Science as Ideology:

The Problem of Science and the Media Reconsidered

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ABSTRACT

This study seeks to undertake an analysis of the topic of 'science and the media' as it has been constituted in academic discourse since the end of the Second World War. It finds that concern has polarized in two distinct camps: The larger, participant in the traditional project of North American media studies, blames the press for what it perceives as a widespread and deleterious "scientific illiteracy" on the part of the laity. The more recent, indebted to critical developments in social theory, philosophy of science, and the study of mass communication, works to expose the assumptions on which press coverage of science has been based and the interests which have benefited.

The thesis argues that the adequacy of the dominant concern to its object of analysis is at best suspect, but that nevertheless its agitations have been chiefly responsible for the form which popular science has predominantly assumed.

RESUME

Cette thèse entreprend d'analyser le problème de 'la science et des médias' tel que constitué par le discours universitaire depuis la fin de la Deuxième Guerre. Elle montre que la recherche s'est polarisée en deux camps distincts: D'une part, la tradition dominante de l'analyse des médias nord-américaine attribue à la presse la responsabilité de ce qu'elle perçoit comme un 'analphabetisme scientifique' répandu et pernicieux de la part du public laique. D'autre part, une tradition plus récente inspirée par la recherche critique en théorie sociale, en philosophie de la science et en analyse des communications de masse cherche à exposer les présupposés sous-jacents à la couverture médiatique de la science ainsi que les intérêts sociaux qui en profitent.

La thèse soutient que malgré l'inadéquation entre la tradition dominante et son objet d'étude, celle-ci est néanmoins reponsable du profil généralement adopté par la science populaire.

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Chapter One

Writing About Writings on Science and the Media: Parameters of the Study

What follows is an examination of the constitution of the topic of science and the media in academic discourse. The undertaking is to survey the range of writings that have addressed the issue of science communication, or popularization, and in doing so to interrogate the terms in which the issue has been framed, inquiry has been conducted, and arguments have been mobilized. The attempt is not only to situate the topic of 'science and the media' in relation to a complex interaction of political interests, institutional needs, and social imperatives, but to show that the labour of this particular branch of media studies is not without ideological import, in that it works overall to establish a certain view of science as necessary and correct, and therefore to agitate in favour of a corresponding tone and content in its representation.

The thesis will argue that, from the 1950s and continuing into the present, those who have addressed the subject of media attention to science have done so predominantly in light of a common set of assumptions about science, and mass communication, and the proper relation between the two. It proposes to expose just those assumptions that have lent such writings their coherence and their impetus, and to consider their political consequences.

Willard D. Rowland, Jr. has noted that although from their beginnings American communication studies have been carried out within a dominant epistemological tradition that has defined the field's characteristic concerns and endowed it with its methodological inclinations, little close attention has as yet been paid to the circumstances associated with the ascendance of this tradition, or to the implications of its dominance.

> Under the current frame of reference, the basic images of ... communications in general, and of their social import remain those of the peculiar, and particularly American, tradition of positivistic science that, as it is reflected in the mass communication research community, continues to be largely unaware of the significance of the industrial and political influences on it.
> Thus there remains for communication scholarship the prodigious task of critically reviewing in considerable detail the intellectual assumptions of the theoretical and methodological forms of that tradition (Rowland 1983, 31).

Rowland's study is an attempt to redress just such a lack, by examining how and why the issue of violence came to dominate research interest in television in the United States, and by demonstrating that the methods and concerns of this research have arrived at certain accommodations with the interests of government and industry.

By virtue of the fact that the bulk of academic inquiry into media representations of science has been conducted from within precisely the tradition identified by Rowland, such inquiry shares many of the characteristics of the work on television representation of violence. Most prominently, work on science and the media has been informed by an essentially positivistic understanding of science, with attendant consequences for both methods and arguments. Such research measures press performance according to positivist criteria; it finds favour and support in like-minded universities and government institutions; and it effaces the social and political context within which its agenda has been established, presenting instead its formulation of the issue as straightforward, obvious, and owing nothing to any outside agency.

Also in common with concern over television violence, sustained attention to popular science on the part of media sociologists and the scientific community began in the 1950s, is clearly associated "with the rise of science as a preeminent institution in American life (Rowland 1983, 20)," and continues into the present. In the process, the subject has established itself as a legitimate research interest in the discipline of communications, spawning its own symposia, conference panels, and a sizeable and growing body of literature, as well as providing a number of university departments with a specific area of emphasis or expertise.

Furthermore, like the issue of television violence, media coverage of science, from its beginnings, has been presented as an issue of more than mere academic interest. Quite the contrary: the traditional view would have it that academic interest was spurred only by the recognition that public understanding of science had become an issue of considerable social import. The logic of inquiry in the two areas of media studies has therefore been all but identical: something is wrong with society (too violent; too ignorant of science) and agencies of public communication are to some degree culpable (violence is over-represented, and typically glamorized or legitimated in its portrayal; science is under-represented, and typically sensationalized or garbled in its portrayal). Effort in both avenues of inquiry has been directed to the documentation of media portrayals of violence and science, respectively; to the specification of the social consequences of such representations; and to proposals for alterations in media performance, championed in the name of the betterment of society.

Thus, as in the case of research interest in television violence, academic attention to popular science developed explicitly as a systematic influence on the practice of that which it sought to investigate: its descriptive findings were to provide the basis for a series of prescriptive agitations. Its influence in that regard has been exerted most significantly in precisely the manner that research on media violence has had an influence in shaping the environment of regulation and community expectation within which broadcasting is practised. That is, just as violence effects research "has served both as a symbolic medium for public debate about the meaning of television in American society and as a means for accommodation among the interests of the principal parties to the policy debate (Rowland 1983, 303);" so too has the constitution of the issue of 'science and the media' provided a forum for public debate about the nature and meaning of science in Western society, and the responsibilities of the press with regard to both the scientific estate and its lay readership.

As similar as the two research traditions may be, however, and as allied as they are in their fundamental theoretical commitments, important differences nevertheless obtain between them. Firstly, popular science has never acquired the status of media violence as a topic of central importance in communication studies. In apt similarity to the status of science writing within the institution of journalism, the study of press attention to science is recognized within the field of communication as a legitimate and serious endeavour, but it is not one that has captured the enthusiasm of the community, and therefore, relative to other areas of inquiry, it is not one that is altogether vigorously pursued. Although the corpus of literature on science and the media is large enough that it is well-nigh impossible to compile a truly exhaustive bibliography, much of this material has been written by concerned scientists, enthusiastic journalists, or "public information" personnel attached to scientific organizations; as well, a good deal of the literature takes the form of practitioners' guides -- "how to" instructions for aspiring science writers. The work on the topic by communications scholars is dominated by the output of a small, but relatively prolific group.

Secondly, and relatedly, although the work on science and the media has been overwhelmingly conducted in the epistemological tradition of American media "effects" research, it has experienced considerable difficulty in its attempts to conform to the obvious research goal of such a tradition: namely, the measurement of "effects" traceable to duly documented media content. That is, those investigating television violence benefit not only from a wealth of violent content in both entertainment and public affairs programs, but from extensive statistical evidence documenting the changing incidence of violence in society. By comparison, the "effect" that preoccupies those who have addressed the subject of popular science is in fact an absence -- ostensibly, a lack of public acquaintance with science -- which is itself seen as a result of a deficiency in the media diet, specifically the dearth of sustained and appropriate media attention to science.

Consequently, the very formulation of the central problematic in studies of media representation of science has meant that inquiry has assumed a distinctive character. Frustrated from the outset in any attempt to apply the full repertoire of methodological techniques made available by the "effects" research tradition, the work on science and the media is a good deal less reliant on data generated by empiricist investigation than have been other issues on the agenda of North American communications research (although quantitative studies, purporting to reveal 'objective' data germane to the questions associated with popular science, are an important part of the corpus).

The 'problem' of science and the media, as it has become known, is therefore more than simply a problem for society (the public good is ill-served by the current state of popular science), or for science (science is similarly ill-served), or for the press (constraints to improved science coverage should be overcome). It is also, in its narrowest sense, a problem for those who have made the subject of science popularization an area of investigation or commentary.

It is, simply, the problem of how the relationship between science, the press, and the various publics is to be conceived, and therefore interrogated. According to what procedures should research proceed? How can the validity of findings or assertions be assessed? What is it that will set the agenda of inquiry and guarantee its legitimacy?

It is *not only* in its general contents and arguments, therefore, that work on science and the media reveals its political labour, but more pointedly in the details of how these contents have been arrived at, and how the assumptions on which the arguments are based have been justified. It is only via an examination of individual contributions to the corpus of research and commentary on press coverage of science, therefore, that one can hope to fully account for the form that academic (and popular) argument on the subject has assumed. It is only through an analysis of the internal constitution of the field and its 'problem' that the adequacy to its object might be assessed. And finally, given not only the explicit recommendation of alterations to press performance, but also the occasionally explicit discussion of the core of assumptions that are to guide attention to science and the media, it is the corpus of academic literature on the issue that spells out most clearly the ideology being served, from epistemological grounding to specific suggestions for political reformation.

One must emphasize, however, that although the academic discourse on popular science is dominated by a predominantly American camp, the 1980s have seen the emergence of attempts to address media representation of science in terms either different from or indeed directly opposed to those of the received problematic. These works are indebted to a tradition in media studies that is primarily European in origin, and quite unlike that criticized by Rowland.

The recognition that there are two different traditions in the discipline of communication is at least as old as Adorno's distinction between administrative and critical research. One is quantitative, positivist, insistent upon the sanctity of science, and coincidentally devoted to providing answers to just those questions which most interest various industrial or state concerns. The other proceeds from a class analysis, is interpretive and critical in its method, and produces little that is of direct use to industry or the state. The tension between these two traditions has been a recurrent theme within the discipline, and most recently the debate as to the proper aims of communication studies, and the relative merits and deficiencies of each approach, has produced the special 1983 Journal of Communication issue, Ferment in the Field.

In the most general terms, the critical tendency distinguishes itself from its counterpart by its concentration on how "reality" is presented to, and apprehended by, various constituencies of the public -- and therefore by the identification of "ideology" as its object of analysis.

Stuart Hall (1982) locates the advent of such a tendency in the recognition that the consensus on which social order is based does not spring naturally and spontaneously from the polity, but is an entity that is formed by political institutions in response to political interests and social circumstances. The realization that the terms in which a society understands itself are social, not natural, creations led directly to questions such as "In what interest did the consensus 'work'? What particular type of social order did it sustain and underpin? (Hall 1982, 63)." Importantly:

> From the viewpoint of the media what was at issue was ... a shaping of the whole ideological environment: a way of representing the order of things which endowed its limiting perspectives with that natural or divine inevitability which which makes them appear universal, natural and coterminous with 'reality' itself. This movement -- towards the winning of a universal validity and legitimacy for accounts of the world which are partial and particular, and towards the grounding of these particular constructions in the taken-for-grantedness of 'the real' -- is indeed the characteristic and defining mechanism of 'the ideological' (Hall 1982, 65).

Cast in slightly different terms, the two central concerns to which the critical tendency became drawn were:

> First, how did a dominant discourse warrant itself as <u>the</u> account, and sustain a limit, ban or proscription over alternative or competing definitions? Second, how

> did the institutions which were responsible for describing and explaining the events of the world -- in modern societies, the mass media, par excellence -- succeed in maintaining a preferred or delimited range of meanings in the dominant systems of communication? How was this active work of privileging or giving preference practically accomplished? (Hall 1982,67-68)

In the specific case of news analysis, then, the two traditions in media studies pursue wholly different lines of inquiry. Work in the North American 'mainstream' largely accepts the aspirations of the fourth estate to objectivity, and insists upon a rigid demarcation between the event, occurrence or activity and its subsequent account -- i.e. between the representation and that which is represented. Such a distinction inevitably directs attention toward the comparison, in one form or another, of journalistic accounts with the realities they purport to document, in efforts to monitor the fidelity of the former to the latter. The project of mainstream news analysis turns, therefore, on the issue of accuracy (or inaccuracy): what is at issue is how well the press represents the doings and features of the world.

Most often, the assertion is made that certain conditions or methods produce more veridical accounts than others (the dispersion of media ownership is to be preferred over its concentration, for example), and that these methods or conditions should be defended. Alternatively, the complaint is voiced that prevailing structures and techniques of news production cannot help but generate a skewed portrayal of social affairs, partial to a select set of interests.

For the critical tendency, the accuracy of news is also a central preoccupation, but for markedly different reasons. Given its theoretical underpinnings, it seizes upon the very capacity of the fourth estate to fix the terms in which the categories and facts of daily life are defined and put into play. The recognition that it is by establishing what is true or proper that the press exerts itself in the realm of social authority comes to the fore, and analysis is directed toward the contents of the press' versions of reality, the processes by which these are adopted, the mechanisms which legitimate them in the eyes of the polity, and the social interests whose benefit they conceal.

Left in these terms, however, the distinction between the traditions in media studies remains overly broad and therefore unavoidably vague. As a result, in examining the corpus of writings on science and the media, this study proposes to document how each tradition has handled what is in name at least the same problem. The hope is that a detailed consideration of a particular instance might further illuminate how, in practice, the two schools have differed.

It should be mentioned from the outset, however, that the critical tendency has not been quick to seize upon science as an operative ideological category, concentrating instead on media representations of topics such as labour-management relations, international affairs, race, crime, terrorism, sexuality and so on. In part, this is likely a result of the backgrounds of researchers themselves, who are more likely than not to have been trained in some aspect of the humanities, and for whom the critical engagement of science may be a daunting, if not intimidating prospect. As a consequence, it has only been since the late 1970s, and capitalizing on a critical reappraisal of science in philosophy and social and political theory which gained momentum over the course of that decade, that studies have begun to appear which seek to consider press coverage of science in terms of the ideological labour it performs.

This thesis will therefore begin with an examination of the contents of this critical reappraisal, proceeding via a review of certain works by two leading contributors, Jurgen Habermas and Paul Feyerabend. At its most basic, the intention in the chapter to follow is to clarify the object under discussion: since this study addresses science as ideology and social authority, it is first necessary to detail what one means by this. In addition, however, the aim is to provide a basis from which an analysis of works on science and the media might proceed. The chapter seeks both to spell out the platform of background arguments which have informed an emergent critical assessment of media science coverage, and to render conspicuous what the dominant concern has been lacking: namely, a willingness to engage the complexities of the social labour of science in the late 20th century.

Once the critical response to the traditional understanding of science has been adumbrated, it will be possible to turn to a detailed consideration of the body of commentary on science and the media. Chapter Three will examine the emergence of the 'problem' in the United States, concentrating on a number of articles which appeared in <u>Science</u> and the <u>Bulletin of the Atomic Scientists</u> in the 1950s and early 1960s. The contention is that it is these texts which first give full voice to a concern over the extent of public familiarity with science -- a concern that had been building since the end of the Second World War. It is these texts that first call for a renewed and reformed journalistic attention to science, and they therefore provide an opportunity to make explicit the assumptions on which such a call is based. The effort will be to place the debut of the problem of science and the media in the context from which it arose.

Chapter Four will then turn to the bulk of work on science and the media produced in the dominant tradition over the course of the past 20 years, so as to review and assess not only findings and arguments, but the internal construction of the field.

Chapter Five will be devoted to a consideration of recent work conducted in an alternative vein, with a view to documenting how the critical reappraisal of science has been taken up within media studies and used to inform a variety of analyses of popular science coverage.

Once the various arguments with regard to popular science have been arrayed, Chapter Six will attempt to assess the adequacy of the major contentions via an examination of current media performance: can the arguments of either tradition be sustained? Finally, on the basis of the contents of the fore-going chapters, the attempt in Chapter Seven will be to come to certain conclusions about the merit and import of work on science and the media to the present.

Chapter Two

Science as Ideology:

The Work of Jurgen Habermas and P.K. Feyerabend

2.1 Toward a 'Critical' Understanding of Science

In 1984, Pantheon Books published Not in Our Genes, intended as a challenge to what its authors perceive as a regrettable tendency in the progress of the life sciences. In specific, their disagreement is with the school of thought broadly known as "sociobiology", but in more general terms the book is an attack on what its authors argue is an inherent reductionism and determinism in much of contemporary biology -- the notion that complex social and psychological phenomena are ultimately answerable to genetic or biochemical arrangements; and that therefore studies at the micro levels of cytology and molecular biology can shed important light on individual and social behaviour, to the extent that they might form a rationale for the administration of such behaviour.

Lucidly written, the book is addressed as much to the educated laity as it is to practising scientists, and indeed it received widespread attention in the popular press both on its publication in hardcover and on the subsequent issue of a soft-cover edition being favourably reviewed in periodicals ranging from the Montréal Gazette to the New York Times, and from The New York Review of Books to Psychology Today. From the point of view of the present study, it is this, in conjunction with its authorship and its argument, that makes Not In Our Genes especially notable.

To begin with, it is an explicit criticism of the conduct of an entire branch of science, delivered from within the community of life science investigators. Although the authors identify themselves with the "radical science" movement, they are nonetheless respected researchers attached to prestigious institutions on both sides of the Atlantic: R.C. Lewontin is Agassiz Professor of Zoology and Biology at Harvard; Steven Rose, a neurobiologist, is chairman of the biology department and head of brain research at the Open University in the United Kingdom; Leon J. Kamin is a professor of psychology at Princeton.

Furthermore, their criticism is of a highly specific order. It is not merely a dispute with specific findings (although considerable effort is devoted to 'debunking' certain truisms, such as the notion that intelligence is innately given and can be measured accurately by appropriately designed tests). Nor is it solely a complaint about methodological adequacy (although this is a recurrent motif). Neither is it a condemnation of the misappropriation of scientific work for social ends (although the social application of biological understanding is its ultimate concern).

The volume is subtitled Biology, Ideology, and Human Nature. Importantly, the authors understand the central concept in terms drawn directly from Marx' and Engels' The German Ideology:

Ideologies are the ruling ideas of a particular society

> at a particular time. They are ideas that express the "naturalness" of any existing social order and help maintain it (Lewontin _et al_. 1984, 1-2; footnote).

Their intervention embarks, therefore, not from an objection internal to the life sciences, but from an understanding indebted to social and political theory, in terms of which the critique of biology that follows is to be conducted. From the outset, then, Lewontin _et al_. interrogate the workings of the science in light of criteria that biologists, themselves, would likely consider external to the proper concerns of their discipline. The aim, indeed, is to show how the content and agenda of the life sciences are intimately connected with the configuration of political interests on which the prevailing social order is maintained.

In that regard, the notion of ideology is indispensable. It is only in terms of the heuristic it makes available that the authors are able to reappraise the claims science makes on its own behalf, and therefore to argue that the 'knowledge' brought into being by biology and its related disciplines is both the product and the agent of social imperatives. It is via the construction of ideologies -- the specification of the terms of the 'real' -- that consensus is engineered/and the order of social hierarchy maintained; and it is despite its claims to provide an accurate, politically neutral understanding -- or, rather, _because_ of such claims -- that science functions so effectively as ideology, and therefore as a social authority.

> The point is not merely that biological determinists are often somewhat naive political and social philosophers. One of the issues with which we must come to grips is that, despite its frequent claim to be neutral and objective, science is not and cannot be above "mere" human politics. The complex interaction between the evolution of scientific theory and the evolution of social order means that very often the ways in which scientific research asks its questions of the human and natural worlds it proposes to explain are deeply colored by social, cultural, and political biases (Lewontin <u>et al</u>. 1984, 8).

The argument that follows is therefore not only unencumbered by the conviction that the methods and results of scientific inquiry are divorced from social and political priorities, but indeed strives to expose just this portrayal of science as false and misleading, and to demonstrate how the objective character of biological science has served to mask its legitimation of certain 'extra-scientific' priorities.

The volume deals specifically with the contributions of the life sciences to the understanding of questions of intelligence, sex, and mental illness. By its insistence that 'intelligence' is a quality that is biologically given, rather than culturally defined and environmentally nurtured, the authors argue that contemporary biology not only asserts that it cannot be changed, but lends scientific authority to the project of intelligence testing, in which the intellectual capabilities of children are 'measured' by a barrage of inherently ethnocentric questions that does little more than reinforce class and social prejudices. Scientifically-informed education policies therefore become compelling means of enforcing social division. In a liberal democracy, one cannot hope for a more brazen legitimation of inequality: 'We must acquiesce to the prevailing social hierarchy, since it is written into our genes.

Similarly, the authors argue that by maintaining that males have been designed by evolution for "productive" labour (the manipulation of objects and ideas) while females have been programmed for "reproductive" labour (childrearing, home care, nursing, teaching), biology serves as an adjunct to a patriarchal order that values the former at the expense of the latter. And by arguing that mental disorders are the result, not of social or psychological factors, but of imbalances in brain chemicals, the discipline urges chemical remedies for maladies of the mind, and thereby promotes the interests of a pharmaceutical industry which demands that every explanation of a disease entail a drug for its treatment.

The merits of its specific arguments and case studies aside, however, Not In Our Genes is a noteworthy document if only because it is so forcefully and directly opposed to what has been the received understanding of the place of science in the conduct of social affairs. It argues that scientific knowledge is and, in the present century at least, always has been ideological in character, operating to establish as correct and objectively-assured assertions that speak and promote a political interest. It is as ideology, the authors charge, that science exerts its authority in matters of social administration; and it is precisely to counter the hold of 'scientism' on the polities of the

Western (English-speaking) nations that the book is offered not only to the practitioners of biology, but also to the members of the laity. The notion is that if the practice of the life sciences is to be remade so as to support a more just social arrangement, then this will have to be accomplished in part by inculcating in the general population a critical awareness of the attendant consequences of scientific labour, and an informed resistance to those biological pronouncements which can be shown to be the product or agent of an un- or anti-democratic order.

> We share a commitment to the prospect of the creation of a more socially just -- a socialist -- society. And we recognize that a critical science is an integral part of the struggle to create that society, just as we also believe that the social function of much of today's science is to hinder the creation of that society by acting to preserve the interests of the dominant class, gender, and race (Lewontin _et al_. 1984, ix-x).

Simply by virtue of pointing to the ideological aspect of scientific inquiry, then, the volume is a radical departure from the treatment heretofore commonly accorded science in Western society, and its appearance and favourable reception at this historical juncture suggest a growing reappraisal of the traditional understanding, not only in academic discourse, but perhaps more significantly in the realm of public, popular discussion.

It is not simply the attention paid to science as a social authority that marks _Not In Our Genes_ as squarely opposed to the traditional view, but the way in which science's action as social authority is conceived. Historians, philosophers, political and social theorists have long identified what has become known as the Scientific Revolution as a period crucial to the development of Western culture, and have seen the rise of science's influence as integral to the changes in status and authority undergone by church and state. However, just as the history of the press has been written as a protracted, but ultimately successful struggle to distance the fourth estate from the influence of other institutions -- in effect, precisely to bring into being a fourth estate by securing the 'freedom' of the press -- so the history of Western science has been traditionally thought of in terms of science's success in removing itself from external influence, most notably ecclesiastical authority. It is this autonomy that ostensibly privileges science with the capacity to apprehend and speak the truth. The traditional and familiar history of science, then, is essentially celebratory: the rise of science, along with the invention of democracy, the creation of a mutually-beneficial economics, the entrenchment of Judeo-Christian values, the liberty of the arts and the political independence of the press, is seen as part and parcel of the triumph of the West.

Hence the history of science is commonly presented as a conflict between a progressive, scientific authority and an older, politically-ossified theological authority over the right to specify the ontology of the natural world. Since, of the two, only science held the means to reliable knowledge about the physical workings of the universe, its eventual victory was, if not assured, then certainly desirable. Over time, the authority of the church in matters pertaining to 'nature' steadily receded. Afer Copernicus and Kepler, the church could no longer instruct on the subject of cosmology; no papal fiat could make the solar system geocentric or return the orbits of the planets to circular perfection. After Darwin and Huxley, it was compelled to relinquish its authority over the determinants of biology and geology. Certainly, by the late 1800s, it had become clear that prayer was no substitute for a scientifically-informed medicine, and that in ailments of the body the church could be of little direct influence. Inexorably, and of necessity, religion therefore retreated into matters of morality and spiritual fulfilment, abandoning the attempt to remain an authority hierarchically dominant over science.

As a result, the view of the scientific enterprise that has emerged is one in which science is lauded as a fundamentally heroic endeavour, and its heroism is founded precisely on the integrity of its inquiries. Science is to be celebrated because it makes possible a reliable and productive knowledge; its assertions are reliable because its inquiries are divorced from social and political -- i.e. external -- influence. In short, the traditional view is one in which it is emphasized above all that science is a non-ideological enterprise: not only the antipathy of ideology, but indeed its only antidote.

Reiss (1982) is amongst those who identify the persistence of this understanding of science as essential to the development of Western culture, and is amongst the most clear on the subject of how, in detail and in practice, the status of science as a source of pristine truths was secured. Indeed, Reiss sees the ascendancy of a system that laid claim to a certain type of incontrovertible knowledge (or, rather, a certain means of guaranteeing its knowledge as incontrovertible) as the central feature of Western culture. In his terms, it gave rise to the "analytico-referential discourse", where discourse is defined as "the visible and describable praxis of what is called 'thinking' (Reiss 1982, 9)." The argument is nothing less than that the whole of Western intellectual production has been coloured by a certain understanding of how 'reality' may be apprehended -- either being guided by that understanding or, latterly, produced in response to it.

While all social systems develop agencies charged with bringing knowledge into being, and provide mechanisms whereby this knowledge is legitimated as irresistable and absolute, Reiss points to the mechanisms whereby scientific knowledge is legitimated as of crucial significance. The analytico-referential discourse

> is achieved on the premise that the 'syntactic' order of semiotic systems (particularly language) is coincident with the logical ordering of 'reason' and with the structural organization of a world given as exterior to both these orders. This relation is not taken to be simply one of analogy, but one of identity. Simultaneous with this claim of logical identity, various devices are elaborated enabling a claim for the adequacy of concepts to represent objects in the world and for that of words to represent those concepts (Reiss 1982, 31).

The notion that the procedures of reason and rationality embodied by science are welded to the actual structure of the physical universe (e.g. the popular supposition that the universe is 'written' in mathematical characters) is what guarantees that science will have access to the 'truth' -- to a knowledge that cannot be otherwise -- and that it will be able to speak this truth without distortion. Within the terms of such a discourse, 'knowledge' (or certainly its highest form, scientific knowledge) is the codified articulation of that which is. It is not a product of human frailty, but an escape from its constraints. And it is this claim that is successively advanced from the Scientific Revolution onwards, only coming into question in its own terms toward the onset of the 20th century:

> It is only at the end of the nineteenth century that the analytico-referential discourse of assertion and possession, of permanent and universal human reason, and of absolute objective truth comes to be opposed by another ... 'Knowledge' will be the process of enuciation itself, not the object of that enunciation (Reiss 1982, 37).

In these terms, the publication and reception of <u>Not In Our Genes</u> can be read as an explicit attack, not only on the conduct of contemporary biology, but on the very claims science makes on its own behalf, in particular those that assure the veracity of its findings. Nonetheless, the mere possibility of challenging the traditional understanding of science does not mean that its hold has been broken.

Scientific discourse was destined to remain the model

> and exemplar of all discourses of truth -- of all <u>knowledge</u> -- with few doubts until the last third of the 19th century and even, though with increasing attacks, to the present (Reiss 1982, 40).

Rather, what the appearance of interventions such as that offered by Lewontin <u>et al.</u> signals is a 'critical' reappraisal of the performance of science in Western society -- critical in the sense that the treatment accorded science neither necessarily shares nor is necessarily guided by the claims made by science about its own efforts and achievements. In specific, effort becomes diverted from the attempt to explicate how it is that science manages to produce objectively-assured knowledge, to the attempt to show how the labours and products of science are inevitably in congress with a given social and political order, and to account for how the seeming objectivity of science serves to mask this essential collusion.

The remainder of this chapter consists of an examination of two prominent and complementary efforts to rethink the operations of science in just these terms. The aim is not to trace the influence of specific writers on an emergent 'critical' treatment of science, or of science and the media; neither is it to conduct an exhaustive review of each author's <u>oeuvre</u>. The intent, rather, is to set out what is meant by science as ideology, so as to establish a framework which can be used to interrogate the constitution of the 'problem' of science and the media in academic and popular discourse.

In doing so, the chapter will draw on selected writings of

Jurgen Habermas and Paul Feyerabend, two writers who, from very different backgrounds and perspectives (the former from social and political theory, the latter from the history and philosophy of science), have mounted critiques of the positivist understanding of scientific activity, and have done so by directly engaging that aspect of science precisely denied by the positivist reconstruction: its action as ideology through the 'rationality' it defends, and the social authority such a rationality permits. The chapter will consider their most explicit contributions -- Habermas' "Technology and Science as 'Ideology'" (1970) and the first two parts of Feyerabend's Science in a Free Society (1978) -- so as to present an understanding of science and scientific rationality that can be used to expose and thereby rethink the terms and assumptions of the 'problem' of popular science, and which can therefore inform a treatment of contemporary journalistic science coverage.

2.2 Habermas on Science

The problem broached by Habermas in "Technology and Science as 'Ideology'" is perhaps the most central and the most grand of sociology as a discipline. It is the attempt to specify the essential conditions of the prevailing social and political order in Western society; in specific, to account for the changes brought about in social organization as a consequence of industrialization. In accordance with a long-standing problematic in sociology, the paper distinguishes between two historically predominant forms of social organization, and seeks to explain what was entailed in the passage from past conditions to present.

It is a passage that has been variously thought of as a shift from Gemeinschaft to Gesellschaft, or from community to society; from a social solidarity based on kinship and interpersonal relations to one based on formal contract; from a society governed by a traditional authority to one ruled by a bureaucratic authority; from an economy founded in the fabric of lived conditions to one directed by a set of ineluctable principles. Habermas, following Weber, argues that what underlies all these movements is the "rationalization" of society: the increasing efficacy of rational decision in almost all areas of social life. His analysis amounts to an attempt, therefore, to grasp the fundamental character of the modern order.

Habermas himself details the development of his thesis as a an appraisal and reformulation of work by Weber and Marcuse. He takes as his starting point Weber's recognition of the centrality of "rationality" to industrial order: the notion that, at root, what distinguishes modern society from its predecessors is the increasing presence in social, cultural, and economic life of the belief that such affairs can, in principle, be controlled by reasoned calculation.

There were two facets to Weber's understanding of the prominence of this rationality in modern society: first, it entailed an extension, or expansion, of those areas of social life that traditionally had been given over to the operation of rational decision; and second, social labour became industrialized, with the consequence that criteria of instrumental action began to penetrate other areas of life that had not previously been answerable to rational decision. For Weber, this type of goal-directed, efficiency-regulated thought and action, concerned above all with power and economy, was in fact rationality in its only guise, and its exemplar was science.

