and complex sounds, despite the apparent rational control of all variables (App.7); and in AV's dissatisfaction with the digital simulation of organic timbres based on

thorough computer analysis of their components - his sense that there was nonetheless something missing (Ch.7.3). These small but significant moments undermine the omnipotent rhetoric that surrounds computer music synthesis.

10.3 Reproduction or transformation? Cultural processes of the long term

The thesis has tried to integrate ethnographic with historical analysis, particularly through the method of discourse analysis as applied to the cultural historical traditions of modernism and post modernism. The point is to examine, in relation to the material, questions of cultural or discursive continuity or change over the long term. I now want to discuss the implications of the thesis for theorising those issues.

I have argued (in Ch.9) that in many ways - aesthetically, but also more generally in its social and cultural forms - the basic character of IRCAM is continuous with the long term development of musical modernism; and that IRCAM's 'post modernism' does not represent a significant change since, as shown for example by its consistent relations of absolute aesthetic difference with commercial popular music, it is less 'different' to modernism, aesthetically and discursively, than other, external post modernisms. Further, we saw earlier this chapter that in the period following fieldwork IRCAM's aesthetic policy appeared relatively immune to change, while significant technological change did occur due to a combination of external forces and internal dissent.

Yet from the analysis in Ch.9 we know that the character of that recent technological change (towards working with small systems) is itself framed within discursive conflicts between modernism and post

modernism at IRCAM. We have seen, then, that the internal details of IRCAM's technological culture - its technological 'irrationalities' (neglect of tape and analog techniques), its internal technological disputes (large versus small systems) - are overdetermined by discourse, ie by tensions, rivalries, assertions of difference between modernism, post modernism, and popular music; just as IRCAM's overall relation to technology - its adherence to the necessity of technology, new media and so on - is itself overdetermined by the character of modernist discourse in general. Thus technologies and the practices associated with them are imbued with meaning at IRCAM only through the mediation of these broader, long term aesthetic discourses; and those meanings are projected into the technologies. All of this suggests in turn that within IRCAM, technological change can be subsumed or absorbed by broader aesthetic and discursive forms that are, essentially, continuous.

This approach to theorising cultural systems of the long term as they both inform and construct practice and the use of technology, and as they tend to reproduce themselves, is reminiscent of the work of both Foucault (1977) and Sahlins (1981, 1985). Foucault's substantive analyses of discursive formations can be criticised in two ways: for depicting the formations as continuously unfolding through history, and so neglecting to either trace or theorise the potential for transformation; and for lack of attention to the differentiation of discourse. Sahlins, on the other hand, does allow for and analyse the transformation of cultural systems. He theorises this as the result of a dialectic of structure and practice, of received cultural orders being enacted in transformed conditions, and especially through the

conjunction of alien cultural systems and their mutual effects. Thus practices formed in one cultural system meet circumstances ordained by another, and both are transformed. However Sahlins' approach has, in turn, been criticised for depicting the cultural systems themselves as inherently stable and self-reproducing in the absence of external factors inducing change from without (eg Toren 1988). For Sahlins, then, change occurs due to external forces, and there is little room in the analysis for intra-cultural change, nor indeed for difference operating within the cultural order.

In the thesis, and unlike both writers, I have been concerned to systematically explore discursive differentiation in both the ethnography and history, and to ask whether it fuels cultural change. I have also set out not to prejudge the issue of the reproduction / continuity, or transformation, of the cultural system in question - here, musical modernism and its expression within IRCAM. I have shown both fundamental historical continuities, aesthetic and discursive, but also some changes - notably the recent change in technological culture. Yet I suggested above that even the internal ideological conflict driving this technological change is subsumed by the antagonistic dialogue between modernism and post modernism. Apart from this, like Sahlins, I have stressed the role of external forces - changes in the dominant commercial computing environment - as inducing this change within IRCAM. Thus, despite tracing intra-cultural difference and conflict, it appears that the thesis supports Sahlins' approach inasmuch as I have produced an analysis suggesting that overall, the cultural system of modernism at IRCAM is not being significantly transformed in the absence of external change, that it is locked into an implicit dialogue with its negation (post modernism), and that it reproduces

itself through absorbing and suppressing potential sources of change.

The result of this analysis should not be taken to imply that all cultural systems are essentially stable and tend towards simple reproduction. Rather, I would suggest that certain dominant, hegemonic cultural systems - as with Foucault's analyses, and as here with musical modernism - do tend towards reproduction, continuity and the absorption or suppression of difference because of the cumulative momentum of historical authority and power that they bear. In the thesis, we have seen some mechanisms by which this is accomplished: the construction of genealogies, the control of reproduction and linking of it to production, and so the cumulative legitimacy of powerful cultural systems (central to Boulez's personal history, the history of modernism, and to IRCAM); and, at another level, the moulding of subjectivity as shown by the processes of intra-subjective fragmentation and repression that prevent different aesthetics from entering IRCAM. However, in principle, not all cultural systems will be equally powerful, nor so able to evade transformation. And despite this analysis, we have seen important factors beyond IRCAM's control that may still produce significant pressure for change within the institute: the push for closer relations with commerce and industry (as with Yamaha); the pressures from the Ministry for better audience figures (Lyotard's legitimation by performativity); and broader technological developments, as they interact with IRCAM's profound technological dependence. Indeed, although it appears that the modernist aesthetic is autonomous from and can subsume or incorporate technological change, the potential effects of small system development may be greater than allowed for in this analysis.

In conclusion, I will return to the question of the legitimation of IRCAM as it relates to the previous discussion. We can now see that IRCAM's legitimation is accomplished by the subtle interplay between two dimensions of modernist discourse. First, by the explicit, substantive ideological and rhetorical content of the discourse, with its utopian stress on innovation, rupture, its orientation to the future. And second, by its implicit structuration: the long term historical continuity of modernism, and so the cumulative authority and increased legitimacy that it has accrued. The two dimensions appear to be in contradiction. Yet when this is overlooked, and the two are unconsciously experienced as complementary, they create together a formidable legitimacy, satisfying both the desire for rupture, newness, progress, and that for historical continuity and consolidation. The tension between the two - between the apparent leaning towards the future, and the careful deep structural conformity to and continuity of tradition - is reminiscent of Lyotard's summarising statement on post modernism. He writes:

"The writer and artist, then, are working without rules in order to formulate the rules of *what will have been done...* Post modern would have to be understood according to the paradox of the future (*post*) anterior (*modo*)" (1986:81, emphases in original).

I would suggest that this describes not so much the practice as the ideology of the avant garde; since, as the thesis has tried to show, once the long term aesthetic and discursive continuity of modernism is traced, this undermines the avant garde rhetoric of innovation and constant change. And it becomes possible to uncover the implicit discursive 'rules' that are being followed and that construct avant garde musical practice, at IRCAM and beyond.

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