However, Habermas credits Marcuse with the recognition that Weber's "rationality" is not rationality as such -- that is, it is neither a necessary nor flawless means of regulating social conduct -- but amounts to political domination realized in the name of rationality. In upholding the notion of rationality that he describes, Weber not only ignores the class content of this shift, but actually serves to conceal it. For Marcuse, Habermas writes, rationality in modern society operates to remove "the total social framework of interests in which strategies are chosen, technologies applied, and systems established, from the scope of reflection and rational reconstruction (Habermas 1970, 82)." And since this rationality applies only to relations of possible technical control, it necessarily involves domination, in the sense that that which is controlled is always subject to a power beyond or outside itself.

Nevertheless, although such a system may imply domination (of individuals as well as nature) and therefore, in Marcuse's terms, implies repression, such repression is removed from public consciousness because it is rendered legitimate by its ability to sustain productive growth and to keep individuals living in conditions of increased comfort. Thus, the social order legitimates itself by virtue of its sustained scientific and technical progress.

> Nature, scientifically comprehended and mastered, reappears in the technical apparatus of production and destruction which sustains and improves the life of the individuals while subordinating them to the masters of the apparatus. Thus the rational hierarchy merges with the social one (Marcuse 1972, 349).

In this, Marcuse points to the political content and consequences of rationality or "technical reason"; and, in doing so, he elevates science from the status of a practice that holds the promise of industrial application (that is, a practice that benefits the advanced capitalist society) to an ideological construct that is crucial to advanced capitalist society, not merely by virtue of its material products and capacities, but by its dual function of endowing such society with its characteristic structure, and by simultaneously legitimating that structure.

Nonetheless, for Habermas the value of Marcuse's contribution is that he is amongst the first to explicitly point to the operation of science, and the rationality it embodies, as a crucial element of social control; he does not accept that Marcuse has made adequately clear the processes by which this came to be, or sufficiently worked through what it entails in the contemporary political order.

> The difficulty, which Marcuse has only obscured with the notion of the political content of technical reason, is to determine in a categorically precise manner the meaning of the expansion of the rational form of science and technology, i.e. the rationality embodied in systems of purposive-rational action, to the proportions of a life-form, of the 'historical totality' of a life-world (Habermas 1970, 90).

Hence, as McCarthy points out, the real problem for Habermas (unlike Marcuse, Adorno or Horkheimer) is neither to account for nor to critique instrumental reason as such, but to account for and to critique its universalization -- the ascendancy of scientific and technical thought not simply as a dominant <u>type</u> of reason, but as the <u>only</u> type of reason. (As we shall see, this, too, is the problem engaged by Feyerabend.) And the proper response is not to break with technical reason, to abandon it (as though this were possible), but to situate it within a comprehensive account of rationality (McCarthy 1978, 22).

It is Habermas' intention to reformulate, and thereby clarify, what is meant by the ascension of "rationality", and he does so by distinguishing at the onset between two forms of social action. The first, purposive-rational action (or 'work'), is governed, according to Habermas, either by rules based on empirical knowledge, or by strategies based on analytical knowledge. Its character is to realize defined goals under specific conditions.

He opposes such purposive-rational conduct to what he calls communicative action (or 'interaction'), which he defines as being governed neither by empirical nor by analytical knowledge, but by consensual (and therefore social) norms. Thus, successful purposive-rational action must be grounded in empirically verified or analytically correct propositions, while successful communicative action need be grounded only in a mutual awareness and understanding of prevailing social conventions. (In the former, one acts in accordance with what one 'knows' to be true as a result of objectively-assured scientific inquiry; in the latter, one acts in accordance with what one 'knows' to be correct, acceptable, or required as a result of being a member of one's own society.) The motive for this distinction between 'work' and 'interaction' is that one can then distinguish between different social systems according to which form of action predominates.

Thus, in Habermas' formulation, the structure of a society (what he terms that society's "institutional framework") consists of norms that guide symbolic interaction. Within such an overall structure, however, there may be subsystems, such as the economic system or the state, in which purposive-rational action is dominant. Simultaneously, there may be subsystems in which communicative action is primary, such as the family or kinship ties. It is this distinction which Habermas employs to redraft Weber's notion of "rationality", and consequently to explain the shift from 'traditional' to 'modern' society.

'Traditional' societies, he writes, distinguish themselves as civilizations (in contrast to more primitive or tribal social groupings) by virtue of a centralized ruling power (the state); the presence of socio-economic classes (in which obligations and rewards accrue to individuals according to their class, rather than their kinship status); and a central worldview (either myth or religion) which serves to legitimate political power -- that is to say, it secures the acceptance of the existence of social class and centralized authority. Such social organization is made possible by the ability to produce a surplus product, and made necessary by the need to distribute the surplus (unequally) amongst the members of the community.

Such 'traditional' societies do maintain subsystems of purposive-rational action since, after all, they require and employ technologies and an accumulation of technically exploitable knowledge. Crucially, however, these subsystems in traditional societies do not attain a measure of extension in which their "rationality" would constitute a threat to the authority of the cultural institutions that legitimate political power. What characterizes traditional societies, then, is that their institutional framework is secured by "mythical, religious or metaphysical interpretations of reality (Habermas 1970, 95)."

This form of social order, characteristic of Western societies for much of their history, begins to break down, Habermas argues, with the rise of a capitalist mode of production, which itself may be conceived of as a mechanism that guarantees the permanent expansion of subsytems of purposive-rational action. By institutionalizing self-sustaining economic growth, capitalism "overturns the traditionalist 'superiority' of the institutional framework to the forces of production (Habermas 1970, 96)." What marks the decline of traditional society and the emergence of "modernization", then, is the increasing extension of purposive-rational action, which acts to usurp traditional means by which power is legitimated. Rationalization no longer derives, in Habermas' terminology, "from above" (that is, from mythic, religious or metaphysical worldviews that describe and maintain an overarching cultural tradition), but rather "from below" (from relations of production, or the base of social labour).

> In this way traditional structures are increasingly subordinated to conditions of instrumental or strategic rationality: the organization of labor and of trade, the network of transportation, information and communication, the institutions of private law, and, starting with financial administration, the state bureacracy. Thus arises the substructure of society under the compulsion of modernization. The latter evidently widens to take in all areas of life: the army, the school system, health services, and even the family (Habermas 1970, 98).

The result is not only that, against the criteria of purposive-rationality, myth and religion lose their power as supreme legitimating structures, but more significantly that they lose their cogency _as_ myth or _as_ religion. Instead, they are reshaped as private belief systems (as opposed to public traditions) which support the new rationality. (Habermas' example, borrowed from Weber, is the formation of the "Protestant ethic".) And the new rationality, itself, assumes its supremacy on the back of criticism of traditional dogma and superstition. The new legitimations claim a scientific character, and use such a status both to dispatch their predecessors as mere ideology (in the sense of false, deluding, or unanchored beliefs -- as myth) and to justify their own ascendancy and entrenchment.

Although science is therefore integral to the advent of a distinctly modern rationality, this rationality is not coincident with the emergence of science as a means of interrogating the natural world. It is only latterly, and in accordance with other changes in social and economic organization, that science is appropriated as the model and paragon of rational action. Although the potential for predictive and technical application is intrinsic to the new type of knowledge sought by science, for the first 300 years or so of its existence, science played a limited role as an agent of social regulation, primarily because it was not immediately conjoined with technical exploitation. Therefore, it is not science _qua_ science that Habermas seizes upon as essential to the modern order -- it is not the appearance of a new epistemology that guarantees reliable, and therefore utilitarian knowledge -- but science within a certain social formation: specifically, one in which the capacity of science to produce reliable, utilitarian knowledge has been appropriated for political and economic ends, to the extent that it is essential to such ends.

This is a view, therefore, that deviates markedly from the traditional understanding, which typically seizes upon the 16th and 17th centuries as the historically preeminent moment for science and Western society. However, as Habermas emphasizes, science and technology did not become inseparably interdependent until the late 1800s, and until that time modern science did not directly contribute to the acceleration of technical prowess. Rather, it bestowed a philosophical approach that -- in its conception of how to address the natural world -- aided the redrafting of structures of legitimation.

This is a view that is shared by others who have examined the rise of science as social authority. Mendelsohn (1983), for example, notes that although the period now labelled as the Scientific Revolution set down science's primary concern to secure dominion over nature, for all its rhetorical bravado science in the 17th century actually wielded little power, and it was not until the 19th century that science became directly relevant to nascent industrial pursuits, and that its professional characteristics were established.

> The heightened pace of the Industrial Revolution enhanced the recognition of the utility of scientific knowledge. From the turn of the century it became clear that science would play a basic role in the new industries ... But even as scientists provided indus-

trial power and gained new stature in so doing, they attempted to obscure the very interests which were responsible for their position and status (Mendelsohn 1983, 35-36).

Similarly, Passmore (1983) points out that the status currently enjoyed by science in the West is a relatively recent development: In Germany, up to the emergence of logical empiricism, the independence of science was denied, and philosophers conducted inquiries which today are properly left to the investigations of science. Even in England, where science after Newton came to form itself as an independent and professionalized discipline, overt hostility to the enterprise was absent only "provided it kept to its proper place, which was, very firmly, downstairs (Passmore 1983, 9)."

Medawar (1984), although he himself would resist the view of science as an ideological agency, nonetheless points out that it was only in the 1840s that the word "scientist" began to enter the common vocabulary,[1] and about that time that science began to exert itself on the political stage as a rationale that might compel action. It was in the 1840s that Edwin Chadwick agitated for the expenditure of public funds on the construction of a central sewage system in London, on the grounds that science had shown diseases such as cholera and typhoid to be spread via the

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[1] He cites its original appearance as being in William Whewell's introduction to The Philosophy of the Inductive Sciences (1840): "We very much need a name to describe a cultivator of science in general. I propose to call him a 'scientist'." Prior to that time, such individuals had been known as men of science, natural philosophers, sciencers, sciencists, scientmen, scientiates (Medawar 1984, 9).

contamination of drinking water. The advocacy was successful, resulting eventually in the passage of the Public Health Act of 1848, which is in itself noteworthy, representing an early and prominent instance of science being explicitly invoked as a means of orchestrating a necessary consensus. It is equally noteworthy, however, that at this stage -- the earliest moments of industrialization -- Chadwick's scientific arguments were vigorously opposed on grounds that had nothing to do with the 'scientific', and that indeed denied science's aspirations to the status of a dominant authority. The Times, for example, not only objected to Chadwick's proposals, but objected to the rationality by which he insisted on them:

> We prefer to take our chance of cholera and the rest than to be bullied into health. England wants to be clean, but not cleaned by Chadwick (quoted in Medawar 1984, 20).

Handlin (1965), too, notes that it was only from the mid-19th century on that knowledge (that is, scientific knowledge) became specialized, professionalized and institutionalized -- a series of developments that had the effect of creating a closed body of skills and information. It was this, he argues, that distanced the laity from science, and therefore set certain of the conditions that would allow science to function as ideology: its judgements were accepted as true, since they were now validated as authoritative, while at the same time the mass of the population was, as it still is, excluded from the actual production of these judgements. And it is this, Handlin suggests, that is at the root of the fear of science that exists in 20th century Western society alongside, paradoxically, an enthusiasm for science's accomplishments: the latter derives from the recognition that science wields a veritable power; the former from the knowledge that it is as much a power over men as it is over things.

> The people who are simultaneously delighted with additional years of life expectancy and terrified by the bomb are in no position to strike the balance of their gains and losses in happiness. In their confusion, they wonder whether the price of the gadgets which delight may not be servitude to the remote and alien few who control the mystery (Handlin 1965, 198).

Thus, although the pressure to augment the productivity of labour through the introduction of new technology has always existed under capitalism, it has been only since the end of the 19th century that the West has felt the influence of the increasing scientization of technology. Prior to the onset of industrialization, technical innovations were dependent upon sporadic and fortuitous inventions. Indeed, although the advent of the Industrial Revolution is often credited to the creative advances made possible by the rise of scientific inquiry, McCarthy points out that the technological potential inherent in science (an endeavour that searches for laws capable of predicting future states, and methods to manipulate relevant factors so that these laws can further be used to bring about a desired state of affairs) did not in fact play a prominent role in effecting the Industrial Revolution. Rather, industrialization was more the result of the combination and application of centuries-old crafts than the first fruits of the scientific revolution -- that is, it was more the product of techne than technology. The close connection (as well, one might add, as the firm distinction) between what would become known as 'pure' and 'applied' research arose only gradually in the 19th century, although it progressed to the point at which, currently, virtually all technology is theoretically grounded (that is, the design and manufacture of machines is informed by a knowledge acquired by science) (Mc-Carthy 1978, 3-4).

The importance of science for industrial activity, and the new alliance between science and technology, is signalled by the historical disappearance of the 'amateur' or 'autonomous' researcher, able to pursue whatever technical or theoretical problems his inclination or income permitted. In the 18th century, for example, as interest in electrical and magnetic phenomena flourished, it was not uncommon for learned gentlemen in Europe and North America to equip and maintain private laboratories for their own personal investigations, and indeed the work conducted in these laboratories contributed a great deal to the formation of an electrical paradigm: a mutually-held and, as far as the experimental record could attest, essentially reliable theoretical model of electrical phenomena.

It is dangerous to make too much of the supposed 'autonomy' of these amateur scientists, however. Although their laboratories were indepedently maintained (that is, indepedent of any corporation, university, or state agency), the investigators clearly worked within an ongoing research tradition and therefore inherited a set of available heuristic concepts, a state of technical capabilities, a common agenda of problems to be addressed, and so on. In that sense, they comprised a 'community', and their work was channeled in certain directions to the exclusion of others. Nonetheless, it _is_ noteworthy that there existed a time in which scientific research could proceed via the capital investment of the researcher himself, unlike the modern age, in which, as Ravetz notes:

> Any significant piece of work is almost certain to cost far more than the individual scientist can afford out of his own pocket; it will generally cost much more than his annual income. Hence he is no longer an independent agent, free to investigate whatever problem he thinks best. Nor is he likely to have personal contact with a private patron who will provide all his needs. Rather, in order to do any research at all, he must first apply to the institutions and agencies that distribute funds for this purpose; and only if one of them considers the project worth the investment can he proceed ... With his loss of independence, the scientist falls into one of three roles: either an employee, working under the control of a superior; or an individual outworker for investing agencies, existing on a succession of small grants; or he may be a contractor, managing a unit or an establishment which produces research on a large scale by contract with agencies (Ravetz 1971, 44).

However, the point here is not, as Ravetz appears to suggest, that an independence once enjoyed by science has been lost to the pursuit of profit. The 18th century gentlemen scientists were undoubtedly no more and no less motivated by considerations of power and practical application than their 20th century professional equivalents. The point, rather, is that science has become virtually fully industrialized in modern society; and, indeed, that it was by conscripting the services of science as both ideology and as material practice that in large part the industrialization of society came about, with all that it entails. The disappearance of the gentleman scientist signals, not the subordination of science to industrial priorities, but the participation of science in the production of a new form of social organization. "With the advent of large-scale industrial research, science, technology, and industrial utilization were fused into a system (Habermas 1970, 104)."

Hence, it is around the turn of the century that Habermas locates the rise of scientific rationality as a crucial social phenomenon -- a historical moment that witnesses the shift from liberal capitalism to advanced capitalism. This movement, he notes, is marked by two tendencies: an increase in state intervention in order to maintain the stability of the system, and a growing interdependence of research and technology, which has the effect of transforming the sciences into the leading productive force, the preeminent source of new technical capabilities, and therefore new products and new markets. Given the consequences and requirements such a movement entails, Habermas takes Marcuse's assertion that science and technology today assume the function of legitimating political power to be the key to analyzing the present situation.

In particular, the regulation of the economic realm by the state arose as a means of correcting dysfunctional tendencies that would threaten the well being (if not the perpetuation) of the system should capitalism be left to its own devices. This, Habermas observes, entails a change in the relation of the economy to the political system: the state is no longer 'merely' a phenomenon of the superstructure, and therefore demands more for its legitimation than relations of production. However, it cannot find its legitimation in the invocation of cosmological worldviews, since these have already been disempowered. "What is needed to this end is latitude for manipulation by state interventions that, at the cost of limiting the institutions of private law, secure the private form of capital utilization and bind the masses' loyalty to this form (Habermas 1970, 102)."

The actions of the state, inasmuch as they are directed toward the elimination of risks that threaten the system, is therefore negative in character. The state commits itself, not to the realization of practical goals, but to "administratively soluble technical problems (Habermas 1970, 103)." The import of this is that the solution of technical problems is not dependent on public discussion -- indeed, public discussion could only disturb or hamper government action, contesting whether many of the problems to which government applies itself are exclusively technical. The politics of state interventionism therefore require the depoliticization of the mass of the population. And yet how is such a feat to be made plausible and thereby accomplished? Habermas finds the answer in Marcuse's writings: by having science and technology also assume the function and the power of an ideology.

However, simply by virtue of its continued, visible successes in the production of machines, pharmaceuticals, and chemical agents, it is undoubtedly easier to grasp how the conscription of science as a source of technical innovation was crucial to the progress of industrialization than it is to appreciate how scientific rationality was equally necessary as an ideological construct. This, in itself, is essential to the operation of science as ideology: science at all times denies that it is an 'ideological' enterprise, or that the rationality in which it participates is anything less than a set of principles and procedures that are <u>necessary</u> if one wishes to have access to understanding that is not politically or otherwise contaminated -- i.e. that is not 'ideological', that is, rather, 'knowledge'. The success with which this claim has been established, and the success with which it has advanced the notion that understanding not produced in accordance with a scientific rationality cannot qualify as 'knowledge', Habermas takes to be the triumph, as well as the flaw, of a positivist epistemology. As McCarthy notes, Habermas argues that positivism conceals its fundamental commitment to technological rationality by virtue of the claim that its entire project is value-free. And yet it is not value-free, certainly inasmuch as it adopts a partisan position in favour of progressive rationalization (McCarthy 1978, 8).

The result is that more and more aspects of social life are given over to the ostensibly pristine workings of a scientific rationality. First, McCarthy explains, elaborating on the contents of "Technology and Science as 'Ideology'," instrumental action is rationalized to the extent that the organization of means to defined ends is guided by technical rules based on empirical knowledge. The laws and findings of the empirical sciences replace criteria of appropriateness rooted in tradition, theology, and so on, or in rules of experience developed in an unsystematic way.

Secondly, faced with alternatives that have been produced by such sound methods, purposive-rational action is rationalized to the extent that a choice between alternatives is correctly deduced from preference rules and decision procedures. This aspect of rationalization refers to the form, not the content of decisions.

Further, it necessarily leads to technocratic decision-making, in which the objective necessities disclosed by experts come to predominate over the inclinations of political leaders. Hence, thirdly, strategic action becomes rationalized so that, in the case of competing interests, decision-making processes are systematically organized so as to maximize the possibilities of gain (in McCarthy's term, they are committed to self-assertion) or to minimize the possibilities of loss. This means that the value systems that remained outside the possibility of rationalization in the first two senses are now relativized in terms of the fundamental value of self-assertion. The suitability of value systems is now judged against a "necessary" and invariant value.

Finally, action systems are rationalized to the extent that their steering mechanisms perform to realize certain formalized goals (stability, adaptability) necessary for self-maintenance. Even the self-regulation of society in terms of its values becomes rationalized. For Habermas, this cybernetic society amounts to a technical control over history: society is no longer a collective of individuals who organize their practices through communication, but becomes instead an instinctive, self-stabilizing system in which the political enlightenment of the citizenry is irrelevant. Such a position, Habermas suggests, claims to have solved the problem of history by asserting that it is possible to "make" history, and to do so consciously, deliberately, and with confidence in the outcome. Yet it does so by confusing mere control and manipulation with understanding and reflection (McCarthy 1978, 8-12).

Certainly, "the development of the social system _seems_ to be determined by the logic of scientific-technical progress (Habermas 1970, 105)," with the result that the problems that present themselves to societies (one could cite examples of inner-city crime, industrial waste, urban planning and management, racial intolerance, economic dysfunction, armed threat from other nations, and so on) do so in such a form that the only conceivable means of solution is by purposive-rational action --

which is to say, by 'scientific' analysis and the consequent proposal of technical solutions.

Further, issues which previously had been self-evidently and properly a matter for community standards and consensually-produced convention increasingly become the preserve of this selfsame technical reason. Where once questions of pornography were decided by arriving at an understanding of what the community would and would not tolerate -- that is, they were essentially questions of taste -- they are now subject to 'scientific' assessments of the 'effects' of erotica on civil behaviour.[2] Where once questions of the consumption of drugs and alcohol were, similarly, a matter for regulation in accordance simply with how a given society wished to conduct itself -- how it defined its pleasures and its canons of acceptable behaviour -- they are now defined and examined in terms of a 'scientific' discussion of addiction, habituation, physical and mental health, sociological consequences, rehabilitation and so on. Where once the raising of children was largely a matter of adhering to socially-specific moral values, child-rearing has become an occupation increasingly subject to the dictates of a 'scientific' psychology.

It is a feature of the modern order, then, that the rationality of science comes to penetrate more and more areas of civil life, with the result that the political will of populations is

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[2] See Alexander Wilson, "The Anti-Porn Roadshow: Feminism as Law and Order," <u>border/lines</u> (fall 1984).

increasingly subservient to scientific pronouncements; and thus, Habermas argues, democracy is "necessarily" reduced to a series of plebiscitary decisions about alternative sets of administrative personnel.

Habermas is not here suggesting that the rise of scientific rationality serves to curtail a method of social governance that is devoid of political interest, or that 'interaction' is capable of arriving at norms and conventions that are non-ideological. The consensus produced by communicative action is the product of competing political and economic interests, and it will necessarily bear the mark of these interests. Rather, the crucial import of scientific rationality, as ideology, Habermas takes to be the detachment of a society's self-understanding from the preserve of communicative action and its replacement with the scientific model, with the consequence that open debate begins to disappear, not merely because it is no longer perceived to be altogether necessary or desirable, but because the dominance of technical reason makes it no longer possible.

> Technocratic consciousness is, on the one hand, "less ideological" than all previous ideologies. For it does not have the opaque force of a delusion that only transfigures the implementation of interests. On the other hand, today's dominant, rather glassy background ideology, which makes a fetish of science, is more irresistible and farther-reaching than ideologies of the old type (Habermas 1970, 111).

The greater efficacy of such an ideology is a result of its success in justifying the organization of social life in terms that exclude considerations of normative convention, and therefore in terms that depoliticize such organization and its justifications, erecting them as uncontestable. That is, if one is aware that the legitimations which uphold a certain order are at root social creations, then one has an avenue of access to dispute -- or at least discuss -- their content. One does so, of course, not without risk. The individual who questions an overarching myth or religion opens himself to the charge of heresy, and to the punishments attendant upon it. However, if one accepts that the legitimations of modern society are not social creations, but scientific-technical ones (that they arise from a natural, not a social, reality; that they are not inter-subjective, but objective), then dispute becomes all the more difficult. To contest scientific-technical legitimations is to reject the scientific rationality, and therefore to render oneself irrational, a charge that in many ways is more weighty than apostasy. The heretic may be evil, he may be the devil's disciple, but he is not necessarily mad.

The difference between the two sets of ideologies -- old and new, traditional and modern -- is indicated by the measures taken to silence dispute. The old legitimations, being more vulnerable, require a cruel defence. The heretic is dangerous and must be made to confess, to repent, under torture if necessary, and may be publicly executed in the auto de fe. Irrational resistance to the dictates of science, on the other hand, is not dangerous, except to the individual himself, and is more likely to be viewed as eccentric, pathetic, or incomprehensible.

The view of science and technology in modern society advanced by Habermas can therefore be characterized as follows: The social and economic developments attendant upon the rise of industrial capitalism, and in particular upon the movement from liberal to advanced capitalism, require at one and the same time a means to sustain economic growth and to legitimate the interventions of the state in the eyes of the polity. The means to do so is found by conscripting science, first, for purposes of technical exploitation -- by harnessing science's inquiries into the structure and operation of the natural world to the service of remaking the natural environment, producing new products, and thereby providing the material on which capitalism can work. On the basis of science's manifest success in this regard, the enterprise is also appropriated as the embodiment of a rationality that permits access to the 'truth' of matters, and that can therefore be used to guide social action in a manner answerable only to reality as revealed by these apolitical and technical procedures. In this way, the actions of the state come to be legitimated as necessary responses to given sets of conditions, and the purposive-rationality according to which science operates comes to invade more and more aspects of social life.

Habermas views the consequences of these developments as ultimately anti-democratic, not only because they constrict the range of political debate and reduce political choice to preferences between competing sets of administrative figures, but because in establishing itself as the <u>only</u> form of 'reason' (i.e.

the only means of arriving at reliable knowledge), purposive-rational action closes off the possibility of communicative action on which democracy depends. Within the confines of 'interaction', individuals may contribute to the formation of the norms and values that characterize their societies; once purposive-rational action has gained ascendancy, social action becomes conducted in accordance with technical dictates that are imposed on the polity.

Habermas' arguments constitute an important contribution to the conceptualization of how it is that science functions as a social authority, particularly inasmuch as they work to 'see through' science's claims to be merely a set of inquiries that seek to understand what the natural world is actually like.

However, as provocative an argument as it is, it is nonetheless presented in in a relatively brief span of pages. The work is therefore not only densely argued -- so that individual sentences are pregnant with implications which the essay itself cannot pause to consider -- but underdeveloped in its presentation of evidence, and in particular in its attention to history. As Habermas himself admits:

> I am proposing an alternative scheme that, in the format of an essay, can be introduced but not seriously validated with regard to its utility. The historical generalizations thus serve only to clarify this scheme and are no substitute for its scientific substantiation (Habermas 1970, 90).

It is beyond the scope of the present study to provide the sort of development of his thesis that Habermas calls for.

However, it is hoped that his arguments might be buttressed by pointing to the work of P.K. Feyerabend, and by showing how, in response to a quite different problematic, Feyerabend has been led to a similar and allied assessment of the place of science in the modern order. Certainly, a treatment of Feyerabend's writings on the subject can only help to make clear what is meant by science as ideology, and therefore further elucidate the complaints about the traditional understanding of science which have come to form the basis of a 'critical' response.

In contrast to the discussion of Habermas' work, however, which paid detailed attention to the contents of a single paper, the consideration of Feyerabend's contributions that follows will take pains to situate his arguments within the context of the research agenda of history and philosophy of science. In part, this is because, having already elaborated Habermas' conceptual scheme, it should not be necessary to devote the same detailed attention to Feyerabend's kindred arguments; in part, it is because Feyerabend's own exposition of his arguments is in many ways less thorough than that of Habermas, since they emerge in response to a different set of theoretical concerns and rely on a different (and distinctive) rhetorical strategy for their force. Nonetheless, their appearance and form not only complement certain aspects of Habermas' work, but give clear indication of the perception of science on which different disciplines have increasingly come to converge.

2.3 Feyerabend and the "New Philosophy" of Science

If Habermas' arguments concerning science emerge in response to the central problematic of sociology, Feyerabend's address the central problematic of philosophy of science: namely, how is it that reliable knowledge is possible? Indeed, his work on the social place of science is the result of a shift in how this philosophical question was to be conceived and answered -- a shift that Feyerabend himself helped to precipitate. Once again, it entails the break with science's claims on its own behalf.

Briefly, up until the years following the end of the Second World War, science had commonly been studied in light of its capacity to arrive at objective and testable knowledge about the natural world. In specific, the questions entertained by the history and philosophy of the enterprise tended to concentrate on how it was that science actually managed to do so. The concerns of the discipline were concerns that were 'internal' to science: The history of science was confined to the reconstruction of procedures of inquiry and priorities of discovery, and largely neglected the attempt to relate the progress of science to surrounding political, social or economic circumstances, or to pursue how scientific discoveries, once arrived at, inserted themselves into social life. The philosophy of science, in like manner, devoted itself to the reconstruction of what it took to be science's ahistorical method, spelling out its apparatus of inquiry in terms of logic and linguistics. Although complementary, there was little contact between the two branches of the discipline, even on those occasions when they were housed in the same university department.

The break with this tradition is often associated with the publication in 1962 of Thomas Kuhn's The Structure of Scientific Revolutions. However, although it is true that Kuhn's work became the most widely read outside the discipline, it is properly viewed as part of a movement within the history and philosophy of science that would include W.V.O. Quine's "Two Dogmas of Empiricism" in From a Logical Point of View (1953), Norwood Russell Hanson's Patterns of Discovery (1958), Michael Polanyi's Personal Knowledge (1958), Karl Popper's The Logic of Scientific Discovery (1959), Stephen Toulmin's Foresight and Understanding (1962), as well as contemporaneous papers by Imre Lakatos and Paul Feyerabend. Nonetheless, The Structure of Scientific Revolutions stands as an exemplar of this "new philosophy of science", as it came to be called. Not only does it rely on historical analysis in order to advance a 'philosophy' of science, but its argument challenged the received understanding by suggesting that the actual practice of science did not, and could not, meet its own standards of rationality. Although in a postscript to the 1970 edition and in The Essential Tension (1977) Kuhn attempted to distance himself from many of the relativist implications of his own work, the argument that science advanced, not by a process of accretion, in which subsequent theories subsumed their predecessors, but through periodic revolutions, and that these moments of controversy could not be resolved through 'rational' debate, drove the discipline squarely toward the consideration of the social context of theoretical innovations and the disputes attendant upon them.

In the period that followed, Feyerabend emerged as the most radical of the leading philosophers of science, and his arguments were as distinctive for the manner of their delivery as for their content -- a feature perfectly consistent with Feyerabend's own views on how it is that inquiry advances in practice. While most writers perceived the relativist import of the new philosophy as a challenge to the integrity of science, and attempted to shore up scientific rationality in the face of the new attacks (e.g. Lakatos' methodology of research programmes), Feyerabend embraced relativism, not as a problem to be solved, but as a principle to be pursued. He advocated "epistemological anarchy," agitated for "the withering away of reason," and called for the rejection of supposed canons of rationality in favour of intellectual inquiry in which "anything goes" (Feyerabend 1975). Importantly, it was his rejection of the validity of scientific rationality (as a means of arriving at objective knowledge) that allowed him to consider its role in ordering and organizing social life, while those who were preoccupied with preserving the rational character of science stopped short of such subversion.

Essentially, Feyerabend's arguments regarding the social place of scientific rationality stem from the attacks mounted on the positivist program in philosophy that reached prominence in the late 1950s and early 1960s, and which focused especially on those moments in the history of science when one theoretical system or explanatory structure was replaced with another. It was in these moments that inquiry 'advanced', and in that sense they were taken to be exemplars of the process of scientific investigation. Furthermore, because such progress occurred only through dispute between competing camps, the historical record of how theoretical advance was effected should be sufficiently fertile to allow the reconstruction of the processes and principles involved.

The traditional account, as Reiss has suggested, insisted upon the compatibility of both reason and scientific language with the structure of the physical world. That is, in case of choice between rival beliefs, the assessment of competitors is conducted within the context of considerations which are pertinent to its outcome. But the scientific rationalist makes a further, even stronger claim: in the case of rival scientific theories, choice is made in light of grounds that are universal in application, independent of epistemic content, immune from considerations of individual psychology, and as objective as the deductive relation between true premises and necessary conclusion. It is the objective ground of science which presumably distinguishes it as an enterprise capable of generating assured knowledge.

The canons of theory choice articulated to preserve the epistemic objectivity of science have invariably been taken to be empirical in nature, on the grounds that only sense data offer the possibility of a valid base for human knowledge, and that therefore belief and conviction are properly secured by virtue of the available observational evidence supplied by and wrested from the world, and in light of nothing else. That is, in order to preserve objectivity in science, the traditional understanding holds that theories must have an incorrigible base according to which they may be judged true or false, superior or inferior, and finds that base in the systematic exposure of the senses to the world.

By the 1930s this view had found expression in the theories of scientific language proferred by logical positivism, in which all meaningful terms necessarily derived their significance from sense experience. Science was therefore the superior -- indeed, the only -- source of knowledge, because it systematically purged itself of notions and explanations that could not be secured by reference purely to the realm of observation.

Nonetheless, although what came to be known as "observation terms", such as red, sticky, or hard, might seem to have meanings which ultimately accrue from subjective sense data, so-called "theoretical terms", such as electron, force, or phospholipid do not. What then distinguished 'metaphysical' (and therefore strictly meaningless) terms such as justice or anguish, from the theoretical terms that performed a good deal of the explanatory work of science?

The positivists borrowed the notion of formal systems from mathematical logic in order to account for the legitimacy of scientific theories and the heuristic terms they employ. According to this notion, theories could be viewed simply as systems whose rules permit the derivation of certain new combinations of terms and symbols from ones already given. If the vocabulary of science is divided into observational terms and theoretical terms, only sentences containing solely the former will be capable of being decisively verified or falsified by sense experience. The role of theories in such a scheme is to provide logical devices whereby new observational sentences can be derived from ones already at hand, thus yielding suggestions for further observations and predictions concerning their outcome. Theories were understood as inheriting meaning by virtue of being descriptive constructions of indubitable sense data; in specific, theoretical terms were said to acquire indirect meaning or "partial interpretation" through their direct linkages with observations. Those elements of scientific theories whose meanings could not be secured via simple ostensive reference were viewed simply as a useful shorthand for immense sets of observation statements.

The exact relation between theoretical descriptions and the observational base varied with the inclinations of the various schools of empiricism. For the strict logical positivists of the Vienna Circle, the truth value of theoretical constructs was supposedly determined by an examination of whether the non-formal constituent propositions conformed or failed to conform to the facts. Subsequent varieties, such as hypothetico-deductivism, abondoned the ideal of conclusive verification, championing instead the capacity of sense data to refute candidate theoretical propositions.

Yet, no matter how the relationship between theory and observation was spelled out, empiricists in all their guises have maintained a view of science according to which the endeavour is answerable ultimately and solely to the world of observation, and it is this incorrigible base which serves as the exclusive arbiter of theoretical disputes. In the event of theoretical rivalry, the competing systems are compared to the evidence, and the evidence settles the contest with clarity and finality. Science thus progresses objectively, rationally, relentlessly.

It was an account of scientific activity that was reassuring in its ideals: the evidence of the senses, since it was held to be incorrigible, was undeniable, with the consequence that every rational individual capable of perceiving the relevant observational facts would be compelled to make the same theoretical choice. Furthermore, adherence to a particular theoretical system may be undermined in the light of changes in the available evidence.

Nonetheless, by the early 1960s it had begun to appear that the rationalist account preserved the integrity of science only at the expense of disenfranchising individual scientists, allowing no role for the exercise of judgement. Presented with a base of immutable facts, the scientist has <u>no choice</u> but to adopt the theory that accords with it. "The attempt by logical empiricists to identify rationality with algorithmic computability is somewhat strange, since it deems rational only those human acts which could in principle be carried out without the presence of a human being (Brown 1977, 147-148)." As well, by erecting its evaluative standards as canons of rationality, the traditional account has the further effect of sentencing scientists throughout history to the ranks of the irrational. Priestley, who never accepted the oxygen theory, and Kelvin, who rejected the theory of electromagnetism (Kuhn 1962, 151) -- both in the face of an irresistable evidential base, in the rationalist view -- cannot be seen as merely obstinate or mistaken, but must be viewed as having violated the rational standards of scientific inquiry.

The attacks on the rationalist reconstruction of science that came to comprise the "new philosophy" were therefore mobilized around the charge that the traditional view did not adequately or accurately account for how science actually worked in practice and in history. In particular, it was charged that the crucial distinction drawn between observational and theoretical terms was one that could not be validly maintained. This is the complaint that the meanings of the ostenible observation terms are in actuality affected by and dependent upon the theories to which they pertain.

One by one, and drawing on evidence ranging from art history to experiments in the psychology of perception to the work of

Sapir and Whorff in linguistics, the new philosophers argued that far from serving as an incorrigible foundation, immune from theoretical considerations, observation is inextricably bound up with conceptualization. That is, contrary to the hard-minded empiricist contention that meaning filters up to theoretical constructs from the foundation of observation, the case was put that so-called observation statements acquired meaning only by virtue of interpretation in light of theoretical convictions. Individuals, it was argued, simply could not behave in the manner advocated by scientific rationalism, if only because the mind is not a <u>tabula rasa</u> upon which the brute facts of simple, stubborn perceived particulars are imprinted. The retinal reaction prompted by a single physical event may not vary from observer to observer, but "people, not their eyes, see (Hanson 1958, 22-23)."

Each of the new philosophers, therefore, took pains to emphasize that observation independent of theoretical guidance was an impossibility: it would lack not only interpretation, but indeed any meaning whatsoever.

> You say "table, table, table ... " until the word becomes a mere meaningless sound. You can destroy meaning wholesale by reducing everything to its uninterpreted particulars (Polanyi 1958, 199).
>
> What a man sees depends both on what he looks at and also on what his previous visual-conceptual experience has taught him to see. In the absence of such training there can only be, in William James's phrase, "a bloomin' buzzin' confusion (Kuhn 1962, 113)."
>
> Eliminate all natural interpretations, and you also eliminate the ability to think and to perceive ... [I]t should be clear that a person who faces a perceptual field without a single natural interpretation at his

> disposal would be completely disoriented, he could not even start the business of science (Feyerabend 1975, 76.)

Such a reversal of the rationalist position on observation changes the status of theories in the progress of science markedly. If to be capable of perception is to have beliefs about the way the world is, then beliefs are present in perception and are not an adjunct to it (Hanson 1958, 22-23). This entails that the meanings of 'observation terms' accrue from the theories in which they are embedded, and that therefore these meanings will change in light of theoretical revision. The existence of a perpetual incorrigible foundation, according to which theoretical constructs may be judged, is therefore an empiricist equivocation. Simply because certain terms seem stable -- for example, just because one cannot now conceive of anything that would alter the meaning of a predicate such as "red" -- this does not imply that no change in prevailing theoretical conviction could alter their meanings. On the contrary, no term's meaning is immune to alteration in light of theoretical shift (Hesse 1974). The view of scientific theory that emerged, then, was one in which theories do not function as mere descriptions of the physical world, but as belief systems which, in the loyalty they command, shape expectation and influence observation to the point that the worlds individuals inhabit are defined by them.

Such a view is clearly damaging to the rationalist account of scientific progress. Since the meanings of language terms are acquired by virtue of theoretical commitment, to adopt a new theory is to alter the meanings of the relevant descriptive terms, recasting them within the context of the new theory. Thus scientists who differ theoretically will also differ linguistically: they not only share no neutral observation language, they apparently share no language at all. "The intuitive idea ... that theories differ through embodying fundamentally different ways of describing the world is captured in the metatheoretical claim that ... theories are radically meaning variant (Moberg 1979, 245)."

The fundamental import of such meaning-variance is that it presumably prevents the application of objective evaluative standards capable of conclusively showing one theory to be superior to another. Theories cannot be compared in the manner suggested by the rationalists if only because different theories refer to different objects -- a property for which the term "incommensurability" was introduced by Kuhn and Feyerabend independently. Hence the meaning-variance of theories was taken to dispose of any vestige of the notion of science as a course of accretion. It is impossible for progress to be a process whereby subsequent theories subsume those that preceded them, since different theories carry altogether different ontological weights and generate their own particular experience. Rather, science came to be viewed as progressing by a series of conceptual shifts, gestalt switches, or paradigm revolutions.

If, however, proponents of incompatible scientific theories share no neutral observations and no common language, then on what grounds can theoretical revision be effected? It would appear that not only do scientists have no access to an assured ground of observational data to which their theories can be compared, but neither can they fully understand the contents and implications of rival theoretical systems, and therefore a 'reasoned' or 'rational' choice between competitors is impossible.

That is, in order to make an informed choice between mutually exclusive alternatives, the discriminating scientist must necessarily be fully aware of what is involved in each. And yet theory incommensurability would seem to suggest that because each scientist 'sees' the world in terms of how he or she understands it (i.e. through theoretical commitment), one cannot possibly come to understand a rival theory without first abandoning belief in one's own. Different competing explanatory structures may use the same terms, but they will inevitably use them homophonically, since what each term will 'mean' will vary from theory to theory.

> Two men who perceive the same situation differently but nevertheless employ the same vocabulary in its discussion must be using words differently. They speak, that is, from what I have called incommensurable viewpoints. How can they even hope to talk together much less to be persuasive (Kuhn 1970, 200)?

It is in this that the new philosophy threatened relativism, and it was the problem of relativism that subsequently came to preoccupy the history and philosophy of science: given that the objective base traditionally claimed for science had been discredited, what was it then that guaranteed scientific knowledge as reliable? In what sense could scientific revolutions be considered to be 'advances'? What was it that distinguished science as an endeavour capable of producing necessary and truthful knowledge?

Within the philosophy of science, effort became mobilized in order to preserve the rationality of science, although on less naive grounds than those claimed by logical empiricism. Certainly, the <u>prima facie</u> suggestion that science did not, in fact, proceed in a rational manner could not be correct. Thus, for example, both Israel Scheffler's <u>Science and Subjectivity</u> (1967) and Harold I. Brown's <u>Perception, Theory and Commitment</u> (1977), two volumes that review and appraise the new agenda in the discipline, do so with a view to repudiate the more forceful relativist implications.

The effort to reclaim a certain rationality for science involved attention to the question of whether it was possible to 'translate' between the terms of two scientific theories (e.g. Papineau 1979). Others attempted to find evaluative criteria which would avoid the problems associated with meaning-variance, and so preserve the need in science for exact standards. Moberg (1979), for example, suggested that theories might be compared and assessed according to their degrees of internal consistency. Hesse (1974) argued that though there is undoubtedly a 'locking' of concept and language, this does not entail that meanings are so mutually dependent that a change in one affects <u>all</u> the rest in a given language system. The meaning of every language predicate may be susceptible to change in the event of theoretical revision, but this does not mean that all predicates' meanings will be subject to flux in any one theoretical change. Further, those predicates whose meanings are not called into dispute may provide a temporarily stable background against which debate can be played out.

Alone amongst the major writers on the subject, however, Feyerabend pressed the relativist attack on scientific rationality, arguing, in effect, that the attempt to defend such a rationality was not only misguided, but amounted to fealty to the political interests that it favours. What is called for, in his view, is not the redemption of scientific rationality, but its unmasking. In what is widely considered his major work, Against Method (1975), he engages in a detailed historical analysis of Galileo's understanding and defence of Copernican cosmology, in order to show not only that science does not proceed in anything approaching a 'rational' manner, but that for it to do so would in fact work to impede its 'progress'. In practice, the niceties of philosophers of science aside, progress in science has been made on the basis of political agitation and rhetorical strategy: in short, on powers of "metaphysical persuasion" that have little to do with canons of objective inquiry. Further, this is precisely as it should be, and efforts to constrain science by demanding adherence to an invariant method are, in Feyerabend's view, spurious and damaging.

> It is clear that allegiance to the new ideas will have to be brought about by means other than arguments. It will have to be brought about by irrational means such as propaganda, emotion, *ad hoc* hypotheses, and appeal to prejudices of all kinds (Feyerabend 1975, 153-154).

Given the investment Western culture has made in science as an inherently rational enterprise, this is an outrageous and subversive argument. It is a measure of the accomplishment of *Against Method* that its contents were not dismissed out of hand, but were received as powerful objections to be engaged and defeated. From the point of view of the present study, however, it was Feyerabend's rejection of scientific rationality that led him toward a consideration of its import for social life: If the 'rationality' claimed for science cannot be sustained, then why does such a concept exist, by what efforts did it become established in the Western tradition, and in whose interests does it serve? For Feyerabend at least, the project of examining the social and political labour of science cannot begin until the hold of rationalism itself has been broken.

2.4 Feyerabend on Science

In that regard, Science in a Free Society takes on a political dimension from which Against Method stops short. While the earlier work is an attack on scientific rationalism -- a school of thought within the history and philosophy of science -- the second book is an explicit attempt to undermine scientific rationality -- the dominant means by which thought and understanding are organized -- and to do so by exploding the very claims that legitimate its authority in public life. It is not that Feyerabend calls for the dismantling of a 'scientific' inquiry, but that, like Habermas, he argues that it be seen for what it actually is, an ideological construct, and that once it is recognized as such its authority will have been weakened and its dominance rendered less secure. Feyerabend does not object to the existence or to the methods of science, merely to the imposition of its standards on other areas of social life. That is, in a free society there will still be science; it will simply know and keep its place.

Science in a Free Society therefore seizes upon the claim made for scientific rationality that it provides, not an available or preferable means of ordering affairs, but the only correct means, and on that basis asserts its dominance. In dissecting the claim, Feyerabend identifies two realms, those of Reason and Practice. The latter is simply the conduct of human affairs -- the creation of drama, the organization of worship, the selection of public officials, and so on. Such affairs are inevitably conducted in terms of a prevailing tradition, which directs action and informs judgement. But although these traditions are necessarily the products of the society to which they pertain, they rarely present themselves as such, appealing for their authority to a realm ostensibly beyond that of human practice.

> [I]t is very difficult to see one's own most cherished ideas in perspective, as parts of a changing and, perhaps, absurd tradition. Moreover, this inability not only <u>exists</u>, it is also <u>encouraged</u> as an attitude proper to those engaged in the study and improvement of man, society, knowledge. Hardly any religion has ever presented itself just as something worth trying. The claim is much stronger: the religion is the truth, everything else is error and those who know it, understand it but still reject it are rotten to the core (or hopeless idiots) (Feyerabend 1978, 19-20).

In order to command fealty, therefore, the possibility of relativism must be closed off. First, a distinction is made between traditions, practices, and other products of human activity on the one hand, and a realm outside of and beyond tradition on the other, which can therefore act to regulate human practice. Second, the structure of this special domain is specified in detail. Up until a certain historical moment it was taken to consist of the word of the Lord, which was powerful and had to be obeyed "not because the tradition that carries it has much force, but because it is outside all traditions and provides a way of improving them (Feyerabend 1978, 20)." Hence the opposition between the imperfect and malleable products of human action and the eternal excellence of the dictates of God. Similarly, in recent Western history the voice of God as an entity outside tradition has been replaced, at least as the authority dominant over human practice, by the lasting canons of Reason -- or, more specifically, of rationalism, the "secularized form of the belief in the power of the word of God (Feyerabend 1978, 20)." In short, the claim is made that science is not a tradition in the manner of other human traditions, but an entity that is above and beyond traditions and that has power over them. It is this claim that Science in a Free Society labours to debunk.

It is not, however, the mere sanctification of canons of rationality that Feyerabend takes to be deleterious. It is the role that such sanctification allows rationality to play in social affairs. Like Habermas, Feyerabend identifies at least two different means of collectively deciding an issue: via guided exchange, or through open exchange. The former is akin to Habermas' notion of 'work' or rational-purposive action. In a guided exchange some or all of the participants adopt a well-specified tradition and operate within it to the extent that only those contributions that conform to its standards will be accepted. "If one party has not yet become a participant in the chosen tradition he will be badgered, persuaded, 'educated' until he does -- and then the exchange begins (Feyerabend 1978, 29)."

The latter is similar to Habermas' concept of 'interaction' or communicative action. In open exchange, the tradition that will guide deliberation is unspecified at the outset and develops as the exchange proceeds. The crucial difference between the two forms of decision-making is that under the conditions of open exchange participants are respected regardless of the tradition they occupy and from which they speak, while under the conditions of guided exchange discussion can only commence once participants have conformed to a dominant tradition. The former is a condition of democratic society; the latter works to impede the possibility of democracy. "A free society is a society in which all traditions are given equal rights, equal access to education and other positions of power (Feyerabend 1978, 30)."

The essential error of rationalism, then, is that it erects its model of scientific rationality as an entity outside the vagaries of human practice, and therefore legitimates the necessity of exchange (or communication) guided by such a rationality. Importantly, it is an error, in Feyerabend's terms, in both philosophy (such a claim cannot be sustained) and political philosophy (it does not, as it purports to, lead necessarily to the best of possible societies).

Feyerabend's notion of freedom and his understanding of democracy -- and therefore the terms in which he judges the political consequences of scientific rationalism -- are drawn from Mill's <u>On Liberty</u>. "It is not possible to improve on his arguments (Feyerabend 1978, 80)." As a consequence, Feyerabend accepts that in a democracy one is not only allowed to think whatever one chooses, but to agitate for such beliefs as one sees fit, and to form associations in order to promote them. Such circumstances are said to be the only way of usefully arriving at 'truth', since these are the ones that allow exposure to the widest possible range of alternatives.

Within these terms, for an individual who does not accept the excellence of science as granted (and who, indeed, believes that he is capable of discrediting it), scientific rationality has become a device whereby the formation of certain beliefs, much less agitation in their favour, is curtailed. The notion of 'the objectivity of a rational debate' has come to direct almost all procedures of decision, no matter that "the standards of such a debate <u>are not</u> 'objective', they only <u>appear to be</u> 'objective' because reference to the group that profits from their use has been omitted (Feyerabend 1978, 30)."

The dominance of science -- its status as something beyond human practice -- can only be justified, Feyerabend argues, if the excellence of science can be sustained, because it is this excellence that supposedly guarantees the validity of science's pronouncements. The onus is on the scientific rationalist to prove that what he defends reigns by virtue of its access to 'truth', and not because, more simply, there is no ready alternative to it and therefore no means to resist its standards. And yet, not only is the case not proven, it is not argued. And it is this that reveals the ideological character of science.

> The excellence of science is <u>assumed</u>, it is not <u>argued for</u>. Here scientists and philosophers of science act like the defenders of the One and Only Roman Church

> acted before them: Church doctrine is true, everything else is Pagan nonsense ... This phenomenon, though remarkable and somewhat depressing, would hardly bother a sensible person if it were restricted to a small number of the faithful: in a free society there is room for many strange beliefs, doctrines, institutions. But the assumption of the inherent superiority of science has moved beyond science and has become an article of faith for almost everyone.[3] Moreover, science is no longer a particular institution; it is now part of the basic fabric of democracy just as the Church was once part of the basic fabric of society. Of course, Church and State are now carefully separated. State and Science, however, work closely together (Feyerabend 1978, 73-74).

In lieu of demonstrations of science's 'superiority', the authority of scientific rationalism rests on three complementary assumptions which have themselves acquired the patina of 'truths'. First, there is the assumption that scientific rationalism is preferable to (superior to) other traditions. Second, there is the assumption that this superiority is a consequence of the internal methods of science, and hence science cannot be improved by comparison or combination with alternative traditions. Third, it must therefore be accepted, and made a basis of society and

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[3] An excellent example of the universality claimed by science is embodied in the search for extraterrestrial intelligence (SETI), in which radio telescopes scan the skies for a 'communication'. How will alien intelligences manage to communicate with one another? They will share the universal language of science: since the laws of physics are inherent in the natural universe, and since the contents of mathematics are in and of themselves necessarily true, they are therefore invariant with respect to locale, and can be used as a basis for interstellar communication. The entire SETI project therefore rests on the contention that science is not a product of social circumstance and that it provides access to necessary truths. It is worth noting that one of North America's most prominent scientists, and perhaps its most prominent popularizer of science, is also a leading figure in the SETI endeavour: Carl Sagan, David Duncan Professor of Astronomy at Cornell University.

education.

It is the second assumption that is the lynchpin of the rationalist position, for it is the ostensibly sacrosanct character of scientific method that privileges 'reason' as an entity unspoiled by human practice. That is, science asserts its superiority because, first, it uses the correct method for getting results and, second, there are many results to prove the excellence of the method.

Yet Feyerabend argues (relying in part on the contents of Against Method) that there is no single, universal, stable method that guarantees the validity of science. There is no single procedure or set of rules that guides all research. Every inquiry proceeds by virtue of its own methods, and every finding must be judged in terms appropriate to it. Further, there is not a single rule that is not violated somewhere and at some time; indeed, such contraventions are necessary for progress. Again and again, Feyerabend insists, results hailed by science as major advances were arrived at because individuals either decided not to be bound by 'obvious' rules, or inadvertently broke them.

> The idea of a universal and stable method that is an unchanging measure of adequacy and even the idea of a universal and stable rationality is as unrealistic as the idea of a universal and stable measuring instrument that measures any magnitude, no matter what the circumstances (Feyerabend 1978, 98).

This is a position shared by Kuhn, Polanyi and others: that science creates its own methods and procedures as it progresses. But while Kuhn then insists that science be left autonomous to do so, lest it be corrupted, Feyerabend argues that the exclusion of external influence lowers the chances of success, and therefore violates one of science's own goals. Further, he presses the attack that an independent or autonomous science is in any case a prevarication, certainly in the 20th century, which has seen the rise of "business science (Feyerabend 1978, 100)."

In addition, the proposition that the results of science guarantee its special position holds only if it can be shown, first, that no other view has ever produced anything comparable and, second, that the results of science are autonomous, owing nothing to extra-scientific agencies.

With regard to the former, Feyerabend points out that, as an end result of Western imperialism, science no longer has any competitors. "Briefly, but not incorrectly: <u>today science prevails not because of its comparative merits, but because the show has been rigged in its favor</u> (Feyerabend 1978, 102)." Non-Western views have been silenced or eradicated, not through debate, but by material suppression.

The latter he takes to be refuted by the simple observation that there is not a single important scientific idea that was not stolen from elsewhere (he cites Copernican cosmology and the medicine of Paracelsus as examples). The result is that science does not, and should not, proceed according to the rationalist reconstruction. "Everywhere science is enriched by unscientific methods and unscientific results while procedures which have often been regarded as essential parts of science are quietly suspended or circumvented (Feyerabend 1978, 105)."

If, then, science cannot be shown to be superior either by comparison to other traditions or by virtue of its internal method, then its dominance in Western discourse rests solely on its technical capacities and a political order that finds such capacities useful. And even if science could be shown to be an agency privileged with access to the 'truth' of matters, it does not follow that it should be accorded the right to impose itself on everyone (Feyerabend 1978, 78-79).

The rationalist will demur, insisting that such a position leads to granting falsehood the same rights and status as truth. Yet to assert that the beliefs and practices of another tradition are 'false' (whether it be the indigenous culture of Hopi Indians or the culture of parapsychology, and no matter that these beliefs may be 'true' for the occupants of that culture and give substance and meaning to their lives) is to impose the standards of one's own tradition on alternatives. To further insist that the 'false' or 'inferior' beliefs be expunged is to engage in a political act, aimed at dominance and control.

And, indeed, it is in terms of just this dominance that Feyerabend sees the social labour of 20th century science. Marx and Engels, he observes, were convinced that science would aid the workers in their struggle for emancipation, and he notes that this was not at all an untoward conviction in the 19th century, principally because at that time science remained one of various competing ideologies, and it had not yet forged its explicit alliance with the state and the engines of industrialization. Thus, like Habermas, he locates the ascendancy of science as social authority in the late 19th and early 20th centuries. Prior to that time, science was indeed a liberating agency -- not because, as its defenders assumed, it had hit upon an avenue of access to 'reality', but because it acted to restrict the influence of other ideologies (Feyrabend 1978, 75). This is no longer the case, in that science has successfully silenced not only its competitors but its critics, and works unswervingly to impose its rationality on society.

(Feyerabend's example is the now-famous "Statement of 186 Leading Scientists" that appeared in the September/October issue of the Humanist. The statement begins with the admission that: "Scientists in a variety of fields have become concerned about the increasing acceptance of astrology in many parts of the world." But why should scientists object to the existence of a belief that provides its adherents with comfort and meaning? Why should they not be content to hold simply that the proponents and followers of astrology are mistaken (in the eyes of the scientists)? Why are they further compelled to attempt to silence astrology, to eradicate it? And why, if science is necessarily 'right' and astrology necessarily 'wrong', does the document rely on 186 signatures, including those of 18 Nobel laureates, to make its case?)

Ultimately, Feyerabend's complaint about the political operation of modern science is the complaint that it prizes the discovery of 'truth' (i.e. its version of reliable knowledge) above all else, and in the name of the discovery justifies social action. Yet, although the generation of reliable knowledge may have myriad applications and advantages, it may not be compatible with all sorts of other things that are just as, or more, important and desireable, such as freedom of thought and liberty of action.

Consequently, Feyerabend calls for a widespread understanding of science as a tradition in the vein of other traditions. That is, it is an ideology -- merely a very specific and different sort of ideology. Once it is understood as such, the way is cleared for the lay supervision of science. Society, not science, should decide what is taught in schools, whether and where nuclear reactors should be built, how resources should be allocated to medical research and treatment, and so on.

> Expert opinion will of course be taken into consideration, but experts will not have the last word. The last word is the decision of democratically constituted committees, and in these committees laymen have the upper hand (Feyerabend 1978, 87).

For a variety of reasons, ranging from the fact that experts are often wrong or in disagreement, to the fact that their pronouncements are the product of, and therefore express the interests of, select social groups, "it would not only be foolish <u>but downright irresponsible</u> to accept the judgement of scientists and physicians without further examination. If the matter is important, either to a small group or to society as a whole, <u>then this</u>

judgement must be subjected to the most painstaking scrutiny (Feyerabend 1978, 96)." He points out that this is the basic assumption of trial by jury.

Again, the rationalist will recoil from such suggestions, on the grounds that lay interference in science means rendering science subservient to social interests, and it is precisely science's autonomy from such interests that allows it to arrive at 'truth'. However, Feyerabend would insist to the contrary that science has always been pursued in the context of social interest, and that lay supervision of science would serve merely to make these interests apparent. Further, even if democratic involvement in science should lower the success rate of the enterprise, this is not a concern for Feyerabend. Democratic values are always to be prized over those of science. Just as, when at war, a democracy is obliged to treat its enemy in a humane fashion even if this should diminish the odds of victory, so a democracy should not subordinate its political commitments to the priorities of science (Feyerabend 1978, 87). Just as a democratic society should fight 'fair', so should it think 'fair'.

2.5 Toward a 'Critical' Understanding of Science and the Media

One need not be detained, however, by the programs of political change advocated by either Feyerabend or Habermas. It is enough, for the present study, to mobilize the contributions of Habermas and Feyerabend toward an understanding of science as ideology, in the effort to examine how the popular representation of science has been constituted as a problem in academic and popular discourse.

Specifically, if scientific rationality is an ideological construct whose authority rests on its hold on individual citizens, then what place, if any, does the popular representation of science occupy in the propagation of this ideology? What part is played by the existence of a body of academic attention to popular science? And in what terms has the subject been constructed as a social problem to be addressed and a methodological problem to be surmounted?

The aim of the chapters to follow will be to entertain just such questions: to consider the constitution of the 'problem' of science and the media, not in light of a view of science as necessarily heroic and inherently rational, but in light of a view that emphasizes the centrality of scientific rationality in the governance of social affairs.

Chapter Three

The Emergence of the Dominant Concern: A Few Seminal Texts in their Context, 1956-1965

3.1 The Post-War Explosion in Science Journalism

Because the 'problem' of science and the media is typically presented as an issue of current and relatively recent urgency, it is tempting to suppose that the popularization of science -- at its most basic, the communication of scientific findings to an audience not participant in the production of this knowledge -- has only lately become an endeavour crucial to the development of the scientific estate and the society that it serves, and therefore a matter warranting serious attention. Nonetheless, it is important to recognize that the public communication of science has long been a priority in the West, particularly inasmuch as it has developed in response to the changing status of science over the course of the past 300 years, and the associated emergence of democratic systems which, at least in theory, require an "enlightened" polity in order to operate successfully.[1]

The 17th and 18th centuries, for example, saw the creation of botanical gardens and museums of natural history, the appear-

[1] Two recent, excellent studies in the history of science which concentrate on the role of popularization in advancing certain scientific tenets and in marshalling public support for social policies founded on such tenets are Daniel J. Kevles' In the Name of Eugenics: Genetics and the Uses of Human Heredity (New York: Alfred A. Knopf, 1985), and Roger Cooter's The Cultural Meaning of Popular Science: Phrenology and the Organization of Consent in Nineteenth Century Britain (Cambridge University Press, 1984).

ance of a caste of itinerant lecturers, and the rise of public demonstrations and experiments. The 19th century, which witnessed the rise of a science directly relevant to everyday commerce, also saw an explicit commitment to the project of popularization. Article II of the Constitution of the American Association for the Advancement of Science (AAAS), founded in 1848, included as one of the objectives of the body: "... to increase public understanding and appreciation of the importance and promise of the methods of science in human progress." Accordingly, the century also inaugurated the tradition of public fairs on the theme of the promise of science and engineering, beginning with the Great Exhibition of 1851, and proceeding through the Centennial Exposition of 1876 in Philadelphia (the first in the U.S.), the 1939 New York World's Fair, and most recently Expo '86 in Vancouver.

As well, in the wake of the fierce public debate following the publication of Darwin's On the Origin of Species (1859), the 19th century witnessed concerted efforts to explain the contents of science to laymen, exemplified by Thomas Huxley's "Workingmen's Lectures", which were motivated by the conviction that the rationality embodied by scientific procedures and the knowledge produced by its inquiries could provide the basis for a civilized and emancipated society. Certainly, the mass press of the 1800s seized upon each new scientific and technical development -- the invention of the telegraph, the laying of the transatlantic cable, the discovery of an innoculation and cure for diptheria, and so on -- as a subject to be covered and a source of popular narratives, to the extent that, in 1877, the New York Tribune initiated a weekly column titled "Science and the People".

It is not the intention here to embark on a history of popular science, but rather merely to point to the fact, often passed over in contemporary discussions of the problem of science and the media, that it is a practice that does indeed have a history. Not only has it been intimately conjoined with the progress of science's fortunes, but its methods and goals have varied with historical circumstance.

In that regard, it is in the decade immediately following the end of the Second World War that press attention to science assumes its current, distinctive form. It is in this period that science is recognized as a legitimate and necessary 'beat' in the journalistic repertoire; that increasing numbers of news organizations come to employ one or more individuals whose special responsibility it is to cover developments in science; and that a sizeable community of 'science writers' is brought into being, whose members come to share common convictions about the nature and responsibilities of their work. As a result, it is in this period that the terms in which science is to be addressed and reported are laid down in detail.[2]

Certainly, the 'professionalization' of science journalism

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2 There are as yet few histories of popular science or press coverage of science, specifically. It is no accident, however, that in writing his doctoral thesis, a history of U.S. science journalism, Bruce Lewenstein of the University of Pennsylvania has chosen to examine the period 1945-1965.

in the post-war years had its antecedents in the first half of the century. In 1919, a year after the Armistice, the American Chemical Society created its own news service, the first of its kind to be established by a scientific organization. Three years later, E.W. Scripps, a journalist, formed the "Science Service" in collaboration with University of California biologist W.E. Ritter, intending to sell science news to newspapers across the U.S. The service was successful -- prefiguring the economics of science coverage later in the century, in which individual news organizations can obtain science news more cheaply from a centralized news service than by engaging their own science correspondents -- and the Scripps organization continues to publish Science News, a weekly science newsmagazine.[3]

By 1934, there were sufficient numbers of reporters with a professional interest in the affairs of science to permit the formation in the United States of the National Association of Science Writers (NASW). Nonetheless, in the 1930s, the project of science journalism had not yet been taken up widely within the fourth estate -- the founding members of the NASW numbered only a baker's dozen[4] -- and, more importantly, it had not yet acquired

[3] Sharon M. Freidman, Sharon Dunwoody and Carol L. Rogers, Scientists and Journalists: Reporting Science as News (New York: Macmillan Co., 1986), p. xiii.

[4] There is actually some disagreement over the actual number of founding members. John Troan (1960) puts the figure 12, as do Friedman et al. in the introduction to their 1986 volume. Barbara Gastel (1983), however, writes of 11 founding members, while Burkett (1973) mentions 13. David Dietz (1937), himself a charter member of the association, names the others for a total of 13.

its characteristic concerns. That is to say, the practice of science journalism in North America was not yet conducted in a social context that identified the public communication of science as a problem of some consequence, and therefore a priority to be pursued.

Indeed, from the vantage point of the present, public attitudes to science prior to 1939 (inasmuch as one is able to gauge such things) have acquired a certain quaintness of character, signalled most prominently in the optimism and confidence with which science was celebrated. It is difficult to imagine, for example, a public anywhere in the West after 1946, amongst the vanquished nations or the victors, embracing wholeheartedly the motto proclaimed in the guidebook to the "Century of Progress" International Exposition in Chicago in 1933: "Science Finds -- Industry Applies -- Man Conforms".[5]

Indeed, the pre-eminent symbol of the social standing of science and technology in the inter-war years remains the 1939 New York World's Fair, the visionary forecasts of which

> were little more than a compilation and distillation of those that had appeared for a decade in the pages of Sunday supplements, in the halls of industry, and, more importantly, in the 'popular science' magazines, Popular Mechanics, Popular Science, and Modern Mechanix (Onosko 1979, 2).

The message of the Fair, capturing at least a portion of the

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[5] Leo Marx, "Are Science and Society Going in the Same Direction?" Science, Technology, and Human Values, Vol. 8, Issue 4, No. 45 (Fall 1983).

spirit of the decade, was that the world might be remade for the better via the investigations of science and the applications of industry -- and that the two were intimately conjoined. Popular attention to science in the 1930s, as a consequence, was orchestrated most typically in terms of the material and spiritual benefits which science would bring about.

Consider the advice given to prospective journalists by Maynard D. Brown in 1937, under the title "The March of Science as News."

> The trained writer in science performs his finest task when he translates the acts and statements of the scientists to the readers of his journal ... He makes known by interpretation what the scientific mind has done for the human race (Brown 1937, 147).

Already, one can detect the presence of certain key contentions which, 20 years later, will come to inform the constitution of the 'problem' of science and the media: there is the assumption that the popular science writer must be suitably "trained" for the specificities of the task, and that chief amongst these is the need to "translate" the vocabulary of science into that of the lay reader. The journalist is pictured as an intermediary between two camps, the lay and the scientific, whose work is to "interpret" the accomplishments of the latter so that the members of the former can fully appreciate them. Above all, there is the explicit admonition that one popularizes on behalf of science, and only therefore to the benefit of society.

As a result, "Science writers must evidence unusual traits," among which are curiosity, accuracy, and an awareness of the readers' interests and limitations (the ability to "speak of mighty things in little words"). Most crucially, however:

> A Love of Science is Important ... Reporters who have a love of science can work more efficiently with the men in the field (Brown 1937, 149).

Nonetheless, at this point the science journalist is instructed to address his subject primarily from the point of view of the technical wonders it makes possible -- indeed, to play to an audience for whom the notion of 'technical wonder' is still a relatively new and exciting prospect. There is no suggestion that the labour of the science writer should involve the ongoing documentation of procedures of academic research; attention is directed, rather, to the moment at which scientific findings admit the potential of technical application. The supposition is that the proper task of science journalism should be to concern itself with science only inasmuch as it is immediately or potentially germane to everyday life.

By doing so, Brown avers (in block capitals), "Science news satisfies many interests." These include: **Tales of Adventure**, **Prophecies of Progress**, **Promises of Progress** ("When news breaks of such scientific discoveries as television, safety glass and glass wool, it occasions further news. Alert reporters interview other scientists, business and financial leaders and heads of allied industries to see what the discoveries may mean in the progress of industry and finance,"), **Lure of the Unknown and**

Mysterious, **The Urge for Riches**, **The Wish for Change** ("Science cures man's dread of monotony,"), **The Wish to Live**, **The Fear of Death**, **The Strife of Machines and Man** ("The news which started out as pure science eventually finds its way to the business columns, the want ads and the suicide reports."), **Love for the House** ("Here too news of science has become news of business and of beauty and comfort,"), **Adornment of the Person** ("... news of these scientific achievements caters to one's natural desire for adornment and beauty,"), and **Preparations for War** ("When armistice comes, the lessons that science bequethed to war are converted into peace-time industrial undertakings,") (Brown 1937, 143-146).

Notice, then, that although by 1937 the science writer has been formally admitted to the ranks of specialized journalists, the project of science journalism is not yet charged with alarm over the fact that the activities of science are inadequately understood by non-scientists. Although there is the warning to take into account readers' limitations, these limitations have not yet themselves become the inspiration for press attention to science. There is no sense of urgency in Brown's primer; no sign of the by now familiar agitation over the extent of public ignorance of science; no indication that the presumed readership of the late 1930s felt alienated from science, or bewildered by it, or frightened by its arcane power; and certainly no indication that the practice of science writing should be guided by such considerations. There is, instead, only the notion that science is a matter of some drama and interest, and that by affording it due coverage the press does its readership a service.[6]

It is only following the Second World War that the ranks of science journalists, and the prominence of science journalism, increase dramatically; and it is coincident with its expansion that the popular science effort articulates the new terms in which its labour is to be conducted.

The increase in press attention to science in the post-war years is relatively easily documented, and just as easily understood. In 1934, those who declared their commitment to the public communication of science as a professional endeavour (by forming the NASW) numbered only 12. In 1939, Science Service conducted a count of "science writers and editors of newspapers, syndicates, and magazines," and the total was 60.[7]

In 1956, by comparison, the AAAS annual meeting, held that year in New York City, issued press accreditation to 212 journalists. All the American wire services were represented, as well as a number of foreign agencies, including Tass. The CBS television network shot a documentary, and a further 63 journalists in the United States and abroad reported on the meeting from abstracts and completed papers mailed to them in advance.[8]

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6 See also David Deitz, "Science and the American Press," Science Vol. 85, No. 2196 (1937).

7 Freidman et al., Scientists and Journalists, p. xiii.

8 Science Vol. 125, No. 3242 (1957), p. 292.

When Science Service polled 1,500 daily and Sunday newspapers in the U.S. in 1960, it found that one-quarter reported employing a full- or part-time reporter who devoted special interest to science, medicine, or technology.[9] By 1963, the NASW counted 195 science journalists as active members (those who were employed by the press or the broadcast media, either directly or as freelancers) and 353 associate members (involved in the science communication effort in some capacity other than journalism: this group represents the rise in the 1950s and early 1960s of public information officers for scientific and medical organizations, government bodies, universities, and so on, as well as the appearance of journalism and communications faculty members interested in the public communication of science).[10] Following the dramatic increase in science communication personnel in the 1950s, numbers continued to grow steadily over the course of the 1960s and 1970s, and the NASW 1984 membership roster lists some 575 practicing science journalists.

Clearly, the new post-war interest in science on the part of the press was occasioned by the contemporaneous, massive expansion of the scientific research community as a consequence of both political priority and economic incentive, and by the increasing (and related) prominence of science and its products in the political landscape and in everyday life. The decades

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9 Freidman et al., Scientists and Journalists p. xiv.

10 Earl Fraley and Warren Ubell, "Science Writing: A Growing Profession," Bulletin of the Atomic Scientists 19 (Dec. 1963), pp. 19-20

following the end of the war marked a period of rapid social change, and there was abundant evidence at the time that much of this change was initiated or fuelled by scientific and technical developments. It certainly seemed as though the coordinates of social conduct were being reshaped by a steady stream of advances in theory and application that showed no sign of abating: this was a period that witnessed the development of the fission (1946) and fusion (1952) warheads; the appearance of the rocket engine and the inter-continental ballistic missile; the construction of nuclear reactors (1951), both by civilian utilities corporations and by the military, in atomic powered submarines and aircraft carriers; the deployment of television; the development of the digital (binary) computer, in the hands of industry and the military; the first use of the jet engine, initially by the military, and eventually by civilian airlines; the dramatic use of the helicopter in the Korean War (1950-53); the invention of the transistor (1948) and the onset of electronic miniaturization; the invention of holography (1948), the maser (1954), and the laser (1960); an onrush of pharmaceutical and medical advances in the wake of the widespread availability of the first antibiotic (and associated talk of medicine's "wonder drugs"); the inauguration of space exploration (1957) and the development of satellite communications (1960).

As well, the same period witnessed a number of prominent developments within the sphere of academic scientific inquiry, including: advances in electron microscopy (invented in 1939);

the discovery of techniques of carbon-14 geologic dating (1947); the development in the 1940s and 1950s of radio astronomy, particle accelerators, and cybernetic theory; the specification of the double-helical architecture of deoxyribonucleic acid (DNA) by Watson and Crick (1953); the invention of techniques of chromatography and electrophoresis that allowed the sequencing of the amino acids that composed bovine insulin (1955), and which confirmed that proteins were indeed chains of amino acids; the overthrow of the conservation of parity in the 1950s, and so on.

Nor, in the wake of the Manhattan Project, was there any doubt in the public mind about the potential and importance of scientific investigation for social affairs. One of the manifest lessons of the Second World War had been that a relatively small group of academics, whose interest was in an arcane area of highly theoretical physics, could not only end a global conflict, but in so doing set down the conditions under which international relations in the post-war period would unfold.[11] It was clear,

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[11] MGM went so far as to produce a docu-drama feature, recreating the invention of the atomic bomb (Reingold 1985). The recognition of scientists' contributions to ultimate victory was not confined, however, to either the Manhattan Project or North America. In Britain, where tales of how the Second World War was won continue to enjoy considerable popularity, post-war culture celebrated the effort and achievements of the scientific community, most prominently in the persons of: Robert Watson Watt, the scientist who had invented the Radio Detection and Ranging device (radar), which alerted the Air Arm to approaching German attack, and gave the outnumbered RAF a much-needed advantage in the Battle of Britain; the engineer who designed the Wellington bomber and devised the "bouncing bomb" used to destroy the dams of the Ruhr valley (depicted in the 1954 film The Dam Busters); the cryptographers and mathematicians who cracked the German Ultra code; the Cambridge researchers who identified penicillin as the first antibiotic, solved the problem of how to produce any

therefore, that any future conflict would pit not only the industrial capacity of one sphere against that of the enemy, but also the scientific talent for both theory and application. The combination of Cold War and economic prosperity fattened defence budgets; the military, accordingly, allotted unprecedented funds to scientific and technical inquiry, and therefore contributed directly and deliberately to the expansion of the research community.

In industry, too, the value of science as a source of technical innovation and refinement was evident in its capacities to create wholly new markets, or to replenish existing ones through continually improving designs (therefore ensuring the obsolescence of previous products).[12] The result was a renewed investment in research and development, of particular significance now that this effort was being conducted by multi-national corporations, with resources that just a decade before would have

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more than minute quantities, and performed the first full-scale tests on British wounded in North Africa; Bailey, the engineer responsible for the mobile Bailey Bridge, used to great advantage in the allied advance across Europe; the theoreticians and engineers who designed and constructed the floating 'harbour' that made the Normandy landing possible, and so on.

Indeed, it is precisely in this post-war period that the caricature of the scientist as "boffin" (United Kingdom) or "egghead" (North America) emerges on both sides of the Atlantic.

[12] In the years following the war, the potential and importance of applied research was recognized in the United Kingdom no less than in the United States, but the priorities that commanded the political and economic stage in Britain rendered the commitment to market innovation problematic in a way not as profoundly experienced in North America. The most comic and enduring popular treatment of this peculiarly British dilemma remains The Man in the White Suit (1951).

been inconceivable.

Finally, the 1950s and 1960s, in North America and the British Isles, was a period of dramatic expansion for the universities, the third major site of scientific investigation. By comparison with that conducted by the military or corporate laboratories, the research pursued by the academic community has typically been less coloured by motives of immediate application, and it therefore conforms most closely to the classical image of science as a system of inquiry for the sole sake of inquiry. However (and with the obvious exception of certain branches of medical research), this has meant that the science practiced by universities has also been seemingly more distant from the lives of the laity, more removed in its implications for everyday commerce, than the science issuing from the industrial and military research organizations.

Nevertheless, it is the science of the academic community that has come to serve as the exemplar for popular science coverage. That is, although there are manifest differences between the means and ends of science conducted in military, industrial, and academic settings, it is university science that has come to dominate press attention, and that has commandeered the terms in which science is to be understood and depicted within the overall project of science journalism.

Obviously, this has had much to do with the relative openness of the academic research community. Military and industrial science does not go unnoticed -- on the contrary, the end products of such "applied" research are regularly unveiled before press and public, often with considerable fanfare -- but the actual processes of investigation tend to be guarded jealously, in the interest of preserving either national security or competitive advantage. One of the foundations of academic science, by contrast, is the principle of public disclosure. Work is announced in journals readily available to the press, and presented at conferences which journalists are largely free to attend.

However, there is a good deal more to the abrupt growth in press attention to science in the 1950s and 1960s than a mere recognition on the part of the fourth estate that science had become a powerful and explicit influence on social affairs; and the coverage that ensues is orchestrated by more than simply the relative accessibility of publicly-financed research projects. Both must be understood in terms of the larger concert of developments that attend the more conspicuous role of science in Anglo-American society.

3.2 Debut of the Problem, 1956-1965

The development of the 'problem' of science and the media can be charted relatively straightforwardly. Although its constituent elements begin to find expression almost immediately after the war, the statement of the problem itself makes its formal debut in the mid- to late-1950s and early 1960s It does so first in the United States, and in journals addressed primarily to scientists, chiefly Science and the Bulletin of the Atomic Scientists.

By the late 1960s, and increasingly throughout the 1970s, the problem of science and the media received open recognition in intellectual life outside the sciences, being discussed in special issues of Daedalus and debated frequently in M.I.T.'s Science, Technology, and Human Values. In particular, it began to attract the attention of communications researchers and media sociologists, who sought to study its features and implications with academic rigour.

At the same time, science communication established itself in the curricula of schools of journalism and those departments of communication which sought to train media and public relations personnel; by 1978, there were some 34 programs and 105 courses at the university level in the United States devoted to the public communication of science.[13]

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[13] Directory of Science Communication Courses and Programs (1978). Compiled by Sharon Freidman, Rae Goodell, and Lawrence Verbit.

This type of institutionalization of the problem has the consequence of encouraging further publication, as science writers and teachers of science writing contribute to the literature -- and to the constitution of the 'problem' in its specific details -- primarily by offering observations, suggestions, and fully-developed stratagems according to which the public communication of science might be effected, and the 'problem' therefore solved. As well, a sizeable and expanding body of students provides an assured market for academic texts on science and the media. The result has been that, since the early 1960s, interest in the problem has increased steadily, to the point at which 1986 alone saw the publication of three books on the subject: two anthologies and a reporting primer; as well, two other volumes were in press.[14]

For the moment, however, attention will be directed to the debut of the problem of science and the media as a distinct concern of post-war Anglo-American culture, because it is here that its broad terms are first articulated, and it is in the context of these terms that the public communication of science develops as an issue over the decades to follow.

There are three immediately notable features of this debut. First, the 'problem' of popular science is broached initially before the members of the <u>scientific</u> community, in non-special-

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[14] 1986 also saw the publication of <u>Expository Science: Forms and Functions of Popularization</u>, but this anthology, European in origin, formulates its 'problem' in radically different terms from those still dominant in North America.

ized yet solidly reputable journals whose readership compasses the range of occupations in science -- researcher, administrator, teacher -- but which are little read outside such circles. Science then, as it is now, was a weekly publication of the AAAS which sought to provide an overview of developments in different scientific disciplines for the members of all scientific disciplines. By the early 1960s, the Bulletin had expanded its editorial interests beyond the narrow (albeit weighty) issues associated with nuclear power and weaponry, and was engaged in the assessment of the wider social responsibilities of science in the atomic age.

Secondly, and despite their appearance in journals which normally feature the work of scientists, most of these early articles were in fact written by individuals already involved in the project of science communication. Kreighbaum was an associate professor in the Department of Journalism at New York University, and chairman of the Surveys Committee of the National Association of Science Writers. Pfeiffer was president of the NASW. Piel was publisher of Scientific American. Thistle, although formerly a biochemist, was at the time chief of the public relations office of the National Research Council of Canada. He later went on to join the faculty of the Carleton University School of Journalism. Troan was a science writer for the Scripps-Howard Newspaper Alliance. Rostand had won the United Nations' 1959 Kalinga Prize for "outstanding contributions to the dissemination of scientific knowledge to the general public." Ableson was editor of Science. Cohn was the science reporter for the Minneapolis Tribune. Ubell was president of the Council for the Advancement of Science Writing, and Fraley was also a science journalist.

In its very emergence, therefore, the 'problem' of science and the media represented a convergence of interests on the part of (at least some members of) the press and (at least some members of) the scientific community. Indeed, the various institutional voices that found expression in the constitution of the problem were by 1958 in sufficient harmony to join together in the formation of the Council for the Advancement of Science Writing (CASW), the board of directors of which would include representatives of the NASW, the AAAS, the National Academy of Science-National Research Council, schools of journalism, the medical profession, and the fourth estate.

Thirdly, expression of concern over public understanding of science is near simultaneous with the mobilization of efforts to redress the 'problem' -- and is in fact inextricably conjoined to such efforts. It is true that there are scattered signs of growing recognition of a problem some years earlier. In 1948, for example, the University of Wisconsin established a science writing research assistantship, whose holders could specialize in science reporting while studying for a graduate degree in any field.[15] Meeting the needs for public understanding of science was adopted as a policy of the U.S. government in 1950, in the

[15] Science Vol. 123, April 27 (1956), p. 720.

legislation that created the National Science Foundation, and in 1951 the board of directors of the AAAS reiterated the organization's commitment to science communication in the "Arden House Statement".

It was in the late 1950s, however, and coincident with the public statement of the 'problem' in the pages of the Bulletin and Science, that the science communication effort was galvanized by the actions or sponsorship of a number of organizations. It was in 1957, for example, that the AAAS produced the paperback Guide to Science Reading, a listing of approved readings in science for the non-scientist. In 1958, the University of Michigan Survey Center study, The Public Impact of Science in the Mass Media, was published, which purported to document a desire on the part of the reading public for more science news, even if this should mean less coverage of other topics, such as sport. In the same year, the NASW (for which the University of Michigan survey had been conducted) unveiled a nine-point plan to enhance the quality of science coverage in the U.S., and the CASW was created to implement just this program. By 1961, the National Science Foundation had lent its support to the burgeoning science journalism project by sponsoring a Washington D.C. conference on "The Role of Schools of Journalism in the Professional Training of Science Writers."

This abrupt burst of attention to the 'problem' of popular science, clustered at the end of the 1950s and the beginning of the 1960s, is clearly linked to concurrent developments on the political stage. The U.S.S.R. had broken the United States' monopoly on nuclear weaponry in 1949. In 1952, the U.S. successfully tested "Mike", the first fusion device, and once more reasserted (what was thought of at the time as) military superiority over its adversary. Nine months later, however, in August 1953, the Soviet Union once again matched the Americans' accomplishment. It was the events of 1957-1966, however, in conjunction with the nuclear capability of Soviet Russia, that shook the United States' confidence in her own scientific and technical superiority, and fuelled a renewed emphasis on science education and communication.

In 1957, the U.S.S.R. launched the first artificial satellite, Sputnik. Two years later, she sent the first rocket to the moon. In 1961, the first man to fly in space was Soviet cosmonaut Yuri Gagarin. In 1966, the first probe to land on the moon carried the insignia of the Soviet Union.

The initiative provided by Sputnik and subsequent Soviet successes to the science communication effort in North America is relatively obvious, and has been noted by other writers. Nonetheless, it is worth reiterating, however briefly, the impact that Sputnik had on the American imagination, if only to further situate the 'problem' of science and the media in the context in which it arises.

One must recall that, unlike the atomic bomb, which had been kept secret until its actual use, Sputnik was not the first the North American population had heard of satellites or rockets. In

1955, both the U.S. and the U.S.S.R. had announced their intentions to launch scientific satellites as part of the International Geophysical Year (1957), but little in the way of public fascination had been forthcoming. "In the following two years, the public was treated to cut-away drawings of a 20-pound Vanguard [the satellite the U.S. Navy proposed to place in orbit]: as intermediate test flights occurred, they were received with polite interest ... "[16]

Indeed, the University of Michigan Survey Research Center found that six months prior to the launching of Sputnik, 54% of Americans knew nothing about satellites, and only 23% were able to recall some information on the subject. This is opposed to 88% who were able to recall some information about the polio vaccine, while only 4% admitted complete ignorance.

On the morning of Saturday, October 5, however, the New York Times carried the news that a Soviet satellite was orbiting the earth at 18,000 miles per hour in a three-line banner headline which pointed out that the device's orbit passed directly over the United States. The front page carried four stories and an illustration about the satellite, and the interior of the paper contained entire pages devoted to the subject. At twilight, in those areas where Sputnik was visible, the streets were filled with people scanning the skies with binoculars and telescopes. In comparison with the 23% of Americans who claimed to have some

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[16] Charles S. Sheldon II, "An American 'Sputnik' for the Russians?" Man on the Moon, Eugene Rabinowitch and Richard S. Lewis, eds. (New York: Basic Books, 1969), p. 53.

knowledge of satellites prior to Sputnik, an international poll conducted afterwards by Elmo C. Wilson found that in Norway 97% of respondents knew that a man-made satellite was circling the globe; in Germany, the figure was 91%; in English-speaking Canada, 83%.

Clearly, the sensation caused by Sputnik in the West was linked to anxiety over the Soviet nuclear threat. While the American Vanguard was to be launched by a rocket developed expressly for the purpose, Sputnik was placed in orbit using a huge ballistic missile that had been designed originally to deliver fission warheads. The fear that the West was suddenly vulnerable to nuclear attack from space was one that, as Sheldon points out, took little account of the realities of celestial mechanics, but it was real enough nonetheless, and in subsequent editorials the New York Times accused the Soviets of engaging in "rocket diplomacy, to cow the world into submission."

Yet Sputnik itself presented no threat to the United States, and the fact of its existence added no new military dimension to the antagonism between the two powers. Its import for the West sprang, rather, from the shock of the recognition that the Soviet Union could surpass the scientific and technical expertise of the United States. In the ongoing dress rehearsal of a Cold War, in which technological capacity is the index of power, scientific accomplishment is the criterion for victory. For the first time, the Soviet Union had shown she could "win".

This was not simply a matter of surrendering a military advantage to an enemy: it represented a direct challenge to the United States' own understanding of herself and her place on the world stage, and to Americans' understanding of the nature of the Soviet threat. Prior to Sputnik, the image of America presented to its citizens was that of a free, just, prosperous and generous power, the like of which the world had never witnessed. America was the exemplary democracy, whose social conditions promoted and rewarded excellence in every endeavour. The Soviet Union, by comparison, was widely understood to be a ruthless police state which perpetuated its rule through the armed suppression of its population of backward peasants. Its economy, without the benefit of the stimulation of the market, was sluggish and austere. Its science, too, at all times subordinate to the dictates of political ideology, was presumably a hobbled imitation of that permitted by Western freedom of inquiry. Certainly, in the days preceding Sputnik, few Americans would have thought it possible for the U.S.S.R. to overtake the technical capabilities of the U.S.: the Soviet threat was considered to lie in the evil intentions and hateful ideologies of her rulers, not in her technological prowess.

Subsequently, the Sputnik 'triumph' would be seen as merely another manifestation of the perversity of a political order that would divert much needed resources to the boastful demonstration of technical competence, while a frightened population continued to go hungry. Media outlets, policy and technical experts, and government spokesmen all took care to emphasize, in the phrase of

Le Monde, that the Soviets had conquered the skies, but only at the expense of the soil.

However, one of the most immediate consequences of Sputnik in the U.S., and in the West generally, was the sense that the democracies had been lax in their state-sponsored pursuit of scientific excellence, while the Soviets, goal-directed and regimented, had identified certain areas of research and development as priorities, and pursued them to their ultimate advantage. In practice, this translated into the belief, most pronounced in the U.S., that not enough scientists were actually being produced (hence the redoubled emphasis on science education in the universities), and the wider concern that science itself was insufficiently appreciated or understood as an element essential to the greater good (hence the rise of the 'problem' of science and the media).

The advent in the late 1950s of public communication of science as an issue of pressing urgency was therefore linked directly to the historical events of the time, and the political tenor of the Anglo-American alliance. The Soviet success with Sputnik did not create concern over the extent of lay acquaintance with science, but it provided the occasion and the impetus for its expression. The specific form that this concern assumed, however, and its contribution to the goals and methods of the project of science journalism, are best revealed via a consideration of the content of those early texts in which it finds its first public airing -- since it is these that lay down the basic terms in which subsequent commentary on and investigation of media science coverage will be conducted.

3.3 Constitution of a 'Problem': A Few Seminal Texts

Although Sputnik and the surrounding climate of international hostility may have provided the occasion for organized attention to the need for public communication of science, the advent of the 'problem' itself is embedded in the larger environment of heightened expectation and apprehension that attended science during the post-war expansion. Certainly, early attention to the issue of science communication situated its concern explicitly within the context of the special problems confronting the industrialized West in the late 1950s and early 1960s. Ostensibly, the new prominence of science as an engine of economic activity and an agency of political authority had worked to redraft the conditions under which government must operate and therefore to which democracy is answerable. Under these new conditions, the fact of widespread ignorance of science amongst the polity (what would become known as "scientific illiteracy"), tolerable in previous eras, came to assume the proportions of a threat to social well-being: alienated from the contents and conduct of science, the individual citizen could not come to informed decisions about the range of issues that presented themselves to public attention; without sufficient schooling in science, there could only be at best political paralysis, at worst susceptibility to the allure of irrationalism; the end result might well be the erosion of public support for the scientific enterprise. Such a society would not only have corrupted the spirit of human inquiry, but would have lost the guidance of science in the conduct of social affairs. Political decisions would be taken without the benefit of the objective contributions of a robust science, and hence there would be no means to assess the adequacy of these decisions, or to guarantee their soundness.

The argument was that the typical non-scientist -- and therefore the bulk of society -- knew virtually nothing about science, was perhaps distrustful of it, and as a result the performance of democracy was impaired: the laity possessed neither the scientific rudiments to come to meaningful decisions on specific issues, nor the rationality that is required if a democracy is to function as such. None of these contentions was founded in anything more than anecdotal or impressionistic evidence, but they nevertheless found repeated expression in the late 1950s.

It was this sense -- that the current state of public acquaintance with science was detrimental, to both science and the public good -- that inspired the science communication campaign from its beginnings. Each of these early texts therefore takes pains to emphasize that lay perceptions of science have become a 'problem' -- since it is on that basis that calls for a vigorous science journalism will be justified:

> The image of the scientist in the eyes of recently surveyed high school students, the popularity of pseudoscience and antiscience, the attitudes of many businessmen as indicated in off-the-cuff statements and in the advertisements they approve -- these and other

phenomena suggest that the public has an exquisitely lopsided view of science (Pfeiffer 1958, 956).

Nor does the danger come only from fanatics, faddists, and cultists. There are some intellectuals who dislike and distrust science, and who would, if they could, throw it out.

Unless we do all we can to prevent the irresponsible use of science -- by governments, businesses, and individuals, they may succeed. And that would be a tragedy indeed, for at its heart, we know, science is now the world's best hope for improvements in the condition of man on this earth (Lessing 1963, 23).

This function of journalism [science writing] has assumed an obvious new importance in our life. The theoretically informed citizenry of our democratic society must be especially informed today about the work of science if it is to make wise judgements in public affairs. But sound public information about science is also integral to the life of science itself, for this is an era in which science must turn to the public for its support ... The ignorant include most of the spokesmen and articulators of the public consciousness: our scholars, artists, writers, lawyers, and legislators and our administrators and executives in business and government (Piel 1957, 793).

Raising the level of scientific literacy in this country is an imperative. This is not just because science has become so large a part of our culture that no one who is ignorant of it can call himself educated, but rather because science is entering so extensively into vital questions of public policy that we cannot tolerate decision-making by executives, legislators, or citizens who are scientifically illiterate ... No wonder the public, so grossly uninformed ... [proves susceptible] to myth and magic, to pseudo-scientific oratory and demagoguery (Fraley and Ubell 1963, 22).

Written for an audience of scientists, these passages give thinly-veiled expression to the frustrations encountered by science in the late 1950s and early 1960s, even at the moment of its grandiose expansion. Celebrated in the years before the war as a source of new knowledge and novel technical capacities, by the mid-1950s science was forced to confront a growing popular unease with its dramatic accomplishments, not all of which appeared to be to the benefit of the greater good. The response was a complementary unease on the part of the scientific community. Unable to understand science, the mass of the population was also, it seemed, incapable of appreciating it, and the result, in the view of the research community, was a prescription for social ruin. In the talk of the laity's inability to make "wise judgements," or to use science in a "responsible" manner, can be heard an elitist dismay over a public incapable of recognizing what is in its own best interest -- a dismay that finds its most brash expression in Fraley's and Ubell's insistence that decision-making uninformed by science can no longer be tolerated. They mean by this that bureaucrats, voters, and elected officials should be familiar with science as a matter of course, and that steps should be taken to ensure that they are; there is also the underlying suggestion, however, that a universal franchise in an age of scientific illiteracy might not be to the advantage of society as a whole.

Most pointedly, then, these early texts signal the recognition that the new social conditions include a 'problem' with science, while simultaneously insisting that the problem lies not with the practice of science itself, but with a flawed and volatile public perception of it, the correction of which should be an immediate priority. Fundamentally, it is this that justifies and orchestrates the attention to the media of mass communication: the media are of interest because, as the chief sources of information about science for adult laity, they are identified as the primary culprits in the perpetuation of inadequate public acquaintance with science, and, by corollary, as the principal agencies whereby such acquaintance might be improved.

One should emphasize that these central contentions -- that the state of public familiarity with science cannot fail to impair the possibility of democratic governance, but that this social deficiency might be remedied via enhanced, improved press coverage -- are nowhere developed or explored in any of these early texts (and only marginally more so later). No examples are offered of how rational government has been thwarted by public scientific illiteracy, or how improved public acquaintance with science might in practice result in a better managed or more meaningfully democratic society. Indeed, in the single instance in which the notion is pursued, the examples are less than convincing. Lawrence Lessing called for an "issue-oriented" science writing, on the basis of which public involvement could be included in the various debates on scientific issues, a number of which he lists:

> The hotly debated decision against an earth-orbital approach to the moon in favour of a lunar orbit (of which debate the public is almost totally unaware). The question of the relative cost and efficiency of liquid-fuel versus solid-fuel rockets as space boosters. The controversy over whether our high altitude nuclear tests over the Pacific last summer did or did not foul up our space communications and delay manned flight experiments (Lessing 1963, 23).

These were unquestionably issues of some importance circa 1963, and they involved debates of which the public should no doubt have been aware. Nonetheless, they are essentially questions whose solutions call on technical expertise. It is not clear what is to be served or gained by a public preoccupied by such debate. It is not established that the performance of democracy is harmed by a public only dimly aware of these issues. And it is far from obvious (given the unlikelihood that the population might be invited to vote on future trajectories to the moon) how public participation is to be effected -- to the extent that it might influence the outcome of debate -- or even if such a thing is desireable.

Like the excellence of science itself, then, the basic tenets of the 'problem' of science and the media are assumed, they are not argued for. And they can only be so unproblematically assumed because they are consistent with a series of larger developments which lend the concern over popular science its cogency.

In particular, in its identification of the 'problem' with a neglect or deficiency on the part of the media, the concern over popular science is expressly articulated in terms of the movement toward 'social responsibility of the press', which by the 1950s was in the process of establishing its priorities as the dominant criteria for the evaluation of press performance. As described by Theodore Peterson:

> Social responsibility theory accepts the role of the press in servicing the political system, in enlightening the public, in safeguarding the liberties of the individual; but it represents the opinion that the press has been deficient in performing those tasks. It accepts the role of the press in servicing the economic system, but it would not have this task take precedence over such other functions as promoting the democratic process or enlightening the public. It accepts the role of the press in furnishing entertainment, but with the proviso that the entertainment be "good" entertainment. It accepts the need for the press as an institution to remain financially self-supporting, but if necessary it would exempt individual media from having to earn their way in the market place (Siebert et al. 1956, 74).

Indeed, media coverage of science would come to provide the lobby for social responsibility with a near-perfect example of an area in which the obligations of the fourth estate to the public good have been apparently usurped by commercial imperatives: the charge is laid that the press neglects science because it perceives no economic gain in vigorous coverage; when it does feature science, it all too often exploits it as a source of startling narratives, perverting reality for the purposes of "bad" entertainment.

In their assessments of the then-current state of science writing, therefore, these early texts both denounce and congratulate the press on its performance. That is, they welcome the advent of a "new" science writing appropriate to the age, a socially responsible science journalism (recall that most of these articles are themselves written by journalists who would remake press attention to science), but they disparage the naive and unsophisticated coverage that they find still all too common.

The task ahead is twofold: to increase the prominence of the former, and to erase the presence of the latter. They speak, in short, with the voice of the vanguard of a movement, rallying support for the cause.

Thus, as early as 1956, Kreighbaum is able to refer to an emergent community of "skilled, professional science writers" whose admirable work is not to be confused with that of "so-called 'humorous' feature writers on metropolitan papers or the scientifically illiterate small-town reporters (Kreighbaum 1956, 707)." Piel, similarly, allows that

> Science writing has shown great improvement in matter and form in this country in recent years. Most scientists will agree that it is distinguished by greater accuracy and by less flagrant affronts to good taste ... But we have far to go (Piel 1957, 793).

Ableson concurs with Kreighbaum that the elite news outlets have shown promising signs in their attention to science, but that outside the major urban centres the situation is less encouraging:

> It is true that the volume of news of science in daily newspapers is increasing. In Washington and New York, coverage is excellent: the writers are exceptionally competent, and sometimes adequate space is devoted to their stories. In other parts of the country science reporting ranges from fair to downright mediocre, or there is none at all. Some good, authoritative material is provided by the wire services, but local editors butcher it with a heavy hand. The material which is printed is usually gee-whiz, Buck Rogers distortions of the facts. Science writers for the wire services, wanting their copy to be used, tend to seek the more glamorous items. With distressing frequency scientist-operators are able to flim-flam the science writers with news stories which excite the imagination

> but have no solid technical basis. Local editors are especially susceptible to these worthless baubles, which they run in preference to less exciting items of solid merit (Ableson 1963, 177).

Given the dismissal of those "humorous" writers who make fun of science, the notion that "most scientists will agree" that good science writing is "tasteful," and Ableson's warning against "glamorous" journalism that seeks simply to "excite the imagination," there can be no doubt that what distinguishes socially responsible science writing from its deleterious cousin is that the former will meet with the approval of scientists, whereas the latter incenses them.

More intriguing, however, is <u>how</u> the new journalism is to distinguish itself from its more common counterpart -- or, rather, what is to be lauded in the new effort and denounced in the old. Lessing is most specific about this, although his sentiment is echoed in the writings of his contemporaries.

He argues that the 20th century has witnessed two distinct stages of science writing, with a third on the horizon. The first,

> extending into the 1930s, has been rightly called the "gee whiz" age. Every new discovery and invention was hailed as an unparalleled "wonder," "miracle," or revolution." ... The result was a maximum of sensationalism, a minimum of accuracy, and almost no real understanding of science (Lessing 1963, 23).

The second, and present stage, was occasioned by the technical progress spurred by World War II, but is marked by the need for greater effort. The third stage, as Lessing foresaw it, would repair the damage to democracy (the public would be able to make informed decisions) and ensure the reasoned management of social affairs (the public would no longer make erroneous or irrational decisions).

> Now, however, we need more than news ... The public is being left without guidance or leadership in making sensible decisions ... To be able to use science intelligently, the public must have a deeper understanding of the surrounding issues (Lessing 1963, 23).

He calls, accordingly, for an "interpretive" age of science coverage, if only because, without it, science might find itself vulnerable to the whims of an ill-educated population.

Clearly, then, what is being advocated is a science journalism directly opposed to that explicitly encouraged by Maynard D. Brown in 1937. Brown instructed that the reporter should exploit the technical capacities of science, and focus attention on its utilitarian contributions to everyday life. Piel, by comparison, laments that popular coverage of science is near-exclusively rendered in terms of its utilitarian aspects and that the inquiries of science are not reported simply on their own merits.

> If the public is to support the advance of science for motives other than utility, then people must be able to share not only the useful but the illuminating and the beautiful that comes out of the work of science (Piel 1957, 794).

The assertion is that the heretofore typical coverage, in giving undue emphasis to the dramatic products of science, pandered to the public taste for sensation at the expense of a sober appreciation of the realities of the research process, inflaming both expectation and apprehension. Such "gee whiz" reportage merely marvelled at the work of science, and in that regard not only made no effort to explain the processes of inquiry, but indeed contributed directly to their mystification: the audience that finds science wondrous is an audience that by definition does *not* understand how it works.

The new science journalism, by comparison, was to be responsible to both science and the public that it served -- which is to say, it was to be from the outset bound up in a project of public education, not one of public entertainment. In that sense, then, the emergence of an acknowledged problem with popular science worked explicitly to advance the neo-liberal notion of the political subject under democracy implied by the social responsibility tendency. Since the problem was taken to lie ultimately in the regrettable ignorance of the laity, the members of the laity themselves were to some degree implicated, and hence a civically-responsible science journalism would have to labour against inherent public lassitude.

> Under the social responsibility theory, man is viewed not so much as irrational as lethargic. He is capable of using his reason, but he is loath to do so. Consequently, he is easy prey for demagogues, advertising pitchmen, and others who would manipulate him for their selfish ends. Because of his mental sloth, man has fallen into a state of unthinking conformity, to which his inertia binds him ... Therefore, the more alert elements of the community must goad him into the exercise of his reason. Without such goading, man is not likely to be moved to seek the truth. The languor which keeps him from using his gift of reason extends to all public discussion. Man's aim is not to find truth, but to satisfy his immediate needs and desires (Siebert et al. 1956, 100).

Hence, Eugene Rabinowitch, editor of the Bulletin of the Atomic Scientists, was able to tell the President's Committee on Scientists and Engineers in 1957:

> Good science reporting is impossible as long as its purpose is assumed to be entertainment and not education. [These stories] cannot be only what people want to hear; they often must be what they ought to hear (quoted in Troan 1960, 1194).

The poignancy of the issue of popular science derived, therefore, from the notion that the effortless and transient satisfaction made available by the post-war media/consumer culture had robbed the citizenry of the patience to keep abreast of the most salient developments in science, or -- worse -- had erased the sense that it might be valuable to do so. The special claim of the entire area of study and comment was that an "improved" science journalism might well provide a solution to this deleterious apathy: a population sufficiently attentive to science, and adequately apprised of the rigour of its methods and the value of its investigations, would be if not more 'rational', than certainly more inclined to listen to 'reason'.

The most eloquent and revealing statement of this sentiment is Ashby's (1960) "Dons or Crooners?". Ashby, then Master of Clare College, Cambridge, argues for the popularization of science amongst working class, urban residents (who, he suggests, left to themselves, prefer light entertainment to hard edification, or crooners to dons). He does so in terms taken from contemporaneous notions of alienation, rootlessness, and the "mass society," presenting the case of Ron Blossom, the typical working class breadwinner, who

> has practically no roots in society ... he feels no continuity with people or place; no continuity with those who run the big industries in the city, or with the professors at the university, or with those who go to the Festival theater in Stratford (Ashby 1960, 1166).

Sir Eric rejects the notion that what he is describing is a class stratification created and imposed by the British social order. Instead, he insists that it amounts to a loss of identity occasioned by the (erroneous) working class conviction that one is not a part of one's own society: that one has been cast as a spectator, not an actor. What is required in order to correct this state is a demonstration of social cohesion, and this, Sir Eric argues, can only come through the popularization of science, since:

> The one force of cohesion which is truly supranational is our common faith in science -- not in invention, not in the wonders of applied science ... but in the way scientists think and work, and in the universality of scientific laws among people of different race and color and religion and political opinion ... This is the knowledge he needs in order to feel he is part of the civilization into which he has been born. Indeed, this knowledge is the most promising solvent for dissolving the stratification which separates Ron Blossom's world and yours, a stratification which even democracy has failed to dissolve (Ashby 1960, 1167).

However, just as the press was to be denounced for its attentions to science (with the exception of a small, but growing corps of specialized science writers), so the public was to be chided for its disinterest in science, with the exception of that constituency aware of the importance of science in social and intellectual life. Paradoxically, then, arguments founded on the notion that the laity was alienated from science and prey to pseudo- or anti-scientific delusions, often simultaneously took care to congratulate the public on its quickening interest in scientific affairs.

Thus Kreighbaum, in the manner that would become typical, asserts that "Not only is there the people's right to know about scientific advantages [because, as taxpayers, they support the endeavours of science], but there is a craving on the part of large sections of the public for this information (Kreighbaum 1956, 708)."

The justification for this contention was a New York University-University of Michigan Survey Research Center pilot study that had recently been completed for the NASW on a grant from the Rockefeller Foundation, in which 200 adults had been polled as to their science journalism reading habits and preferences. The findings showed a lively interest in science amongst a large proportion of the sample, and "a potential for growth of the science audience at all levels of readership."

More than three-quarters of those surveyed claimed to read science news. One-quarter read all the science items contained in their local papers. More than a third professed a desire for more science coverage.

Interestingly, however, the survey sample was skewed toward the upper end of the socio-economic spectrum in that more than a third of its members had attended a post-secondary institution -- much higher than the national average. Given that the study also found a positive correlation between level of education and level of interest in science coverage, this would account for the high proportion of those expressing such an interest. It is also possible that university-educated individuals might profess a greater interest in science news than they actually hold, simply because they 'know' science to be a subject meriting serious coverage -- in much the same way as Canadians, when surveyed, consistently voice their support for more domestic television programming, but equally consistently ignore such programming when it is offered in favour of the American product.

Nevertheless, the findings were taken to suggest first, that there was a basic constituency for science journalism, and second, that this readership tended to be university educated, upper income, and white collar. The task for science journalism therefore would be to capitalize on this base by providing suitable and adequate reportage, and to promote a similar interest amongst the less well-educated.

This survey evidence -- later corroborated by the findings of the full-scale study, published in 1958 -- provided the early science communication effort with virtually its only source of information about its audience other than the impressions of scientists or journalists. As a consequence, it was much cited, and its findings became accepted truisms in the writings on popular science, guiding the course of discussion.

In particular, the evidence was taken to indicate that editors and publishers had misjudged the popular interest in science, and therefore it was the press, more than the public, that was to blame for the incidence of scientific illiteracy. Especially given the wish for more science coverage on the part of one in three respondents -- and hence the at least partial recognition on the part of the public itself that press coverage of science was inadequate -- the implication was that the press had been responsible neither to the public good nor even to the will of its readership. And although there was no direct indication that a more vigorous science writing would result in circulation gains, there was the assurance that a sizeable body of readers for such reporting was already in existence.

Those respondents who expressed a preference for increased science coverage were asked which types of news they would be willing to curtail in order make the necessary space. Some mentioned society news, others sports, and still others would have made do without the comics. With hindsight, these suggestions seem odd, if not indeed arrogant: the comic and sports pages are amongst the best read of any newspaper's contents, and the society columns have a notoriously devoted following. To advocate pruning this content in order to make way for more science news -- as unlikely a possibility as it might be -- is to willfully recommend sacrificing the pleasure of others, at best for some notion of the greater good, at worst for a pleasure of one's own. Kreighbaum draws attention to these responses, however, in order to underscore the support for enhanced science coverage amongst certain segments of the public.

What does not capture attention is the assumption on which such a question is based: an assumption that is accepted without comment and that inserts itself into the sinew of the 'problem' of science and the media. It is the notion that an important constraint on the amount of press attention to science is that the newshole of any paper -- the space available to editorial content -- is fixed, and is always smaller than the amount of news available. Science news must therefore compete for space with a range of other news items, and its paucity is the result of editorial decisions inside the newsroom: not only at the daily, individual level of the copy editor, who must decide whether or not to find room on the page for a particular science story, but at the level of the executive editor, who must decide whether to establish science as a recognized beat, and assign a reporter full-time to its coverage.

Thus Troan argues that a major reason for the failure of the press to adequately communicate the activities of science to the widest possible readership is:

> the fierce competition for space in newspapers and magazines. After all, readers are not interested in science alone ... Thus, much science news fails to get into print. It is shucked aside in favor of other news items which are deemed to be more appealing to the readers (Troan 1960, 1193).

By insisting that the demand for science news on the part of the laity outstrips the amount made available by the press, writers on the problem of popular science close off the possibility that the current extent of science writing accurately reflects reader interest in the topic, or that science news receives only cursory play because it is inherently less popular than other forms of journalism. Instead, the onus is placed on editors to revise their judgements about the newsworthiness of science, and indeed much of the campaign for enhanced science communication would come to consist of the attempt to persuade editors that science reporting deserves a higher ranking in the hierarchy of journalistic concern. ("First of all, more editors must be convinced that their readers want more news about more aspects of science than they now receive (Troan 1960, 1194).")

As well, the survey results appeared to indicate that the desire for more science coverage was also a desire for precisely that type of coverage advocated by the champions of an improved science writing:

> While he did not ignore the more practical applications of science in his choice of reading, a typical individual who read about science extensively and regularly tended to prefer stories concerning more abstract subjects. His interest, for example, was high in items about molecular theory, archeology, and space travel when he was given a list of possible news stories and asked to tell those that would interest him (Kreighbaum 1956, 708).

Most significant, however, was that these ideal readers -- those who followed press coverage of science with regularity --

displayed none of the tendencies to irrationalism or distrust of science. Thus, Robert C. Davis, writing on the results of the completed 1958 study, is astonishingly detailed in his characterization of the ideal reader as:

> more attuned to the large world around him; his vista is more cosmopolitan than local ... His concern with the broad picture is reflected in his reasons for reading science: ... It helps him make sense of the world as well as to function in his personal life. He sees science as beneficial, and assesses its impact on society in terms of improving our way of life. Although he may be concerned with possible bad consequences of scientific discoveries, such as atomic warfare, he does not blame scientists for these consequences.
>
> Rather, scientists are viewed as diligent, educated, intelligent people whose hard work is motivated not by self-interest in the economic sense, but by the intrinsic interest in the endeavour called science. He sees the scientist as different from the average person, but dedicated to constructive ends ...
>
> He is less likely to be concerned with the possibility that science is shaking the traditional and moral foundations of society ... He is optimistic as to the range of problems that science can tackle; he feels the world to be not mysterious chaos, but to be knowable and orderly.
>
> In terms of his view of his social world he is also more inclined to see it as manageable and essentially benign.
>
> All in all, the science consumer confronts the world with a general desire to know and understand it. The world is, in a broad sense, not overwhelming or threatening, but an area in which to act and master, either by his own endeavours or by vicariously participating in the enterprise called science (Survey Research Center 1958, 224-225).

The implication, of course, was that as press coverage of science expanded, and as an interest in matters of science was cultivated amongst the wider population, similar attitudes and values might become more common. Indeed, several of these early writers are forthright in their admission that the goal of the science communication project should be the promotion of just such attitudes, and that schooling the laity in the actual details of scientific investigation could only be at best a means to this end, at worst a structural impossibility.

In fact, as early as 1958, Mel W. Thistle had argued that the barriers to communicating scientific information to a lay public were such that it was foolhardy to suppose that any technical detail whatsoever might be imparted via the popular media.

The first barrier, the hurdle of language and sophistication, Thistle suggested has to do not only with the requirement that specialized scientific languages be translated into colloquial English, but with the fact that the principles and concerns of contemporary science are alien to the laity's formal schooling in "classical" (i.e. 19th century) science, and that the public therefore lacks the conceptual apparatus to comprehend the content or import of the latest scientific developments.

The second, that of security (military, political, and otherwise), prevents the public communication of whole areas of scientific inquiry.

The third, printability, ensures that only those scientific developments deemed to be "newsworthy" receive press attention.

The final barrier has to do with the fact that not all that is printed in a newspaper is actually read, and not all that is read is actually understood or remembered.

The result, Thistle concludes, is that the goal of using the popular media to educate the citizenry in the technical contents of scientific research is thwarted from the outset. However, it may be that the most important thing to transmit is something of scientific attitudes," since, if nothing else, the laity might benefit from the example of scientific inquiry, and from the portrayal of scientists as role models:

> While scientists have managed to retain the sense of wonder and the intense curiosity of very young people, in other respects they have advanced to a maturity of outlook that might be valuable in other parts of our society ... In short, modern scientists make excellent citizens (Thistle 1958, 954).

Rostand, too, concurs that the practical benefits of popularization aside, the science communication effort should be geared at its most basic to imparting the joy and wonder of scientific investigation: if not to encourage members of the public to think like scientists, then to encourage them to like the way scientists think:

> The true and specific function of popularization ... is purely and simply to introduce the greatest number of people to the sovereign dignity of knowledge; to ensure that the great mass of people should receive something of that which is the glory of the human mind and not be kept apart from the momentous adventure of our kind; to bring man closer to man by striving to reduce the terrible if invisible gulf of ignorance; to struggle against mental starvation and the resulting under-development by providing every individual with a minimum ration of spiritual calories (Rostand 1960, 1455).

From its very beginnings, therefore, the science communication effort was bound up in a project that extended far beyond the urge to 'educate' the laity in science -- i.e. to impart a body of factual knowledge. It was also a part of a larger movement that claimed to detect a disquieting disenchantment with science on the part of non-scientists, and that in the name of the greater good sought to correct this disenchantment through the systematic and prominent portrayal of science as an inherently meritorious and beneficial endeavour. The conviction on the part of the champions of improved science coverage that science is indeed a heroic enterprise, and that to view it otherwise is an error of enormous proportions, does not negate the ideological import of the project being advanced.

As concern over the state of popular science makes it debut, therefore, the 'problem' is considered to lie in a widespread public ignorance of science that is exacerbated by a flawed and opportunistic coverage on the part of the press. These early texts are explicit in their agitations for a new type of science journalism -- one that will concentrate its attention on processes of investigation (and therefore on academic inquiry); that will be motivated by the need to educate the laity in the contents and methods of science; that will be answerable to the scientific community for the accuracy of its coverage; and although perhaps critical of science in specific instances, will ultimately have as its aim the promotion of scientific interests and the creation of a public appreciative of science, accepting of its findings, and supportive of its efforts.

Toward such ends, in 1958 the NASW called for a nine-point program to enhance the quality of science coverage in the U.S., advocating greater contact and cooperation between the journalistic and scientific camps. The agenda included calls for further training to produce more full-time science writers for large news agencies, and more local reporters capable of handling science news on a part-time basis; the development of science writing curricula in graduate and undergraduate schools of journalism "and the inclusion of more academic science training in the programs of all journalism students, whether or not they indicate any desire to specialize in some phase of science reporting (Troan 1960, 1195)."; sabbatical leave for senior journalists who wished to improve their grounding in the sciences; the training of public information officers for scientific and medical organizations; the development of science exposition techniques tailored to television; the organization of seminars to inform journalistic personnel of the importance of covering science, and of current developments; and continuing research on the science news audience, so as to ascertain the success of the science popularization project, and to devise means of improving it.

As ambitious and detailed as such proposals were, they nonetheless left open how, in practice, the goals of the project were to be accomplished. Given the caveats placed on the effort with regard to the priority of education, the sins of sensationalism, and the inherent lassitude of the less educated, the difficulty remained as to how to present scientific information to the public in a manner true to its actual workings, but in a form that would capture the popular imagination.

> We still do not know precisely how effective any single method [of popularization] is in practice, nor do we know enough about the comparative effectiveness of different methods. We do not know what problems most urgently require the use of new methods. In other words, popular science is itself an area that demands further research (Pfeiffer 1957, 957).

As attention to the issue expanded in the 1960s, 1970s, and 1980s, therefore, it was mobilized in terms consistent with the basic project called for in these early texts, but it focused more specifically on how the goals of the project were to be met. That is, as the issue was taken up by media researchers and teachers of journalism, the 'problem' of science and the media came to be one of how the professional demands of science and journalism could be reconciled so as to produce a science writing acceptable to both and beneficial to the public at large.

Chapter Four

The Entrenchment of the Dominant Concern, 1967-1987

4.1 Reiteration

The first book devoted explicitly to media coverage of science -- Hillier Kreighbaum's Science and the Mass Media -- saw publication in 1967.[1] Since that time, at least a dozen other such works have come into print. All of these have been slim volumes, commonly less than 200 pages, even those which include a number of articles and essays. The sole exception is Scientists and Journalists (1986), an anthology which boasts three editors and 33 other contributors.

This is not, as it might seem, a trivial observation. Rather, it points to an important feature of learned commentary on science and the media. Books on the subject are brief because each in its turn repeats an argument that is in essence straightforward, widely accepted, and therefore virtually free from challenge. In short, it is difficult to write a lengthy book on popular science because there is not a great deal to say on the subject that has not been said previously.

While other areas in communication or media studies have developed via processes of internal debate -- in which subsequent work contests or comments on that which preceded it -- academic discourse on science popularization has been marked by an

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1 The 1958 University of Michigan Survey Research Center volume was a report on survey research findings.

enduring and widespread consensus. It describes an argument of *reiteration*, in which individual contributions work to further entrench and buttress the positions first fully articulated in the late 1950s.

Near uniformly, then, popular representation of science has been addressed first and foremost as a problem of some social consequence, and academic attention has been characteristically oriented toward its management and mollification, if not indeed its eventual solution. In that regard, the notion that lay acquaintance with science is insufficient, to the detriment of both science and society at large, has been preserved as a guiding principle. It has been the need to "better" public understanding of science that has motivated and informed the attention to media coverage.

As a result, texts on science and the media typically take pains to establish from the outset the value of science and the corresponding need for sustained and responsible media treatment, since it is on this basis that the project of science journalism is to be justified. Equally typically, these assertions represent mere elaborations of those contained originally in the first texts to identify a 'problem' of popular science. Consider the following opening passages, the first from Kreighbaum's 1967 volume, the second from Nelkin's work published 20 years later.

> Many of the more important and complicated problems facing United States citizens today are heavily intertwined with science and technology. They cannot be approached soundly without an appreciation of their scientific implications ... To illustrate, think of the

> background needed to discuss intelligently such topics as population explosion and birth control, uses and abuses of automation, pollution of the natural environment, water conservation and irrigation, uses of insecticides and pesticides, testing of nuclear weapons, peacetime uses of atomic power, and the relationship of cigarette smoking and cancer ... Thus, if the public is to make wise and intelligent choices, it needs to know its science now and the most accessible way for it to get this information is from printed media, radio, television, and film (Kreighbaum 1967, 14-5).

> Public understanding of science and technology is critical in a society increasingly affected by their impacts and by policy decisions determined by technical expertise. At the community level, people are continually confronted with choices that require some understanding of scientific evidence: whether to allow the construction of a nuclear plant or a toxic waste disposal dump, whether to tolerate a child with AIDS in their schools. Similar choices must be made at the personal level: whether to use the pill, whether to eat high-fiber cereals, whether to avoid smoked meat.
>
> The press should provide the information and the understanding that is necessary if people are to think critically about decisions affecting their lives ... Good reporting can be expected to enhance the public's ability to evaluate science policy issues and the individual's ability to make rational personal choices; poor reporting is cause for alarm (Nelkin 1987, 2-3).

This, then, is the essential justification for a renewed project of public science communication, dressed up in current examples, but unchanged from the 1950s. Linked to it in the literature are the familiar related arguments: science should be the subject of sober and prominent press attention because it is financed by tax revenue; so as to guarantee its financial support; in order to combat a growing popular disenchantment with it, and a concurrent growth in interest in the paranormal; because there already exists a sizeable demand for science news that is not being satisfied by the media.[2] The bulwark of the agitation for an improved science journalism, however, has been the argument that the performance of democracy demands a scientifically literate lay population.

It is an argument that has been so widely accepted that a search of the literature reveals only a single instance in which it is directly contested, and one other in which reservations are raised. Alone amongst those who have addressed the topic, Leon E. Trachtman describes the efforts to enhance science communication as "missionary activity," and questions

> the glib assumption that a scientifically informed public is a prerequisite for effective functioning of a democratic society in an age dominated by science and technology and the corollary of this assumption that a major policy commitment should be made to further public understanding of science (Trachtman 1981, 14).

Trachtman's own survey of the literature reveals that this central assumption is based on three major premises. First, that

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[2] Typically, the assertion that there is a widespread demand for science news is made without a source being cited to support the contention. It is, rather, taken for granted as an obvious and widely recognized truth. Thus Jean Mayer states baldly that "The appetite for news about science in our public is considerable (Mayer 1981, 1)," and moves on. Similarly, the introduction to Scientists and Journalists opens with the observation that "many people with little formal training in science have a compelling interest in all kinds of science (Friedman et al. 1986, xi-xii)." Cristine Russell presumes the benefit of hindsight when she claims that "public interest in the subject has never been stronger (Russell 1986, 94)."

The sole source for these contentions would appear to be the University of Michigan survey data from 1958, and an update contained in the U.S. National Science Board's Science Indicators 1980, in which 36 percent of respondents expressed an interest in new scientific discoveries, while only 10 percent felt very well informed on matters of science and technology.

knowledge is simply good in and of itself. Second, that people will be able to make more intelligent, personal consumer choices if they are more knowledgeable about science and technology. And third, that the very structure of a democratic society depends upon the existence of an enlightened citizenry. The political and social behaviour of this body in voting, in influencing elected and appointed officials, and in engaging in political and social activism, will better serve society if it is informed by a solid scientific understanding (Trachtman 1981, 10).

With the first, Trachtman has no quarrel, although he maintains that it alone can hardly justify the considerable expense involved in mounting a campaign of forced public education.

As for the second, he argues there is little evidence to suggest that individuals' habits of consumption are much influenced by their levels of technical sophistication; and that, in any case, it is unlikely that consumption is an activity in which there are "right" or "best" choices that can be determined on scientific grounds. Even in those areas where scientific expertise conceivably might be of relevance -- choices as to medication, for example, or diet (the types of examples offered by Nelkin) -- the available "scientific" evidence is ambiguous, unclear, and continually subject to revision.

The third rationale -- that a scientifically literate public is essential to a true democracy -- Trachtman finds equally specious, first on the grounds that scientific work is often of little relevance to the ethical, moral or political problems posed by social organizations, and there is therefore something amiss with any insistence that a scientific understanding must underpin attempts to address such problems. Thus, he points out that

> people who are consistently willing to make economic sacrifices in the interests of environmental preservation -- or their opposite numbers -- are unlikely to have their convictions and political activities modified by learning more about the life cycle of the Chesapeake Bay oyster (Trachtman 1981, 12).

Secondly, he notes that if crucial social questions actually did depend on the complement of scientific and technical information making its way into the public realm, the citizenry's abilities to come to decisions on these matters would be seriously hampered, if only because on any given issue there is a wealth of contradictory, tentative, qualified information and supposition. The accepted notion that the public should be equipped with a certain scientific understanding which will then guide individual citizens in making sound, rational and informed choices -- i.e. correct choices -- is flawed, Trachtman contends, because in areas of political controversy (nuclear power, population control, pesticide use) the scientific community is itself divided. To rely on the pronouncements of science in such cases would paralyze, not aid, decision-making.

In response, the champions of an enhanced science writing might answer that Trachtman proposes a surrender to ignorance; or that he has insufficiently explored how it is that a sound acquaintance with science might beneficially influence political choice. However, the proponents of greater public understanding of science themselves neglect to pursue the question of how widespread scientific literacy would in practice alter the operations of democracy for the better.[3] It is assumed, not established, that lay knowledge of science is less than sufficient. No examples are given of how this inadequate understanding has harmed the performance of democratic governance. No mention is made of what would constitute "adequate" public understanding.[4] The suggestion is simply that a laity enthusiastic about science is preferable to one that is wary or indifferent.

Nevertheless, even if Trachtman were correct in his contentions, his opponents might still fall back on the assertion that a public alienated from science might lose the resolve to support

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[3] Indeed, on those few occasions when the notion of democratic involvement in science is considered, it is rebuffed as an unworkable perversion of the scientific process. Farago, for instance, holds that: "The lack of public concern [for science] is genuine, and may it long remain so, for if a camel is a horse designed by a committee, a new chemistry developed by public request would be a horrendous monster indeed (Farago 1976, 49)." It would appear, then, that the democracy envisioned by the champions of greater scientific literacy would not extend to lay supervision of science.

[4] Take, for example, the issue of nuclear power -- a common example cited by the proponents of an invigorated science communication effort. If the public is to come to wise choices about whether and where nuclear reactors are to be built, it is said that individuals must have a sound understanding of the relevant science. And yet in what would such an understanding consist? Would it be necessary to master the mathematics of controlled fission? Or merely possess a conçeptual grasp of the theoretical terms of subatomic physics? In what sense might either sort of knowledge have a bearing on whether it is possible -- within the practicalities of engineering -- to build safe reactors or to safely transport and dispose of nuclear waste?

its inquiries. A campaign of public education would still be justified, therefore, as a means of instilling in the laity the requisite respect for the scientific venture.

However, writing in the same issue of Science, Technology, and Human Values which featured Trachtman's reservations, Allan Mazur notes that the widely held assumption that the American public harbours a growing distrust of science is not confirmed by a series of 10 national opinion studies conducted from 1966 to 1980.

He reviews the results of this survey research, which attempted to determine public confidence in a number of American institutions, including medicine, the press, labour, television, religion, major U.S. corporations, education and the military, as well as science. He finds that confidence in these institutions did indeed fluctuate over time, but did so uniformly. That is, confidence in all U.S. institutions appeared to drop sharply from 1966 to 1971, rose to a minor peak in 1974, and then remained relatively stable from 1975 to 1980. Indeed, science fared better in public esteem than most institutions, enjoying more confidence throughout the 1970s than any save medicine.

Mazur concludes, first, that these data challenge the frequent assertion of a rising public distrust of science; and, second, that they question the need to raise public confidence in science.[5]

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[5] The literature on science and the media does contain some evidence to support the contention that the public esteem of science might not be at its best, and that enhanced press

press in its coverage of science, and with formulating strategies and tactics whereby science communication might be improved.

The remainder of this chapter will be devoted to a review of the work conducted in the dominant tradition over the past two decades. It is an analysis that is informed foremost by work on the social place of science made available by those 'critical' writers discussed in Chapter Two. Specifically, the attempt will be to demonstrate that the dominant concern serves to advance precisely the type of understanding of science exposed and criticised by individuals such as Feyerabend and Habermas. The critical theorists argue that the portrayal of science as heroic, apolitical, and inherently rational is itself a political artifact -- the creation of a social order which has found in science a vehicle for the legitimation of a prevailing order. The chapter hopes to show that the writings on science and the media in the dominant tradition have been a major avenue by which this politically charged portrayal has been defended. Further, the influence of the dominant concern on the actual performance of the press has worked to ensure that this positivist view of science is promulgated for popular consumption.

4.2 Transmission

Notwithstanding that science and scientists feature regularly in prime-time dramas, in popular cinema, and in advertising of all descriptions -- and despite the fact that commentators refer frequently to the problem of science and the _media_ -- writings on popular science have in fact been preoccupied with _press_ coverage exclusively. The sole prominent exception has been the content analysis of 1600 American network television programs broadcast between 1969 and 1979, conducted by a University of Pennsylvania group under the direction of George Gerbner. As part of its overall inquiry into the conceptions of social reality fostered by television, the group examined the portrayal of science and scientists, finding, first, that the subject featured proportionately more often in drama than in news; second, that it was commonly associated with moments of crisis or danger; third, that scientists were most often portrayed as eccentric or forbidding characters; and finally, that the overall depiction of science was as an arcane enterprise removed from popular experience (Gerbner _et al_. 1981).

Nevertheless, the immediate goal of the University of Pennsylvania group was not to examine the portrayal of science, specifically, in prime-time drama. Rather, science was merely one of a number of categories employed in the content analysis. By contrast, those who have made the representation of science an area of special interest or expertise have limited their attentions primarily to the press, and secondarily to documentary accounts in broadcasting.

The reason for this is two-fold. First, dramatic or fictional representation of science is not subordinate to the need for public education; its goal is not to impart a substantive knowledge of science or its findings. The requirements to which it is answerable may be varied (from the need for prime-time commercial drama to appeal to the largest possible audience, to the need for all fiction to observe certain conventions of story telling) but the responsibility to be at all times faithful to the actual conduct of science does not feature prominently.

Secondly, therefore, fictional representation of science is neither guided nor constrained by canons of objective representation. As a result, it cannot be easily faulted for inadequate or inaccurate attention to science, nor can it be readily pressed into the service of a campaign of lay edification. Hence, it does not figure largely in the 'problem' of science and the media.

Insofar as the dominant concern therefore has been the 'adequacy' of documentary coverage -- how accurately and sufficiently the press represents the doings and features of science -- the problem has been constituted forthrightly within the context of an understanding of the press (and an approach to media studies) that sees journalism, ideally, as the neutral and veridical announcement of events, activities, and utterances.

Specifically, commentary has been organized by an understanding of the science communication process that emphasizes above all the flow of information from the scientist-source, through mediating agencies and individuals, to an eventual audience -- and the abiding concern has been the quality and quantity of this information. Like the basic assumptions that public acquaintance with science is insufficient and that greater scientific awareness would improve the performance of democracy, the features and validity of this model are nowhere explored. Nonetheless, it is clear that it is a relatively simple and generalized version of the types of models of the communicative act that were current in the late 1950s, when formal attention to press coverage of science made its debut, and the terms of the 'problem' were first articulated .[7]

It is essentially a linear model of mass communication (<u>pace</u> Claude Shannon and Earl Weaver), in which messages are transmitted from an origin, through certain channels, to an ultimate destination, and in which external factors ("noise") may intervene to distort or limit the information content transmitted. This basic conception is further indebted to "gatekeeper" studies of news flow into the public domain (<u>pace</u> Warren Breed), with the result that the intervening "noise" is commonly conceived in terms of the needs and constraints of media organizations, which work to influence and alter the messages that eventually reach readerships and audiences.

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7 These are described by Melvin L. DeFleur in Elementary Characteristics of the Communicative Act, Chapter V of his <u>Theories of Mass Communication</u> (New York: David McKay, 1960).

Importantly, there is no consideration of "feedback" in this scheme, despite the fact that most kindred models of mass communication make some allowance for feedback between audience members and message sources. Although the capacity for feedback may be more limited in instances of mass communication than in interpersonal settings, even commercial television networks clearly feel and respond to the influence of viewer preference. The understanding of science promulgated by the champions of an enhanced science journalism, however, is such that (beyond the notion that a public ignorant of science might revoke its support for such expensive inquiry) there is no suggestion that the reception of information by the public about scientific activity might -- or should -- influence the conduct of science itself. Nor, given the insistence that audience demand for science news outstrips the quantity made available by the media, is there any suggestion in this case that public preference alone might exert an influence on media performance.

Although this fundamental understanding underlies all the work conducted in the traditional vein, it finds its most explicit statement in the four chapters which comprise the first section of Friedman _et al_.'s (1986) _Scientists and Journalists_. Under the overall heading "Understanding the Actors," four of the most prominent contributors to the literature divide up the science communication process into its constituent elements, emphasizing the uni-directional flow of information: Sharon Dunwoody begins with "The Scientist as Source." Sharon Friedman follows with "The Journalist's World." Carol Rogers considers "The Practitioner in the Middle," (referring, not to practitioners of science, but to "the science information person" -- the public education officer employed by universities, scientific organizations, research hospitals, and so on, who acts as a liason between the scientist and the journalist). Jon D. Miller deals with the endpoint in the process in "Reaching the Attentive and Interested Publics for Science."

At its most basic, then, the problem of science and the media has been shaped by a heuristic which sees science as an avenue of access to assured findings, and scientists -- in the dissemination of these findings -- as the initial source; the members of the laity are understood purely as recipients of this information; journalists and public education personnel are viewed as intermediaries, through which scientific findings filter. The task of the science communication effort -- the fundamental problem for those who have made popular science their concern -- is the transmission of as much scientific information as is necessary or relevant, in as pristine yet understandable a form as is possible.

There are two preeminent consequences of such a formulation of the problem. First, it drives inquiry toward the examination of the operation and interaction of the various elements in the process of science communication (as they have been specified by the basic model). That is, in order to overcome the various obstacles which intervene to prevent or distort the public communication of science it is first necessary to identify what these obstacles are, from whence they arise, and only on that basis devise strategies whereby they might be surmounted.

Second, from the very outset the scientist-source is established as hierarchically dominant over all other actors. The scientist is not only the origin in a linear process, but often the author of the findings being disseminated. Since the goal is undistorted communication, success must be measured against how well the final product matches the intentions of the scientist-source. Although the limitations of the audience and the organizational constraints of the media must be taken into account (so that "successful" popularization is rarely a matter of reproducing the content of scientific texts or mimicking the exposition of scientists), it is the scientific community that is constructed as the ultimate arbiter of the adequacy of popular science in general and specific. That is, the limitations of lay readers and the operations of the press are taken as factors which influence the science coverage made available, but they are not themselves the primary criteria according to which science news is measured as to its quality.

Indeed, the first -- the sociological investigation of the interactions of the various groups involved in science communication -- is most often conducted in light of the second -- the hierarchical dominance of the scientific camp.

4.3 Accuracy

Given that attention to popular science has been marshalled largely as a lobby for its improvement, the deficiencies of the press in publicizing science recur throughout the literature as a consistent theme, and the corpus is rife with anecdotes illustrating how the fourth estate has ignored, misunderstood, or otherwise misrepresented scientific work.

Occasionally these anecdotes, whatever their rhetorical utility, are apocryphal, if not indeed flatly spurious. Jon Franklin, a science writer for the Baltimore Evening Sun, illustrates his contributions to the volumes Communicating University Research and Scientists and Journalists with the same tale: he recounts that "back in the 1950s (Franklin 1981, 100)," or "in the late 1960s (Franklin 1986, 131)," (the dates, equally vague, vary from one rendition to the other) the first pulsar was discovered using Cornell University's radio telescope at Arecibo, Puerto Rico, the world's largest. It is now accepted that pulsars are rapidly spinning magnetized neutron stars -- the dense, collapsed remains of what were once gaseous giants -- but at the time, all that was known was that something in the galaxy was emitting seemingly regular bursts of electromagnetic radiation.

The astronomers, Franklin continues, judged that their discovery was of sufficient significance that the public at large should be informed. Initially unsure as to how to go about publicizing their find, they elected to contact the largest circulation newspaper in the country. The paper duly dispatched a correspondent who toured the facility and interviewed the scientists involved. Intrigued that the astronomers were at a loss to account for the regularity of the radio signals they had detected, the reporter asked whether they might not be artificial in origin -- the product of an extraterrestrial intelligence.

> The astronomers laughed, sort of pleased that the fellow was beginning to grasp the basic vagueness of science. Sure, I suppose, sure. It could be anything ... And so it was that the most important astronomical discovery of the decade was announced on the front page of The National Enquirer. The banner headline, in 72-point type, said something like: ALIENS CONTACT EARTH (Franklin 1986, 132-133).

Franklin tells (and retells) the story ostensibly to illustrate the pitfalls of science popularization. The scientists are chided for their naiveté and their trusting manner; The National Enquirer ("a scandal sheet that focuses on cancer cures and the tribulations of the widow Onassis (Franklin 1981, 101),") is derided for its flagrant misrepresentation of an important scientific discovery; and its vast readership is deplored for its gullibility and taste for sensation. Nonetheless, the anecdote itself is plainly a fiction.

This is not simply because certain of its elements fail to ring true.[8] Rather, the story is a fabrication because the first

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[8] Why would the radio astronomers believe their discovery merited the most immediate and widespread publicity when they themselves were unsure what it was they had discovered? Why were they so blissfully unaware of the character of the National

pulsar was not discovered using the Arecibo telescope.

It was in fact detected in late 1967 by graduate student Jocelyn Bell, working under the direction of Anthony Hewish, and using the Cavendish Laboratory's Mullard array at the University of Cambridge.

Neither would the supposed Enquirer treatment have been altogether a misrepresentation. The first pulsar is now designated as CP 1919 (Cambridge pulsar at 19 hr 19 min right ascension), but the signals that were detected in 1967 were so regular -- flashing once every 1.33730 seconds -- and therefore so anomalous that Bell and Hewish named the source LGM-1, LGM being an abbreviation for Little Green Men. Carl Sagan, Cornell University astronomer, recounts that when he heard of the discovery he was moved to speculate that the source might be an interstellar navigation beacon of a spacefaring extraterrestrial civilization.[9] Indeed, the announcement of the find was delayed until February 1968, in part because Hewish and his colleagues wondered whether the signals might not be artificial in origin.

Franklin is a Pulitzer Prize-winning journalist, and in committing such an anecdote to print without first verifying its contents he is guilty of a serious breach of routine journalistic conduct. Ironically, he demonstrates by example precisely the

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Enquirer? Do Cornell scientists not frequent supermarkets? And why, in any case, would they announce their find first in the popular press, bypassing their own research community?

[9] Carl Sagan, The Cosmic Connection: An Extraterrestrial Perspective (London: Hodder and Stoughton, 1973) p. 260.

complaints raised by the critics of popular science coverage: that the press, in its zeal to tell an engaging story, takes insufficient care to ensure the veracity of its accounts.

Nevertheless, Franklin's anecdote serves to point up the terms in which the performance of the press has been typically assessed. The primary concern has been the accuracy of science coverage. Hence an important element in the literature on science and the media has been the study which attempts to assess the correspondence of reporting to the work being described.

Broadly, these studies have assumed two distinct forms: First, there are those which seek to quantify reporting accuracy by placing a numerical value on journalistic success in disseminating scientific information. Second, there have been a number of case studies examining ongoing coverage of established scientific issues (stories followed by a number of different news outlets).

Most of the former have been published in Journalism Quarterly, although the error rates thus revealed are quoted widely elsewhere in the literature.

Tichenor et al., for example, assembled a pool of lay respondents to read a total of 73 popular science articles, and asked each respondent to recall the contents of the reports he or she had read. The respondents' remarks were then presented to the scientist-sources quoted in the articles for an assessment of their accuracy. The scientists' judgements varied widely, although on average 64.52 percent of the respondents' recounts were judged to be accurate. The study also found that while the scientists criticized science news in general (only 58.9 percent rating science journalism as "generally accurate"), 94.5 percent judged the sample articles in which they, themselves, were quoted as accurate (Tichenor et al. 1970).

James W. Tankard Jr. and Michael Ryan eliminated the intervening variable of readership comprehension and had a pool of scientists judge for themselves the accuracy of press coverage of their work. Clippings of science articles were mailed to a total of 242 researchers who had served as sources for these reports, along with a four-page questionnaire in which respondents were asked to check for inaccuracies. Toward that end, the scientists could select from 42 different types of errors provided by the authors of the study. These ranged from errors in content to spelling mistakes, and included such categories as misleading headlines, misquotations, omission of relevant information, science reported in a humorous vein, and so on. In the second part of the study, the authors attempted to measure scientists' attitudes to science writing in general.

The results showed a markedly higher incidence of error in science stories (a mean of 6.22 per article) than had been detected in previous studies of "straight" news (which had been found to contain on average one error per story). Only 8.8 percent of the science stories were judged to be error-free, as opposed to about 50 percent of "straight" news accounts.

In general, the scientists reported considerable dissatisfaction with the accuracy of science stories, 82.4 percent of respondents agreeing that headlines were misleading, and 76.3 percent agreeing that information crucial to the understanding of research results is often omitted from news stories (Tankard and Ryan 1974).

These figures are in accord with the results of a survey of some 80 Canadian scientists conducted in the mid-1970s for the Ministry of State, Science and Technology, in which approximately 75 percent of scientists polled found the media's coverage inadequate in both quantity and quality (Dubas 1976, 38).

While these studies concentrated on the quality of science coverage, Clyde Z. Nunn addressed its quantity, reporting on the results of a 1977 U.S. survey which attempted to measure reader interest in various news genres. The survey revealed that while 24 percent of all editorial items were rated as "very interesting," respondents expressed significantly higher interest in items dealing with science and invention. Of these, 32 per cent were rated as "very interesting," and a further 34 percent were judged to be "somewhat interesting."

At the same time, however, the survey showed that less than five percent of all editorial content was devoted to science-related material. Nunn concludes that editors have consistently underestimated public interest in scientific matters, and calls for increased coverage of science by the press.[10]

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[10] One might point out that such a recommendation does not necessarily follow from the data. The crossword puzzle, for example, is consistently amongst the most popular of a news-

Complementing these quantitative analyses have been the more general case studies of press performance, no less concerned with the accuracy of journalism in its science coverage. R. Gordon Sheperd's much-quoted examination of reporting on the marijuana issue of the 1970s pursues two major lines of inquiry. First, how does press portrayal of marijuana compare with the content of scientific findings on the subject? That is, what studies receive press attention? Are these the most reputable as gauged by the scientific community (the value of a study being determined by its subsequent quotation)? Second, what is the scientific status of the individuals quoted by the press as sources and therefore presented to the public as authorities? To what extent do their views coincide with predominant and prestigious opinion as revealed by a survey of the scientific literature?

His major finding is that, on the whole, "the press has done a respectable job in reporting the marijuana issue (Sheperd 1979, 25)," being reasonably faithful in reproducing the findings and opinions of "reputable" scientists -- although he omits specifying what these findings and opinions are. He does demonstrate, however, that while the authorities repeatedly quoted by the press were well-established scientists, the majority had done little or no scientific work on marijuana themselves, and tended rather to be administrators of research departments. This is presented as a potential deficiency in the science communication

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paper's regular features, and is sorely missed on those occasions when it is unavailable. This does not mean, however, that newspapers should print more than one a day.

process -- the implication being that, properly, it should be the researchers themselves who should comment on the results of their work -- although Sheperd's study does not extend to an investigation of why senior administrators featured in the press more commonly than their research colleagues.

Weigel and Pappas examined the 1975 press coverage of sociologist James S. Coleman's assessment of busing as a tool of racial desegregation in the U.S. Coleman, a proponent of desegregation, claimed to have found that court-ordered busing was in fact harmful to the cause it was intended to further, since it encouraged what became known as "white flight": inner city white families, in order to avoid forced movement of their children to new schools, were either fleeing to (predominantly white) suburbs or placing their children in private schools, thus in effect contributing to the racial segregation of American society.

The authors point out that there were a number of objections to these findings and to their seeming policy implications. First, other social scientists insisted that the findings were not, as Coleman suggested, generalizeable; second, that there was no forced busing in the districts Coleman examined, and that therefore busing could not be the cause of white migration; and third, that even if his data were correct, what would be called for would be wider application of desegregation orders, not their abandonment, so that whites would have nowhere to flee.

The study consisted of a content analysis of newspapers in 15 American cities, along with three newspapers and three newsmagazines prominent on the national scene. The major finding was that while Coleman's work received wide and prominent exposure in the press, stories featuring methodological and other objections to the work appeared only much later, were far less frequent, and largely noted that there was disagreement within the community of social scientists without actually detailing the nature or cause of the objections. In the view of Weigel and Pappas, this amounted to a distortion of sociological research on the part of the press.

In the Freimuth et al. study of media coverage of cancer, once again newspaper reports are analyzed in order to determine how closely they correspond to the actual nature, incidence and body sites of the disease. That is, a content analysis of press reports in which cancer featured prominently was compared to data supplied by the National Cancer Insitute (NCI), and the accuracy of press coverage was determined by its correspondence to or deviation from this data. The NCI itself financed the study, and one of its members is listed as co-author.

The paper enumerates a number of discrepancies between overall press coverage and the NCI data: statistics on the incidence of cancer in general were lacking in the newspapers examined; colon-rectum cancer was under-reported relative to its actual incidence; news coverage of cancer tended to emphasize dying rather than coping; approximately half of newspaper stories mentioning the causes or risks of cancer carried headlines that were coded as "fear arousing." The press is directly faulted in that it is suggested that many cancer victims could be saved if only journalists would publicize the availability of the procto-sigmoidoscopy, a means of early detection for colon-rectum cancer.

These three studies may be taken as representative. Each is an attempt to pronounce on the accuracy of the press. Each renders its judgement on the basis of a view of what press coverage <u>should</u> contain. Importantly, each selects as its object of analysis an issue of manifestly political dimension -- consumption of marijuana (and presumably the legislative posture to assume toward it); enforcement of desegregation (and the appropriate means to do so); the presence of cancer (and the correct attitude to adopt toward it and its treatment) -- and each presumes to rule on press representation by appealing solely to the testimony of the scientific community or its agencies.

In that regard, the prominence of <u>accuracy</u> as a concern within the problem of science and the media assumes a further significance. It is difficult to contest that press reports on scientific work should be ultimately answerable to the scientist-authors for the accuracy with which their work has been represented, or to the peer group which evaluates the worth of this research. It makes little sense to argue that the journalist might "understand" the scientist's findings better than the scientist himself or herself, or that the journalist's assessment of the work's scientific import is somehow superior to that of the scientific community. Hence the journalist's success in capturing and communicating the contents of the research or theory in question must be measured against scientists' own understanding of its nature and import.

However, on the basis that the purely technical content of science journalism should be "accurate" (in the eyes of the scientific community), the further claim is made that science should be the rightfully dominant authority over the adequacy of press coverage of any issue to which science contributes. There is a slide from the premise that journalism should be required to get the scientific details right, to the assertion that these details themselves dictate the form and tone coverage should adopt.

This is perhaps most pronounced in the Freimuth et al. study, in which the inaccurate coverage of the press is implicitly blamed for public "misapprehension" of cancer, characterized presumably by inordinate fear and pessimism. That is, Freimuth et al. assume not only that the NCI findings speak the 'reality' of cancer, but that there is a correct attitude toward the disease which derives from these data, and that in its misrepresentation of the available figures the press also promulgates a flawed and deleterious public sentiment.

On the basis of such findings, it has been established to the satisfaction of the majority that there are distortions in the communication process which work to inhibit the faithful or adequate dissemination of scientific work. The quantitative analyses give an authoritative measure of consistent deficiencies in popular science. The case studies lend detail to the more precise numerical findings. Almost all scientist-commentators are able to recall a colourful anecdote in which the press garbled or over-played a science story, thus complementing the larger case studies with the universal readiness of individual examples.

But these studies and their findings do more than merely confirm the dissatisfaction of the scientific community with popular representation of science. They work, in addition, to further entrench the fundamental terms in which the dominant concern conceives of the problem of science and the media, and in doing so they serve to organize subsequent inquiry in light of this understanding. Attention is therefore directed toward the identification of those factors which intervene to thwart or inhibit the science communication process.

Importantly, however, in the very formulation of the problem these intervening factors are taken to be extra-scientific in their origin -- they arise subsequent to the actual production of scientific knowledge, and impose themselves on the contents of this knowledge to garble its public communication. As a result, the dominant understanding perceives the inadequacies of popular science near-exclusively in terms of the corrupting tendencies of the press.

4.4 Science versus the Press: The Structural Deficiencies of Translation and Sensation

Although the dominant position accepts that there are consistent, systematic distortions in press coverage of science, the notion of "bias" does not play a large part in commentary on science and the media -- a feature that is in itself revealing. In other contexts, when the press is accused of bias in its accounts, the charge carries with it the implication that the inaccuracies work to the benefit of select parties. In such instances, "bias" may be traced to the witting or unwitting intervention of political motive on the part of reporters, editors, or publishers.

In the case of science reporting, however, there is no suggestion that any interest is served by the distortions characteristic of popular science (other than, perhaps obliquely, the press' own interest in cost-efficient editorial operations or circulation gains). Rather, the deficiencies of the fourth estate in this case are seen as issuing from the structural difficulties involved in reconciling the demands of science with the needs of the press.

Sharon Friedman (1986a) explicitly delineates the essentials of the problem by identifying two separate "worlds," the scientific and the journalistic, each with its own set of rules and procedures. She emphasizes that the goals of the former include "more explanation, more in-depth coverage, more attention to details," and that these are at unavoidable odds with the workings of the latter, including "the size of various organizations, lack of space or air time, 'hard news' requirements, deadlines, source use, editorial pressures, and reporter and editor education (Friedman 1986a, 18)." That is, the scientific community's wish for regular, responsible and detailed coverage of science is frustrated by the interference of press constraints.

The impediments to adequate science communication therefore not only stem predominantly from the press itself, but would seem to be inherent in the operations of the media. In June Goodfield's list of what she considers the seven most prominent obstacles to the adequate public communication of science, all are constraints imposed by the press:

1. The temptation to sensationalize (that is, "to create interest in an irresponsible way, by bending the facts, exagerrating the impact, distorting the consequences (Goodfield 1981, 18).")

2. The need to structure science stories differently from news stories (i.e. the need to "educate" means that standard journalistic conventions of story-telling are ill-suited to the presentation of scientific information).

3. The requirement of "newness," in which only the latest developments merit press attention.

4. Lack of resources on the part of news organizations.

5. The ignorance and indifference of editorial staff with regard to science.

6. A fashionable tendency to view all science as dangerous, costly and secretive.

7. The reliance on established scientific authorities as sources and spokesmen (Goodfield 1981, Chapter 1).

Both Goodfield and Friedman here identify the concerns which, in the problem of science and the media, have captured the place occupied by "bias" in other avenues of media studies. The basic opposition between the aims and constraints of science and the press gives rise to what are identified as the two major sources of distortion in science coverage: the problem of translation and the danger of sensationalism.

The former derives from the fact that, while scientific theories or research findings are produced in the context of a specialized knowledge (from which they emerge and to which they refer) and an equally specialized vocabulary (only in terms of which their meaning can be fully realized), successful public communication demands that they be recast in as vernacular a form as is possible and that their comprehension require minimal reference or appeal to other knowledge. The issue, therefore, is whether and under what circumstances it is possible to "translate" scientific work into an idiom accessible to the laity, without at the same time corrupting the contents of the work itself.

The danger of sensationalism is related to this problem, although its exact nature varies from author to author. Many commentators apply the label "sensational" to any science writing they deem so simplified that it can hardly do justice to the work on which it is reporting. Others use the term to designate reports which abandon the goal of undistorted communication (and public education) in order to tell a flamboyant story, purely for the sake of exciting reader interest. (This is the charge often reserved for the tabloid press, which is said to exploit science without actually contributing to its public understanding).

More generally, however, the tendency toward sensationalism is seen as an unavoidable aspect of press performance, deriving from the need at all times to narrativize journalistic accounts. That is, the mandate that press reports should entertain as well as inform is especially pronounced in the case of science coverage, in which it is supposed that the laity must be enticed to read about subjects that might otherwise be ignored as arcane, difficult, or foreign to everyday experience. The result is that press coverage is all too often marked by a measure of narrative flourish absent from scientific discourse, and it is the presence of this artifice which gives rise to charges of sensationalism: when the allure of the story itself is seen to detract from, or be dominant over, the sober communication of scientific work, the coverage is said to be "sensational." Indeed, many critics of press performance hold that this is an indelible characteristic of media operations:

> Many of the American media can be said to have no social responsibility at all, other than to sell their product or get the ratings. They will report bad research, good research, and unsubstantiated opinion with equal aplomb. They will perpetuate practices that get reader or viewer attention, even if those practices also perpetuate aggression (Tavris 1986, 22-23).

However, as central to the dominant concern as the problem of translation and the danger of sensationalism are, they have proven notoriously difficult to engage in anything approaching a rigorous fashion. The problem of translation, for example, strikes to the very heart of broad questions of pedagogy: How is it that individuals come to be conversant with previously unfamiliar concepts? What is the nature of explanation? In what does understanding consist, and is there a difference between first- and second-hand comprehension (i.e. between the understanding of scientists and the understanding of the 'educated' layman)?

The difficulties in specifying (or avoiding) the presence of sensationalism are similar. At what point does the journalistic labour of the science writer cease to work to the benefit of science (by cultivating lay interest in its endeavours) and begin to detract from the overall goal (by obscuring the actual character of science)? On what grounds can the charge of "sensationalism" be proven?

As a consequence, most authors are content merely to point to the difficulties of adequate translation and to the constant danger of press sensationalism as prominent causes of distortion in science communication, without further exploring their details or ramifications. Those studies which do directly address the topics have been few, and of limited success.

First, in the case of the problem of translation, the available studies are in sharp disagreement. The most forceful and sustained are by Schiele (1983) and Schiele and Larocque (1981), which argue in part that the very process of popularizing science -- of decribing its efforts for a non-specialist audience in a language and context alien to science itself -- cannot help but distort its actuality; and that in fact the historical function of popularization has been precisely contrary to that of its announced goal. They argue that "vulgarization" of science works, in practice, not to enhance public understanding, but to deprive the laity of "un savoir veritable." They hold that this is, first of all, inevitable: true dissemination of scientific knowledge would have to reproduce the conditions of its original production; the exigencies of popularization are such that this cannot be done. Secondly, it is socially convenient: in lieu of strictly accurate depictions of science, the popularization project has substituted an overall portrayal which serves to legitimate the scientific estate in the social sphere.

The contributions of Schiele and Larocque will be considered in more detail in the chapter to come. For the moment it is sufficient to note that these two papers, written in Canada and in French, feature nowhere in the bibliographies of those who have written on science and the media in the traditional vein. This is most likely because the dominant concern is a predominantly American phenomenon, and the fact of these papers' existence may have escaped attention. However, it should also be noted that the arguments they advance run counter to those of the dominant approach: Schiele and Larocque are not concerned with "improving" popular science coverage so as to better public appreciation of the enterprise, nor do they suggest means whereby science might be "translated" in a superior fashion for public benefit.

While Schiele and Larocque tackle the issue of translation in a manner informed by theories and techniques of textual analysis, the studies which do feature in the bibliographies of the dominant approach are primarily devoted to the measurement of readability and comprehension: the attempt is to ascertain rules of writing which will combine maximum information gain with maximum reader enjoyment, while simultaneously minimizing distortion.

Thus Hunsaker's 1979 study saw publication under the title "Enjoyment and Information Gain in Science Articles," and was designed to provide at least a partial answer to the question: "Can a science writer convert dull journal reading into enjoyable magazine or newspaper articles without sacrificing authenticity (Hunsaker 1979, 617)?"

Toward that end, three different versions of popular science articles were prepared, describing a graduation of "difficulty" in prose and composition. After reading one of the three versions, subjects were tested for their enjoyment of the articles and for their information gain.[11] The study found that

[11] In the normal course of media exposure -- turning to a science article, or choosing to watch a science documentary -- individuals are not aware that they are part of an academic study and do not presume that they may be tested on what they have read or viewed. One might complain, therefore, that the study fails to reproduce the conditions under which individuals actually read science news. However, it is difficult to gauge enjoyment or information gain without subsequent testing, and hence subject awareness is likely an unavoidable feature of the experimental

although readers expressed significantly different levels of enjoyment and interest depending on which version they had read (the least difficult also being the most enjoyable), the level of information gain remained invariant.

Hunsaker himself refrains from speculating on the ramifications of his conclusions, although obvious possibilities include: that journalistic effort in packaging scientific information for popular consumption does not impede the actual communication of this information, and may on the contrary enhance it by cultivating reader interest; that the media are limited in the amount of information they can impart to an audience, no matter how this content is packaged; that it is the background and education of audience members that primarily determine information gain from popular science, not the manner of journalistic presentation.

Whatever the ramifications, Hunsaker's findings would appear to be in accord with those arrived at previously by Funkhouser and Maccoby (1971), who found that minimization of scientific terminology, use of more "activity words," lower Dale-Chall readability scores, provision of examples, and mention of practical applications, all contributed to favourable audience reactions to science writing.

Their 1973 study, financed by the U.S. National Science Foundation, attempted to codify optimal techniques of popular science writing. Information packets were prepared in three areas of science: enzymology, polymer chemistry, and plasma

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design.

physics. The packets manipulated what the authors call "information variables." There were 10 such manipulations: example vs. analogy; concise statement vs. devious statement; giving exceptions vs. not giving exceptions; "science-ese" vs. plain English; redundant presentation vs. non-redundant presentation; opening with a question vs. not doing so; straight statement vs. striking image; rule-example vs. example-rule; rule-example vs. example-example. All of the packets were disguised as popular science articles.

Various versions were then distributed to different groups, either to junior college students, students at a "prestige" university,[12] and professional scientists. After reading the articles, subjects were tested on information gain, enjoyment of the article, inclination to read more on the topic, difficulty of the article, comparison of the article to other science writing with which the reader was familiar, and perceived competence of the author of the article.

The study concluded, first, that it is possible to present the same scientific information in a range of styles, from that available in popular science magazines to that available in professional journals; second, that differences in style can

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[12] In the United States, post-secondary education is divided between junior (or teaching) colleges, in which the student body is composed entirely of undergraduates, and research universities, which conduct graduate research in addition to providing undergraduate instruction. The research universities are further divided between those financed by individual states and those which are privately endowed. It is likely that, by "prestige" university, Funkhouser and Maccoby mean a privately-endowed research university.

result in measurable differences in the effects on educated lay readers; and third, that "simplified" science writing is enjoyed at all levels of readership, not merely at the lowest.

The study generated the following "rules" of effective science writing:

1. One should decide beforehand what it is one wishes to communicate. (Authors are urged to think of a test on their subject matter, and to organize their material so that an attentive reader would score 100 percent.)

2. Use examples, analogies, general rules, and exceptions to general rules.

3. Be explicit.

4. Use as little scientific terminology as possible without compromising the material.

5. Use shorter, simpler sentences with shorter, simpler words.

6. If the article is brief, section headings are unnecessary.

7. Sweeten the article with something other than hard science.

8. Mention practical applications.

9. Avoid large words and technical vocabulary.

10. Vary vocabulary, sentence length, and organization. (Funkhouser and Maccoby 1973).

Although reasonably obvious (it is difficult to imagine any science writer adhering to their opposites, eschewing examples and analogies, deliberately favouring a specialized technical vocabulary, or opting for a convoluted exposition over an explicit one), these guidelines represent the most direct attempt in the literature to address and overcome the problem of translation in popularizing science. As frequently as the problem is cited as an inherent obstacle to the adequate dissemination of scientific information, its features are not explored except in the most cursory manner.

The same is true with regard to the dangers of sensationalism: commonly mentioned, but only sparingly examined Attempts to actually document the presence of sensationalism in press coverage are limited to Glynn (1985), Glynn and Tims (1982) and Glynn and Tims (1980).

The 1982 and 1980 papers are near-identical reports (the earlier version slightly more detailed) on a content analysis of news coverage of an environmental debate. Over the course of the 1970s, a controversy surrounded the construction of the Tellico dam in Tennessee. Proponents of the Tennessee Valley Authority project maintained that the dam, and the creation of a new lake, would provide recreational facilities for the area, promote economic development, increase electrical production capacity, and assist in flood control. Opponents argued that energy production and flood control would be of mere marginal benefit, a historic and productive valley would be flooded, and the habitat of a rare fish, the snail darter, would be destroyed. This last occupied considerable prominence in the battle to complete or halt the project. The snail darter was discovered only in 1973, and was placed on the endangered species list in 1975. After earlier injunctions on other grounds had been dismissed by the courts, the threat to the species would provide opponents of the dam with their strongest case: that the Tellico project would violate the Endangered Species Act.

Glynn and Tims conducted a content analysis of the issue's coverage in the Knoxville (Tenn.) News-Sentinel and the New York Times from January 1973 (when the snail darter was discovered) to December 1979 (when the project was brought to completion). The primary aim was to determine the incidence of sensationalism in local and national press accounts. In the very design of the study, therefore, "sensationalism" is accorded the status of an entity that can be identified and tabulated. It is not merely a charge laid by aggrieved scientists -- a value judgement -- but an object that can be straightforwardly recognized and coded. Specifically, "sensationalism" was considered to be statements appearing in the body of articles which met one of the following five criteria:

1. Seemed to be an obvious overstatement of fact;

2. Placed exceptional emphasis on unique aspects of the situation;

3. Introduced apparent bias based on value judgements;

4. Associated the subject of the story with an irrelevant issue;

5. Treated the story in a frivolous manner (Glynn and Tims 1980, 102).

A total of 511 articles, editorials and letters-to-the-editor from the News-Sentinel were coded, along with 84 from the New York Times. The amount of coverage was not uniform over the seven years studied, but was found to rise and fall with the occurrence of local and national events (completion of various construction stages, court injunctions, and so on).

In an effort to ascertain the emphasis of coverage, the authors coded for five different topics: impact of the dam; news of the dam's construction; legal/political aspects; the snail darter; and the Endangered Species Act. It was found that the emphasis of local and national coverage differed measurably. The local paper began covering the story with regularity some two years before the national paper; until 1978 its coverage focused on legal/political aspects and the snail darter, and in 1979 on legal/political aspects and news of the dam's construction. The national paper, on the other hand, focused predominantly on the snail darter, the Endangered Species Act, and legal/political aspects until 1978, and thereafter only on the latter.

On the whole, the authors suggest that both newspapers' attention to the snail darter detracted from coverage of the broader environmental issues. "Perhaps this form of issue control can be viewed as sensational to the extent that the press assumes dam impact is not as newsworthy as controversy over a small fish (Glynn and Tims 1980, 107).

Based on the five criteria of "sensationalism," the study found that 91 percent of the letters-to-the-editor, 90 percent of the editorials, and 23 percent of news stories in the News-Sentinel contained sensational elements. In the New York Times, five of the seven letters, five of the nine editorials, and 10 percent of the news stories were judged to contain sensational statements (those stories concerning the snail darter being the most commonly sensational).

Although most of these sensational statements were attributed to sources quoted by the newspapers rather than to the newspapers themselves, the exception in both cases was coverage of the snail darter, in which it was the press that was found to be responsible for the sensationalism. The study concludes that organizational constraints specific to the press -- in particular, the need to concentrate on "newsy" aspects[13] that pander to reader interest -- work to skew coverage to the detriment of adequate and fair attention to substantive issues.

However, despite the authors' insistence that their content analysis is a "quantitative procedure which provides an objective measure of the importance and emphasis of explicitly defined content (Glynn and Tims 1980, 102)," it should be noted that the criteria according to which "sensationalism" was measured are shot through with subjective assessments and value judgements.

Stories were judged to be sensational if they contained what "<u>seemed</u> to be an <u>obvious overstatement</u> of fact," (although it is not specified what would constitute an overstatement of fact); if they "placed <u>exceptional</u> emphasis on <u>unique</u> aspects of the situation," (neither "exceptional" nor "unique" being defined); if they "introduced <u>apparent</u> bias,"; if they "associated the subject of the story with an <u>irrelevant</u> issue,"; or if they "treated the story in a <u>frivolous</u> manner." Like all such quantitative analyses, no examples of the actual press coverage

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[13] The phrase is the authors' own.

are quoted.

Once again, then, the charge of sensationalism stems simply from a view of what coverage should have contained and what emphasis it should have adopted It is only in light of such an alternative that elements of coverage can be characterized as irrelevant, frivolous, or carrying undue emphasis on certain aspects. In this instance, however, there has been a shift from scientist-sources as the arbiters of press accuracy, to the media researchers themselves. It is Glynn and Tims who reserve the right to pronounce on the adequacy of coverage, and the disguise of an objective method is used to advance their own subjective assessments.

In Glynn's 1985 paper, the definition of sensationalism was stripped down to "placing exceptional emphasis on unique aspects of a situation (Glynn 1985, 70)." The attempt in this study was to assess the differences in attitude toward sensationalism on the part of science writers and their editors. The major findings were that editors are more inclined to play to reader interest by allowing "sensational" elements in stories, and that this was most likely the result of their longer service with the newspaper, which made them "more ingrained and 'compatible' ... with the values of the organization (Glynn 1985, 74)." The conclusion of the paper reiterates that of the 1980 study virtually word for word.

In focusing on the differences in attitude between reporters and editors, however, Glynn (1985) contributes to a long-standing vein in work on science and the media, one that has received more detailed attention than the more general problems of translation and sensation. Some 22 years earlier, Johnson (1963) found that newspaper editors stressed "colour" and "excitement" first in rating the value of a science story, while "accuracy" and "significance" were secondary. Similarly, Tannenbaum (1963) found that although scientists, science writers, and readers considered science stories valuable regardless of whether they were also "exciting," editors rated the worth of a science story primarily in terms of its excitement.

As a consequence, much of the academic attention to popular science has been directed to the character and behaviour of the individual actors in the science communication process. The attempt has been to account for the form and content of press coverage of science by detailing the norms and values of the various groups involved, and by specifying how these interact to influence the information that makes its way into the public realm.

4.5 Scientists, Journalists, Readers: Research Findings

At least since the publication of Rae Goodell's (1977) The Visible Scientists -- a study of that coterie of "media celebrities" who serve as unofficial spokesmen for the scientific estate[14] -- researchers on science and the media have been aware that the "flow" of information, from its scientific production to its acceptance as common public knowledge, is regulated by the actions of various participant communities. Not all scientists come into contact with the media; indeed, as Goodell shows, within the scientific community there is a small set of individuals who feature as commentators much more frequently and prominently than their colleagues. Neither do all journalists write about science; rather, a disproportionate amount of the science news available to the American public is in fact generated by a small number of specialized reporters. Nor do all readers and viewers pay equal attention to science journalism; there would appear to be a number of different constituencies, ranging from those who follow news of science avidly to those who systematically ignore it. Much of the research effort has therefore been directed to the examination of these various groups and the factors influencing their behaviour.

Dunwoody (1986a) provides a review of the findings on scientists as media sources. Research reveals that individuals

[14] Prominent current examples would be Carl Sagan (U.S.), David Suzuki (Canada), Jonathan Miller (U.K.).

employed by universities or governments are more likely to have contact with journalists than are those employed by industry. As well, social scientists are far more likely to have contact with the media than researchers in the biological or physical sciences, despite the fact that science journalists themselves apparently hold the social sciences in disdain relative to what they consider the "harder" disciplines.[15] Dunwoody attributes the prominence of stories dealing with the social sciences to the fact that editors judge readers will enjoy them, since in their subject matter (social organization and human behaviour) they are less arcane and more relevant to the everyday than scientific research that deals with the inanimate or the non-human.

Perceived credibility, she observes, will also determine whom the journalist seeks out as a source -- in which credibility will depend upon a combination of mainstream status, administrative credentials, and previous contact with the media. That is, the typical scientist-spokesman is untainted by a reputation for dissent, is employed by a "legitimated institution," is more often than not an administrator rather than a researcher, and has had the benefit of prior media exposure.[16]

Nonetheless, Dunwoody goes on to point out that, unlike the members of other professions (politics is the example given) who cultivate media contact and public visibility, scientists are typically reluctant to speak to the press. Research suggests

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15 See Dunwoody (1986b).

16 See Dunwoody and Scott (1982).

this is because the scientific community prizes only the actual process of inquiry, and frowns on anything that detracts from it.[17] Therefore, the scientist who devotes time to contact with the media may well raise his or her public profile, but may simultaneously damage his or her professional standing. Accordingly, research shows that the most common media sources are scientists who established their professional reputations <u>before</u> raising their public profile.

Indeed, other studies have suggested that the benefits individual scientists receive in return for co-operating with the media come from outside the scientific system (a verdict that itself accepts that the popularization of science, even when conducted by scientists, is not part of the scientific process). The rewards are said to include: the personal satisfaction that comes from "increasing the public's understanding of science,"; celebrity, with its various attractions; employer recognition; political recognition, potentially useful when soliciting research grants; and the likelihood that one's work will be more widely publicized throughout the scientific community by the <u>New York Times</u> than by a specialized journal.

Nonetheless, Dunwoody argues, if there is a tension between journalists and scientists, it derives from the imbalance of risk and reward for the latter relative to the former.

> The crux of the problem seems to be that while journalists need information from scientists, scientists

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[17] See Dunwoody and Ryan (1985).

> rarely need what journalists have to offer. Traditionally, public visibility has brought with it no cachet for scientists (Dunwoody 1986a; 14).

This contention is a prominent feature of the dominant concern over popular science. It is taken to be a serious obstacle to optimal science communication and the sole major impediment thrown up by the scientific community. Indeed, many texts assume that the majority of scientists are less than inclined to deal with the press and unconvinced that science communication is a project meriting their support: these feature opening chapters or sections with titles such as "Why Bother?" (Kreighbaum 1967) or "Why Communicate at All?" (Goodfield 1981), stressing the need and value of vigorous involvement by scientists in the popularization of their work.

Nonetheless, the notion that continued contact with the media is somehow self-serving and has little to do with the actual practice of science appears to enjoy an enduring currency within certain segments of the scientific community. In Canada in the early 1970s, a controversy developed over the decision of biologist Dr. David Suzuki to devote his sabbatical leave from the University of British Columbia to serving as host of the CBC television program Science Magazine (now defunct) and the CBC radio program Quirks and Quarks. Some members of the university charged that Suzuki was not using his sabbatical leave to enhance his scientific knowledge, and it should therefore be terminated. The Canadian Federation of Biological Sciences took up the case, issuing a press release in which the organization's chairman, Dr.

Gordon Kaplan, defended Suzuki's popularizing efforts: "People have a right to know what scientists are doing . . . because out of the labs are coming solutions to problems such as pollution of our environment and cures for cancer (quoted in Dubas 1976; 27)."

Dunwoody herself ends on an optimistic note, observing that more scientists are now willing to speak to the press; that increasing numbers are bypassing journalists altogether, writing their own books, popular articles and television programs; and that a number of American universities have begun to offer science communication courses for their science and engineering students.

Much of the work on the community of American science journalists has also been conducted by Dunwoody, the most frequently quoted study being "The Science Writing Inner Club," originally published in 1980, and reprinted in the 1986 volume co-edited by her.[18] Like her earlier report, "Science Writers at Work," it is a study of the news-gathering performance of senior U.S. science writers at a meeting of the AAAS in the late 1970s. And like Goodell's work, which demonstrated that media exposure of scientists is concentrated amongst a relatively small group of high-profile individuals, Dunwoody found that a comparatively small group of newspaper, magazine, and wire service reporters (comprising some 25 to 30 individuals) largely determines the science

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[18] Page references here are from the 1986 publication. Other studies include Dunwoody's "Science Writers at Work," originally published in 1978 and reprinted in the 1981 anthology Communicating University Research, as well as Ryan and Dunwoody (1975).

news available in the U.S.

Furthermore, she found that these individuals form a close-knit, informal network meriting designation as an "inner club," and that the network itself influences the news-selection behaviour of its members. It does so because the club functions as a cooperative entity rather than as an internally competitive one. This is cited as a "negative effect (Dunwoody 1986; 156)," since the homogeneity it encourages in evaluations of "newsworthiness" tends to reduce the variety of science news made available. This is further compounded by a lack of grounding in the social sciences on the part of club members, with the consequence that topics in the physical or life sciences are favoured.4

Dunwoody locates the genesis of the club in the 1960s, when the American space program brought together a pool of journalists whose members covered NASA on a regular basis and went on to establish themselves as specialized science writers. Cooperation among the pool came about as a means of sharing expertise, and therefore of ensuring accuracy, but also as a means to satisfy editors. The science writer could assure the home desk that he or she was covering an event such a moonshot or a scientific conference competently, not by scooping fellow reporters, but by matching the stories of competing news organizations.

She also found that inner club members "generally are affiliated with the prestige print media," the suggestion being that these are the "media that can afford to make science a national or even international beat (Dunwoody 1986; 158)." No support is provided for this contention, and no consideration is given to why prestige journals should be any more able to afford science reporters than their more populist and more profitable competitors. Nevertheless, the study concludes that the small number of inner club members exerts a disproportionate influence on the science coverage available to the American public since they are employed either by wire services, which provide coverage for newspapers across the continent, or by prestige papers which maintain their own news services (such as the New York Times wire service, the Los Angeles Times/Washington Post service, Scripps-Howard and Knight-Ridder). And although the 1980 version speculated that the influence of the inner club members would diminish as younger journalists expanded the ranks of the science writing community, an update to the more recent version notes that these younger colleagues have themselves joined the inner fraternity.

With regard to the readership of science news, the most prominent work has been conducted by Miller, Prewitt and Pearson (1980) and Miller (1982). These were surveys conducted under grants from the U.S. National Science Foundation which sought to ascertain public sentiment toward science, and their results are most comprehensively presented in the chapter "Public Attitudes to Science and Technology" in the NSF's Science Indicators 1982. The aspects most immediately applicable to the problem of science and the media, however, are described by Prewitt (1982) and Miller (1986).

Following the vocabulary developed by Gabriel Almond in _The American People and Foreign Policy_ (1950), the authors argue that the 'public' on any given issue or topic can be divided into "attentives" and "non-attentives." (The distinction roughly mirrors that made by Lazarsfeld, Berelson and Gaudet between "opinion leaders" and "followers"). The notion is that, in the case of foreign policy, the interest of most of the population is sporadic: fuelled by crises or threats of war, but dissipate during periods of international calm or stability. A small portion of the population, however, maintains a relatively continuous interest in matters of foreign policy and displays a steady pattern of information acquisition, which in turn results in a comparatively well-developed knowledge about the topic. These are said to comprise an "attentive public."

Miller _et al_. (1980) argue that just as there are attentive publics for issues such as foreign policy, civil rights, the status of women and so on, so too there is an attentive public for science, composed of some 10 to 20 percent of the U.S. adult population (depending on the criteria of measurement used). This public includes a large number of non-scientists -- people who may watch PBS science documentaries regularly, subscribe to popular science magazines, or seek out the science sections of newspapers -- and is composed of younger, predominantly male, better educated individuals who are more likely to have taken a college-level science course. Although the attentive public for science policy[19] is less internally organized than that for foreign policy, the researchers suggest, first, that these individuals are "capable of forming reasonably well-informed views about policy questions (Prewitt 1982; 9),"; second, that they tend to share the views of scientists themselves; and third, that they are consistently more favourably disposed to science than the rest of the population.

This does not mean that non-attentives hold negative attitudes about science, but merely that attentives are more enthusiastic than their less interested peers. The attentives expect further scientific accomplishments in the future, they tend to perceive more benefits than risks accruing from science, they are reluctant to impose constraints on scientific investigation, and they hold that science and technology are largely responsible for improvements in the quality of life.

In addition to the attentives, a further 20 percent of the American population, termed the "interested public," display a relatively high interest in science and technology, but "lack a functional understanding of the process or the terminology of science (Miller 1986; 57)." These individuals, Miller suggests, will constitute the constituency from which "additional attentives" might emerge should "conditions stimulate wider public

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19 The surveys are detailed and methodologically careful. Nonetheless they assume that a) there is in the legislative and executive branches of American government a science "policy" that can be considered equivalent to foreign policy, and that b) interest in developments in science is also (or entails) an interest in science policy, and vice versa.

concern about science policy issues (Miller 1986; 57)."

In Miller's view such conditions are to be encouraged so that the involvement of the electorate in science policy might be enhanced. Atypically, however, he specifies the conditions under which he believes public participation in matters of science would be possible.

First, there are those instances in which "science policy leaders" register serious differences of opinion on a given issue, with the result that each faction will appeal to the public for support in efforts to sway the issue. (The example provided is nuclear power).

Second, there are cases in which science policy leaders find themselves at variance with political decision-makers, and under such circumstances appeals for support may be made to the public (e.g. when governments order cuts in financial support for — science education or research).

Finally, upon occasion a "scientific" issue (or, at least, an issue to which science contributes) becomes a matter on which the public is called upon to exercise its franchise, often in the form of a direct referendum. Miller mentions the referenda on water flouridation in the 1950s and 1960s, and those on nuclear plant construction in the 1970s (Miller 1986; 58-60), to which one might add the smoking bylaw referenda of the 1980s.

At the same time, however, he warns that even of those classed as attentive to science policy, two-thirds cannot pass a relatively minimal test of scientific literacy (Miller 1983; 45-

46), and he advocates efforts to increase public understanding, primarily amongst the attentive public, although the interested and non-attentive publics are not to be abandoned. The interested public can be reached through commercial network science programs[20] (as opposed to science journalism magazines or PBS documentaries) and pictorial essays such as those in National Geographic. The task with regard to the non-attentive public "is to persuade them that it is important to be scientifically literate (Miller 1986; 66)." This is extremely difficult, however, and as a result the best long-term solution

> is the improvement of science education in the pre-college and college years ... Once these formative years have passed and no interest in science, or a fear or dislike of it, has been created, the effectiveness of later communication efforts will be very low (Miller 1986; 68).

Although Miller is therefore pessimistic about the efficacy of the media in galvanizing public interest, most of the work on popular science has assumed that press coverage can be improved, and that it would be to the public benefit to do so. At the very

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[20] The example offered is the short-lived CBS program Universe, hosted by Walter Cronkite. Indeed, Cronkite himself shared Miller's views, arguing that "Universe is going to be a popular science program. The aim is to excite interest among those who are not now interested (quoted in Weiner 1980; 9)." The program failed to attract sufficient viewers, however, and was cancelled after only a few episodes.

As well, although Miller considers Nova a program for attentives, the series' own promotion argues otherwise. An advertisement in the March/April 1981 issue of the Columbia Journalism Review described Nova as "the PBS TV show about science -- for people who didn't know they were interested in science."

greater fidelity. Furthermore, the entrenchment of translation and sensationalism as the basic terms in which the problem has been understood, together with the sociological evidence regarding the various actors in the communication process, have come to underpin the various recommendations for improvement. It is in light of this background that the science communication project proposes its strategies and tactics for the repair of press attention.

4.6 Strategies and Tactics

Because the impediments to the adequate public communication of science are seen to derive predominantly from the mediating influence of the press, the practical effort in the reformation of popular science has been directed to softening or limiting this influence -- i.e. to reducing the "noise" contributed by journalistic handling. The broad goal, therefore, has been to acquire greater scientist-control over the communication process: to reassert that the norms of science are hierarchically dominant over the conventions of news production, and that these conventions, when necessary, should be suspended (or circumvented) to ensure accuracy and balance.

The lobby for reform has advocated three distinct, but complementary, strategies for the pursuit of this end:

First, journalists are to be schooled in the procedures of science, so that these might be better respected.

Second, scientists are to be made aware of the constraints and requirements of the media, so that in their dealings with the press they might be better able to compensate.

Third, scientists are to be encouraged to bypass the journalistic community altogether, and to advance the science communication project by addressing the public directly.

Each should be considered in its turn.

The first is an endorsement of the expansion of science and technology as a specialized beat within journalism. The notion is that the complexities of scientific method and content are such that the general reporter -- otherwise prized for his or her universal competence -- cannot do them justice. At its most basic, the aim is to minimize the errors in science news caused purely by the ignorance of the journalist. The expansion of science as a special topic of coverage, however, offers other advantages, recognized and advocated by the lobby for reform.

To begin with, the position of science writer should require a background in science, or at least exposure to it at the university level. This is the point of the Ryan and Dunwoody (1975) study, which not only surveyed science writers in the U.S. and Canada on their academic and professional training, but asked them to recommend the most appropriate training for future science writers. The study noted with approval that science journalists in 1975 were significantly more educated than those polled by Kreighbaum in 1940, but that even these recommended more university courses in the physical sciences for future science writers than they themselves had taken. Such a background, it is widely agreed, would not only provide a grounding in the content of the sciences, but would equip the reporter with a fundamental commitment to the values of the scientific enterprise.

As well, the lobby for reform advocates university-level training in the special circumstances associated with the communication of science, for scientists and engineers as well as journalism students. Nelkin notes that there are already some 43 programs in science journalism in 67 U.S. colleges and universities, 14 of which offer masters degrees (Nelkin 1987, 181). Seminars and university science instruction for practicing science writers are similarly encouraged, so as to foster "a program of exchange, in which science departments or colleges award fellowships to journalists and journalism programs teach courses in basic scientific philosophy and methodology (Goldstein 1986, 8)."[21]

In addition, within a news organization the creation of a full-time science beat means that science is no longer a topic to be covered sporadically, as issues or events dictate, but a subject on which coverage must be made available on a consistent basis. This makes the science writer dependent on the cooperation of the scientific community, particularly since, unlike the courts reporter or the city hall correspondent, the science journalist has no set forum whose affairs can be covered on a daily basis. If science is to be a ready source of material, then the journalist must cultivate the trust and respect of scientists. This can only be accomplished by producing coverage of which scientists themselves approve. Thus the literature is dotted with the reminder that, in the words of Nathan S. Heseltine of the Washington Post, "... the successful science writer builds his success on the esteem of the scientists (quoted in

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[21] It is not clear in what way this suggestion amounts to an "exchange". It proposes that science departments instruct journalists in science, and that journalism departments instruct journalism students in science.

Kreighbaum 1967, 120)."

Furthermore, the position of science writer -- the nature of the work it involves, and its place in the hierarchy within the newsroom -- is such that it encourages little mobility. As Dunwoody (1981) confirms, whereas other journalists often shift beats or careers, science writers tend to stay with what they do. This, too, is seen as an advantage, in that numerous years of service bespeak not only a continuing on-the-job education in science, but an individual who is happy in his or her occupation -- who shares the excitement of science, and who believes that its popularization is a worthwhile and important endeavour. As well, a science writer of long standing must presumably have won the respect of the community on which he or she reports.

The overall result is that the role of science writer -- as promoted in the literature -- differs markedly in character from the traditional role of the journalist. The able science reporter is constructed as considerably more deferential to his or her subject matter, more answerable to the constituency being covered, than would be appropriate in other departments of the newsroom. There is no allowance for performance as gadfly, watchdog or adversay, as there is in the political bureaus, on the city desk, or even in the financial section. Rather, the role advocated is that of a skilled and sympathetic translator.

There is no overt suggestion that the journalist should serve as merely a spokesman for science -- as its deputized press agent. On the contrary, the science writer is urged to be critical and extolled not to "try to hide the human, institutional, and theoretical difficulties of science and the misdemeanours of scientists (Farago 1976, 13)." Nonetheless, this criticism must always be conducted in the service of the larger enterprise, since the science writer

> must believe that in their totality the aims, ideas, thought-processes, and motivations incorporated in science are on balance beneficial to the world at large ... (Farago 1976, 13).

The consequences, otherwise, will be dire:

> If he does not believe all this, although the belief may be only half-conscious, his work is pre-judged to be sterile, and his efforts will be in vain, not only for the two publics he serves but for himself. He will be destroyed not only as an expert and a craftsman, but also as a human being (Farago 1976, 13).

In addition to the call for more specialized science writers, the lobby for reform advocates greater awareness on the part of scientists of the exigencies of media work. Hence many of the texts on science and the media address themselves as much to interested scientists as to journalists or public information personnel. A few presume a readership composed predominantly of scientists, e.g. Gastel (1981), Miller (1986a), and the Goldstein (1986) anthology. This last, Reporting Science: The Case of Aggression, is the most militant in its advocacy of scientist-control of the communication process, and therefore makes most evident certain of the motives that underlie such a demand.

The book presents itself at the outset as an analysis of news coverage of a specific scientific issue -- namely research on the causes of, and remedies for, "aggression" in humans. It develops, however, that it is largely an angry complaint on the part of aggrieved scientists that aggression research has been harmed by consistently unkind press portrayals. It is, as well, an agitation in favour of the continued use of animals in experimentation, on the grounds that this research may well eventually lead to solutions of problems of urban violence and national militarism. As a consequence, central to its complaint about press coverage is the charge that undue attention to the issue of animal experimentation has distorted public understanding of aggression research.

The volume is therefore a primer for scientists on relations with the press, its aim being to educate those who conduct research using animals in the rigours of dispensing "sound information" to the public. "Well-financed animal activists," Neal Miller warns in the Foreward, "... are highly motivated to distort information ... and are becoming increasingly sophisticated in exploiting the media (Miller 1986, viii)." Scientists, then, must become adept at using the media themselves.

The tactic in doing so is fairly straightforward. Scientists are to cultivate the ability to present their work calmly and lucidly, and to present themselves as reasoned, objective, and sound.

> If you are invited to appear with an animal activist on a talk show or other program, you should accept.... You should have prepared a few key points that you will try

> to make clearly and briefly if given even the remotest chance. You should try to avoid being distracted into spending your time answering your opponent's horrible examples. You should resist being interrupted just as you are about to make a telling point and, if your opponent succeeds, you should resume with "I would like to complete what I was saying when you interrupted me." (Miller 1986, viii).

The same theme is reiterated throughout the volume. Groebel, for example, conducted "a longitudinal field study on the effects of TV violence,"[22] following which he concluded that "negative effects, however small, were most probable (Groebel 1986, 47)." He complains that in a Der Spiegel cover story his findings were presented alongside the dissenting opinions of the less well-informed.

> I am not suggesting that the scientist's opinion should be above the others, but it is my belief that empirical work has a different analytical value compared to essayistic opinions of ad-hoc experts. Consider the situation of a TV discussion where you have presented your results and are then told "... but I think the contrary." (Groebel 1986, 47)

It is difficult to construe this, however, as anything other than a suggestion that the scientist's voice should be hierarchically dominant. The scientist's findings, in Groebel's view, are objective, uncontestable, and enter into public discourse only so as to be recognized as true. Dissent is fruitless (in the long run), an annoyance (in the short run), and

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[22] J. Groebel and D. Krebs, "A Study of the Effects of Television on Anxiety," Cross-Cultural Anxiety, C.D. Speilberger and R. Diaz-Guerrero, eds. (New York: Hemisphere/McGraw-Hill, 1983).

counter to the public interest

> [I]t is up to the scientist to inform about the complexity of the world. This is especially important, as many of the today's problems arise out of the inability to handle complex systems, e.g., politics, economics, military affairs, law Who, if not the scientist, can point out the respective problems? In this context, we cannot leave the decoding of complex analyses to the press alone, we have to do it ourselves . . . (Groebel 1986, 51).

Thus each contributor to the volume advocates dealing with the press, but only under certain circumstances and with clear aims. Tavris, for example, urges scientists to "consider the brief live interview as a paid ad for aggression research (Tavris 1986, 29-30)," but recommends dealings with the press only under those circumstances in which the scientist can be assured a measure of control over the proceedings.

> Will [the newspaper] inevitably distort what you say? Most of the horror stories that academicians tell about the media have to do with sensational newspapers (Tavris 1986, 27).

Scientists ill-equipped to publicize their work in the best possible light (perhaps as a result of camera-shyness or poorly developed skills of elocution) are advised to "use the best professionals you can find in publicity, writing, editing, and advising (Tavris 1986, 28)."

The most detailed and widely circulated treatise on scientist interaction with the media, however, is Neal E. Miller's "The Scientist's Responsibility for Public Information: A Guide to Effective Communication with the Media."[23] The primer is a compilation of tactics in dealing with the press culled from a discussion between science writers and scientists at a Science Writers' Seminar organized by the Public Information Committee of the Society for Neuroscience in May, 197?.

It opens by addressing scientists' foremost reservations, assuring the researcher that "You Can Control the Interview." The primary risk in public communication is taken to be damage to the researcher's professional reputation, and hence the second heading promises tips on "Avoiding Criticism from Colleagues". Scientists are advised that material discussed with the press should already have passed peer review (been published in a scientific journal, or accepted for publication, or presented as a paper at a scientific conference),[24] and are reminded to give appropriate credit to colleagues working in the same or related areas.

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[23] Published in the Friedman <u>et al.</u> anthology (from which page references here are taken), in the Goldstein anthology (under the title "A Guide to Effective Communication with the Media"), and as a handbook by the Scientists' Institute for Public Information.

[24] This is a mechanism to prevent erroneous or unsound research from receiving widespread publicity, and to prevent unscrupulous or self-serving scientists from using the media to their own advantage. It is most strictly policed by the <u>New England Journal of Medicine</u> in its "Inglefinger Rule," named after a former editor of the journal. Only under the most exceptional circumstances will the NEJM accept for publication work that has been publicized previously in the mass media. The Inglefinger Rule therefore also has the consequence of protecting the "newsworthiness" of the NEJM itself. See Relman (1979), and the debate between McBride (1981), Grouse (1981), and Relman (1981).

Beyond these general recommendations, the primer reminds scientists to keep their expositions simple and brief, to point out the meaning and implications of their work (without overselling), and to avoid making statements that will claim too much if editorial factors require cutting subsequent qualifications from the completed piece. They are advised to check the accuracy of quotations attributed to them prior to publication, to recognize that journalists often work to imminent deadlines, to inquire as to journalists' credentials (so as to avoid dealing with sensational organizations), to use the public relations or information offices attached to their institutions, and whenever possible to cultivate a personal relationship with reliable science writers. As an additional means of controlling the content of the journalist's work, researchers are encouraged to prepare a written statement summarizing their field or their own contributions to it and composed, like a press release, in the inverted pyramid style. The suggestion is that the reporter may then work from the scientist's own statement in preparing his or her story.

Finally, the lobby for reform advocates that scientists and scientific institutions should publicize their own work themselves.

> In short, the general reporter, especially if at a small newspaper or station, is likely to lack science training, to have few sources of science information other than interviews, and to be hurried and harried. Thus the job of presenting science to the public depends largely on the scientist (Gastel 1983, 24).

In part, what is meant here is that more scientists should participate in the popularization of their fields via books,[25] op-ed or feature articles in local newspapers, documentary production for local broadcasting, and so on. Friedman et al. (1986) include an entire section devoted to contributions from scientists who have ventured into popularization. The most likely form such participation might take, however, is via collaboration with the public information office of one's own institution.

In the U.S., most large research universities maintain news offices or media centres which publicize the institution's achievements, often by feeding pre-prepared reports on research activities to commercial radio stations. These stations, many with meagre news staffs and reliant on broadcast service reports for all but local coverage, may well be inclined to accept the free offer of a competently-produced report on some aspect of academic inquiry, particularly if it is germane to some topic in the news. Audiences for these reports, as a result, can be size-

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[25] Indeed, although near-exclusively ignored by the dominant concern as a topic to be examined, books are a bulwark of the popular science effort, and the most prominent tend to be written by scientists. One might think of Jacob Bronowski's companion volume to The Ascent of Man; Stephen Jay Gould's The Flamingo's Smile, The Panda's Thumb, and The Mismeasure of Man; Carl Sagan's The Dragons of Eden, Broca's Brain, and Comet, as well as his companion volume to Cosmos; Douglas Hofstadter's Godel, Escher, Bach; Richard Feynman's Surely You're Joking, Mr. Feynman?; Lewis Thomas' The Lives of a Cell and The Medusa and the Snail; Jonathan Miller's companion to The Body in Question; David Attenborough's companion to Life on Earth.

able.[26]

Because the success of the media office's effort depends on how well it can mimic the performance of the press -- how newsworthy its offerings are, and how competently they reproduce standard journalistic conventions -- the media office itself runs very much like a small newsroom. Story ideas must be generated, scripts prepared, interviews edited. To enchance the chances of this material being "picked up," output must be matched to events external to the university. Thus, for example, university economists might be called upon to review and assess sweeping changes about to be made in tax legislation.

At the same time, however, because media office personnel are not employed by the press, but by the university (or hospital, or scientific organization), they are considered to be insulated from many of the pressures which are said to skew journalistic coverage of science. In particular, they are directly accountable to the researcher for the accuracy and tone of the coverage produced, and therefore scientist involvement with a public information department is commonly seen as direct

[26] At Cornell University, the reports sent out over the wire consist of a short prepared radio news story, complete with one voice clip of the academic interviewed. This is then followed by a further five voice clips, punctuated by commentary from the "reporter" placing each clip in context. This permits the commercial station to either air the university-prepared report, or to edit the voice clips together with the station's own commentator to "create" its own story or interview.

A junior faculty member, asked to comment in 1986 on network television's treatment of social issues in narrativized made-for-TV movies, was heard in radio markets from Texas to Alberta comprising a potential audience of 8.1 million.

address to the public, or as near as is possible.

Indeed, the call for direct communication to the public is not only addressed to the individual scientist, but to the scientific organization, in which what is advocated is precisely the creation of this type of information office. Thus Walum's "modest proposals" to the American Sociological Association for the solution of "major problems" in public communication include: having the association's Committee for Public Information prepare a manual briefing members on relations with the press; the development of a public relations office; employing a clipping service to monitor press attention to sociology and, where necessary, to correct "misstatements"; and making efforts to secure the employment of sociologists as technical advisers for television programs (Walum 1975, 31).

In fact, many large American scientific organizations maintain this type of public information arm. The American Psychological Association, for example, published a _Media Guide_ by K. Holmay in 1980, and a handbook on _Communicating with the Public via the Media about Psychology_ by M.M. Olean in 1977. The American Physical Society has published _Physics Goes Public_, and the American Chemical Society makes available _The Chemists and the Media_. The American Institute of Physics, financed by the National Science Foundation, produces two-minute video clips about physics, which are then sent to television stations across the country. The Ontario Medical Association maintains a communications office whose members give presentations, make speeches, write and edit publicity. Indeed, since the debut of a widely-acknowledged 'problem' of science and the media, the growth in science communication personnel has not been concentrated in the press, but in public information offices attached to hospitals, universities, museums, research institutes, the research and development laboratories of large corporations, and so on. At present, there is a far greater likelihood that a student specializing in science communication will find employment in the capacity of information officer than as a science writer for the press.[27]

These, then, are the basic strategies advocated to rectify the problem of science and the media. Journalists are to respect

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[27] Consider the difficulties -- rarely touched upon in the literature -- of the young journalist hoping to specialize in science. His or her first job may be at a small-circulation paper, in which case there will be little call for science coverage and little time in which to pursue it. Certainly, there will be few opportunities to develop an expertise. Alternatively, one's first employment might be at a metropolitan daily as an intern or student, but such organizations do not indulge the tastes of junior reporters. Even if, after a period of internship, the young reporter is hired permanently, the position of science writer will either be occupied, or it will not exist. Since junior reporters are only very rarely hired to fill "beats" (a beat is more commonly awarded to a reporter who has spent at least a year, possibly more, in general assignment; even then, there is a hierarchy among the available beats, and junior reporters with only a few years experience, no matter how talented, are first assigned the more workmanlike responsibilities), it will require some years of lobbying, with no guarantee of eventual success, to acquire science and technology as a specialty.

The realities of journalism, therefore, are such that the apprenticeship required by the profession may frustrate the ambitions of the prospective science journalist. It is no accident, then, that many senior public information personnel came to their positions after having transferred from posts in journalism (Rogers 1986; 44).

the demands of science in their coverage, and this is to be accomplished by suitable and on-going training. Scientists are encouraged to participate in the communication process, and are drilled in how to handle the press. Scientists are to forego the press entirely and finance their own agencies of public communication. The tactics in each case are left vague, but the goal is clear: the minimization of journalistic interference by engineering scientist-control over popular science.

There are only two issues in the literature left outstanding. The first is the reservation, only recently raised, that the campaign for reform has had the effect of rendering the press overly compliant to the scientific estate, thus contributing to a glorified (and therefore skewed) portrayal of science. The second is the more long-standing reservation that; if the press were wholly responsible in its science coverage, eliminating all tendencies toward sensation, what then would ensure that disinterested readers would pay attention? The first is the problem of deference. The second is the problem of disinterest. They are the only instances of disagreement within the dominant concern.

4.7 Deference: The Case of Recombinant DNA

Although the subtitle of Nelkin's (1987) volume is How the Press Covers Science and Technology, the title itself is Selling Science. The book shares the format of its predecessors, arguing that science is an increasingly important element of social life, that it is ill-understood by the majority (to their own detriment), and that media performance in its coverage has been less than exemplary. The difference is that Nelkin contends the American press has been unduly subordinate to the scientific community, and that the science communication effort overall has taken on the form of an institutional advertisement.

She locates the cause of this, once again, in the interaction between the communities of scientists and journalists. The interests of each conspire to skew coverage so that science is typically represented as progressive, problem-solving, and beneficial, and is most often represented by senior, conservative scientists. The result, Nelkin argues, is a superficial and ultimately erroneous portrayal that neglects the tentative nature of scientific inquiry and the political context within which it is conducted.

Nelkin relies on the available literature to mount her argument, and her conclusion that the press is on the whole too subordinate to the interests of science is, within the dominant concern, a relatively subversive contention. Nevertheless, the form in which the contention is rendered -- that press attention to science is shallow and unrealistic -- is not only one with which scientists themselves presumably would have little quarrel, but which is essentially a variation on the complaint, first voiced in the 1950s, that popular science is too "gee whiz," too preoccupied by the power and success of science to probe or explain the processes by which it actually works.

The recent divergence on the question of deference -- of scientist-control of public communication -- is best illustrated in the different assessments of what became, if not a common case study, then certainly a common source of evidence and examples in the discourse on science and the media: the debate over recombinant DNA, and the management of the press during the most significant conference on the topic.

Goodfield (1981) devotes considerable space both to the meeting, held in February 1975 at Asilomar, CA, and to the surrounding controversy over microbiology.

The technique of recombinant DNA was heralded in the early 1970s as a new tool for the analysis of exceedingly complex genetic phenomena. It allowed researchers to remove specific genes -- the human gene that codes for insulin, for example -- from their enormously complicated natural environments, and place them in the relatively simple surroundings of bacteria, where the processes whereby such genes are read and expressed (that is, the instructions contained in their arrangement of nucleic acids are recognized and carried out) could be examined with considerably greater ease and success.

In addition, however, techniques of recombinant DNA were taken to harbour the potential for widespread industrial application. The micro-organisms which were to act as hosts for the supplanted genes replicate themselves rapidly, exponentially, and therefore in vast quantities. If a host could be so engineered as to express (for example) the human gene for insulin, and so produce the substance while it reproduced itself, vast cultures of the organism could, in effect, function as cheap and efficient factories for the production of a beneficial and highly marketable human hormone.

There were, however, perceived risks attached to recombinant DNA research. Goodfield calls these "hazards" and avoids specifying their nature. It is a curious omission, since the conference she goes on to describe concerned itself precisely with the question of safety guidelines to minimize any risks.

In fact the concerns about hazards sprang from the recognition that one could not be certain that genetically-altered micro-organisms, if released from the laboratory to the larger environment, would not be harmful. As articulated by the popular press, there were a number of worst-case scenarios that magnified the perceived risk by magnifying the extent of the potential disaster. One involved the fear that a hardy, carcinogenic virus, originally designed for the study of cancer, might escape its containment and cause pandemics of incurable disease. Another worried that a microbe designed initially to digest oil spills would spread throughout the environment, feeding on the world's oil supplies. Most of these worries would prove to be exaggerrated, but at the time there was a genuine concern about the possibility of environmental contamination.

At the Asilomar conference which drew up guidelines for experiments involving recombinant DNA, non-scientist involvement was limited to a panel composed (apparently accidentally) exclusively of lawyers, and to the presence of 16 invited journalists, who were present only as observers, were enjoined to stay for the entire three-and-a-half day conference, were premitted to file stories only when it had concluded, and were denied the use of any but still cameras (thus eliminating television coverage).

Goodfield lauds such organization, noting that the conference produced not only three award-winning articles, but a marriage between two of the attending journalists. Press coverage was further enhanced by the fact that "the most vivid publications stayed away," and the eventual result, Goodfield concludes, quoting Richard Hutton, was that "Informed public scrutiny of science had become a real possibility (Goodfield 1981, 49)."

In Goodfield's view, therefore, the most appropriate and advantageous relationship is one in which the scientific community takes a small number of carefully selected journalists into its confidence, isolates them from outside sources, and stands in judgement of their ability to reproduce scientists' own understanding of the proceedings. It is a view shared by others: "This compromise [Asilomar] worked well (Russel 1986, 93)."

It is also a view that recently has been contested, notably by Altimore (1982) and Goodell (1986). Goodell's study is the more detailed, seeking to show that the community of American science writers is both dependent upon and subordinate to the priorities of science as an institution, and that this relationship involves the complicity of the press.

She argues that media coverage of recombinant DNA can be divided into three major periods: the first, from about 1974 to 1977, was marked by a concern for the safety of the new research; the second, from about 1977 to 1979, amounted to the curtailment of the controversy; the third, from about 1979 to the present, saw a shift of attention to the industrial applications of genetic engineering. Taken together, they reveal a gradual increase of the influence of the scientific community on press coverage.

She notes that press attention to recombinant DNA was initiated by scientists themselves when, in 1974, letters to Science and Nature debated the potential risks associated with the research. On July 18, 1974 a committee of the U.S. National Academy of Sciences held a press conference to announce that it was about to publish a letter in scientific journals asking for a postponement of certain types of recombinant DNA experiments for some seven months, until an internal scientific meeting could be held to assess hazards and set down safety guidelines. Although some news stories had appeared previously, beginning about 1971, it was after this press conference that recombinant DNA emerged as a science story of national scope.

Goodell points out that the coverage which emerged following the press conference was precisely of the sort deplored by the scientists, emphasizing as it did the hypothetical, the dramatic, and the threatening. As the Philadelphia Bulletin announced in its headline: "Genetic scientists seek ban -- world health peril feared."

As a result, the scientists resolved to exercise greater control over the press at the international safety conference held in Asilomar. At first, attempts were made to exclude the press entirely[28]; eventually only 16 reporters were permitted to attend. The CBC correspondent was denied press credentials.

The reporting that was produced was, at the time, widely praised for its quality and clarity. As Goodell observes, however, the embargo had the consequence of encouraging coverage that adopted the terms favoured by the scientists present.

> Thus, much of the press largely accepted the scientists' definition of the problem -- a narrow question of health risk -- and the scientists' approach to a solution: self-regulation by the researchers. Both organizers and the press failed to anticipate later criticisms about the technical importance of including experts from other fields, such as epidemiologists and occupational health specialists, and the political importance of opening the meeting to more lay participants. Ironically, although many of the Asilomar organizers were reluctant to admit the press, they would later point to the reporters' presence as evidence that the meeting had had "public participation" (Goodell 1986, 172-173).

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[28] Goodfield (1981) mentions that initial plans were to invite only two journalists.

Goodell detects certain recurring oppositions in coverage: stories would come to pit "opponents" of the research against "proponents", or risks versus benefits. In the wake of Senator Edward Kennedy's hearings, which called for greater lay participation in the debate, stories began to be structured in terms of the opposition between "public involvement" and "freedom of scientific inquiry".

Over the course of 1977 and much of 1978, however, concerted lobbying by members and organizations of the scientific community succeeded in dampening the urge to impose federal regulation on recombinant DNA work. At the outset of 1977, some such legislation seemed inevitable; by late 1978 it had become clear that only a serious accident in microbiology would resurrect Congressional action.

Goodell attributes the lobbyists' success to two persuasive lines of argument which came to dominate public discussion and press coverage. The first insisted upon the availability of new data that showed the risks associated with recombinant DNA work to be much less than had been originally supposed. (Goodell cites an article by Barbara Culliton in Science which argues that the "new data" argument was stressed to legislators in part as a rationale by which they could withdraw support for regulation of biological research, should the need arise).[29]

The second, and related, path of argument was that the vast

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[29] B. Culliton, "Recombinant DNA Bills Derailed: Congress Still Trying to Pass a Law," Science, Vol. 199, January 20 (1976).

majority of scientists, including many of those who had initially raised concerns about the proposed experiments, were now satisfied that the work posed no special danger: i.e. that many "opponents" had now become "proponents", that the ranks of the latter now vastly outnumbered those of the former, and that those who continued to resist the course of inquiry were in any case hampered by their lack of expertise and panicked by unreasonable fears. In the course of the lobby, Goodell reports, individual scientists were advised that research grants or promotions might be jeopardized by continued criticism of recombinant DNA research, and leaders in the field began to deny interviews to journalists who planned also to interview opponents of the work. As a result, criticism of the research diminished, with the effect that safety aspects of the issue eventually disappeared.

The lull in reporting on recombinant DNA was brief, as coverage relatively quickly turned to what Goodell describes as a "news story" -- the promise of the genetic engineering industry. In fact, it is possible to see this new press interest as a natural outcome of the disappearance of reservations about the safety of the research, and of the victory of those who touted its potential as a tool. Nevertheless, Goodell observes that while the U.S. Congress was in the process of drafting legislation, industry took no pains to publicize its involvement in recombinant DNA. As legislation began to appear less and less likely, however, industry embarked on a campaign of public relations that capitalized on technical successes and promoted the potential for benefits and profits from genetic engineering. Once again, Goodell argues, coverage followed the views of scientist-spokesmen, and neglected the cautions of health specialists, financial analysts, or critics of any hue. A headline in Newsweek hailed "The miracle of spliced genes." Life referred to the "Miraculous prospects of gene splicing." More recent coverage has dealt with the ethical issues attendant upon university researchers engaging in joint ventures with private industry, but Goodell notes that, again, this was a worry first voiced by scientists, not by journalists.

She accepts that some variant of the relationship between scientists and the press obtains in all avenues of journalism, but she suggests a number of reasons why its features should be so pronounced in the case of science writing, and therefore so "unhealthy (Goodell 1986, 177)."

Firstly, journalists are just as intimidated by science as other laymen, with the result that editors are inclined toward stories that feature sources with obvious credentials and pre-established credibility -- a policy that tends to focus press attention on the mainstream of scientific work and opinion.

Secondly, inexperienced journalists are unlikely to embark on investigative ventures that involve acquiring and evaluating information that has not been volunteered by the scientific community. Even experienced journalists are wary of such reporting, since it might well jeopardize the relationship they have developed over time with a distrustful scientific estate. As well, veteran writers all too often share scientists' enthusiasm for science, and, like scientists, worry that reporting on the political aspects of the endeavour will merely tarnish its image. The end result is that

> scientists and science reporters have frequently assumed that the views of scientists on scientific issues are definitive, the product of expertise and collective wisdom, and that the views of lay participants such as environmentalists, labor leaders, or religious leaders, are somehow inferior or extraneous (Goodell 1986, 177).

As a consequence, it would appear that within the dominant concern over popular science a relatively new criticism has begun to emerge: namely that, far from ignoring or distorting science in its coverage, the press is in fact unwittingly complicit in the advancement and protection of the interests of the scientific estate. The significance of this development lies not in its exposition -- the criticism is once again advanced on the back of an alternative view of what science coverage <u>should</u> contain -- nor even in its assertion that the norms of journalism should not be subordinate to the demands of science, but in the suggestion that the interests of science are not necessarily those of society as a whole, and that the voice of scientific authority should not be necessarily dominant over all others. Such a suggestion derives from a very different, albeit tacit, understanding of the nature of science and its proper place in social affairs than has heretofore informed the writings on science and the media. Indeed, although neither Nelkin, Altimore, nor

Goodell actually say so explicitly, it implies that the science communication effort since the 1950s has been successful -- it has domesticated the press as an agency for the transmission of scientific pronouncements -- but that the motives and the results have not been exclusively to the public good.

At present, however, the implications of such contentions, and the significance of the discourse on popular science in bringing about the current state of science coverage, remain largely unexplored.

4.8 The Problem of Disinterest: Exciting the Unexcited

There remains one final problem for those who would improve science reporting. Given the finding by Miller et al. that the public "attentive" to science is at most perhaps one-fifth of the total population, and given the drive to purge science coverage of "sensational" elements that appeal to reader interest, the issue becomes how, in practice, to produce a science writing that, while true to science itself, is nonetheless sufficiently arresting to capture widespread public attention. That is, even if the press dramatically increased the quantity and quality of its science coverage, what would guarantee that the laity would respond? Would the simple presence of more and "better" science news result eventually in a scientifically literate population?

In essence, after all the studies, the content analyses, the essays and recommendations, what remains is the rarely-spoken fear that without the narrative artifice that comes with press handling, science (to the non-scientist) makes for unfortunately dull subject matter. It is ignored by the press because the majority of readers express no particular appetite for it, and it is distorted by attempts to render it compelling.

Hence, in a poll of 2,000 Canadians conducted in the mid-1970s for the Ministry of State, Science and Technology, it was found that while 82.1 percent agreed that "it is important to be kept informed about science," (only four percent disagreeing), 54.1 percent also agreed that "most information about science is difficult to understand because the subjects are too technical." As well, 53.9 percent agreed that "most information about science is difficult to understand because of the vocabulary used," (Dubas 1976, 13).

The report emphasized, however, that:

> Science news and science features need not be dull; science need not be irrelevant and it need not be technical. Instead, scientific activities, if written with a happy combination of interesting subject matter and good news style, can stimulate the motiveless reader and attract the casual reader in the same way that any good story or feature will claim attention (Dubas 1976, 16).

Nevertheless, in the caution that "science news ... need not be dull," there is the clear indication that at present it is indeed dull, and that this is in part responsible for lay ignorance.

Farago, similarly, points to "the implicit, and often explicit, view that a great deal of writing received from the paper's own science correspondent is uninspired or downright bad, and he is being kept on as a general background fill-in, a token of good intentions (Farago 1976, 33-34)." Partly, he concedes, this has to do with science as subject matter: although there are those who expound "on its interest, thrill, and intellectual challenge ... [t]he truth is that large areas of science are tedious (Farago 1976, 42)."

Nevertheless, if science writing is to be successful, it must entice readers; to attract a readership, it must promise a pleasure in return. Barring startling tabloid-style treatment or coverage stressing imminent technical benefits, science has in fact only one pleasure to offer -- the pleasure scientists themselves derive from their work. The responsibility of the science writer therefore comes to include not only the transmission of scientific content, but the communication of the sense of wonder and adventure that drives science. Certainly, science writers themselves are capable of speaking about science in the most grandiose terms.[30]

The problem remains, however, as to how to capture and reproduce the pleasure of scientific inquiry. The solution most often proposed -- indeed, the only specific solution proposed -- is to treat scientific work as a form of investigation. As a tactic, this has a number of advantages.

First, it serves to divert attention from the sensational preoccupation with the "results" or technical applications of science, and instead focuses on the process of inquiry, as has been called for.

Second, in detailing the researcher's own procedures of inquiry -- the attempt to reason out the problem; the fortuitous discovery that is only meaningful given a certain theoretical grounding and experience[31] -- the journalist presumably comes

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[30] Thus Jon Franklin comments that "science in the last 20, 30, or 40 years has had much more impact on our society than politics has, for instance (Franklin 1981, 103-104)," and that "right now [scientists] offer the greatest hope and the only viable dream that we have (Franklin 1986, 146)."

[31] One might think here of John Polanyi's Nobel Prize work in the first instance, and University of Toronto astronomer Ian Shelton's discovery of Supernova Shelton 1987 A in the second.

closest to capturing the joy of scientists themselves, the achievements rooted in the mundane.

Third, by wilfully constructing his or her article as an account of an investigation, the journalist acquires the narrative element necessary to attract reader interest: a readily-available mechanism whereby the contents of scientific <u>reports</u> might be transformed into science <u>stories</u>. Clearly, the pleasure offered the reader is that of the detective story, in which a mystery is solved, a puzzle is pieced together, and a solution is eventually revealed by dint of effort, expertise, and either a flash of genius or luck, but most often both.

This basic format allows a good deal of latitude for the science writer, just as it does for the mystery writer, and the experienced journalist will likely have written a number of variations on the central theme. Drama is invariably heightened though when the stakes are high and investigation is also conducted under the pressure of time, and so two common variants are the "race against the clock", and the "race against a competing research institution" (both prominent elements of coverage of the Apollo program in the 1960s and of AIDS in the 1980s).

As a consequence, it is the process of investigation that is stressed in the literature, both as more true to the nature of science itself and more likely to cultivate lay interest:

> One must argue that the very best science writing does succeed in evoking this response in the reader: a feeling of working together to solve an important problem. The satisfaction the reader derives will therefore be not only intellectual but also emotional

... (Farago 1976, 11).

The most explicit directions are offered by De Witt C. Reddick in an undated handbook[32] titled Literary Style in Science Writing, published by the U.S. Magazine Publishers Association. Reddick emphasizes throughout that journalistic accounts of science should endeavour at all times to tell a good story, and tutors his readers in "the literary components of narration," which include:

> **Foreshadowing**: ... at the outset the reader must get the impression that the sequence of details is for a purpose, leading up to something significant.
>
> **Climax**: ... An informative story, as truly as an adventure yarn, should progress in stages, with each stage planned so as to have a beginning that suggests an objective or goal for that stage and a high spot for a climax ...
>
> **Conflict**: creates a sense of drama. The conflict in a science article is seldom between individuals; rather it emerges in the scientist's efforts to overcome obstacles to discovery and understanding.
>
> **Personalizing or humanizing**, of the story makes easier the reader's sense of participation ... A central character or hero gives the reader a viewpoint with which he can relate (Reddick, 18-19).

It is the very detail of Reddick's advice, however, that betrays the dangers of narrativizing science as a means by which problems are solved. The tactic is common, but it also admits of the complaint that it portrays science in altogether too heroic (and unrealistic) a fashion. Although this complaint is similar

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32 It was most likely published in the mid- or late-1970s.

to that made by Nelkin and Goodell, in this instance it is raised by scientists, and on quite different grounds.

Most particularly, the narrativized portrayal works to feed the sentiment that the scientist who has extensive contact with the media does so out of motives of self-promotion. Individual scientists may register no complaint in being cast as the heroes of grand procedures of investigation,[33] but their colleagues might well resent and deprecate such a representation. (It is to dampen such a possibility that Miller (1986b) cautions scientist-sources to give due credit to colleagues). As a consequence, it is a technique of science writing that may well inhibit scientists' inclination to cooperate with the press; certainly, it is a technique that risks on occasion the charge of "sensationalism."

As well, widely and repeatedly applied, it works to portray science in far too successful and reliable a light for the comfort of many scientists. Science-as-investigation stories, unless they are exceptional variations on the theme, require that the investigation actually result in findings of merit: the mystery must be unravelled if the reader is not to feel cheated. As a result,

> the public image of science tends to be one of a methodical force, ruthless and unstoppable in its logical and rational assault on the problems that face

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[33] Hence Tichenor et al.'s (1970) finding that while most scientists judged science coverage in general inaccurate, the vast majority rated stories in which they themselves were quoted as accurate?

> mankind. To use C.D. Darlington's analogy, what comes across is a picture of science as a giant steamroller, "cracking its problems one by one with even and inexorable force (Trachtman 1981, 14)."

Such an image, flattering though it may be, is judged naive by scientists themselves, who are all too aware that though their work _can_ be personally and socially rewarding, it is not perpetually so. Secondly, the portrayal may work to inflate expectations about what science can and cannot accomplish. These sentiments are most commonly expressed in the complaint that the press, in focusing on the successful outcome of investigations, cheapens science by representing it as a series of "breakthroughs" -- a complaint that features in the literature from the earliest text to the most recent. Kreighbaum (1967) made the point by quoting Dr. Edward L. Tatum, a 1958 Nobel prize winner in medicine and physiology, who objected not only to the overuse of such words as "breakthrough" and "major advance", but also to "those stories written as if the most recent findings were completely new, instead of based simply on, and continuing from, earlier work (Kreighbaum 1967, 165)."

Almost 20 years later, Fred Jerome lamented that still:

> All too often, the "Eureka!" approach to reporting science prevails. A review of cover headlines in _Discover_, _Science 82_, and _Science Digest_ for the first half of 1982 shows that "New!" was still the headline-writer's favorite word: "New Science and Fireworks," "New Facts Stun Paleontologists," "New Physiology," "A New Science That Can Predict Winners and Losers at Sex," "A New Geometry of Nature," "New Windows on the Body" (Jerome 1986, 150).

Like Nelkin (1987) and others, Jerome advocates coverage that would concentrate on "science policy" matters.[34] However, beyond the vague call for a science writing that will train scrutiny on the institutional aspects of science -- its politics and economics, presumably -- there is no attempt to specify what form such coverage might take, whether the scientific constituency would welcome such a development, whether editors would agree to it, and whether readers would find it an attractive innovation. That is, the call for the "politicization" of the science beat has thus far failed to set out what this entails and how it might be effected. It rests for the present purely on a dissatisfaction with the character of science coverage currently available.

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[34] A call that mirrors Lessing's (1963) appeal for an "issue-oriented" science journalism.

4.9 The Dominant Concern, Reconsidered

There is an irony in the dominant concern over science and the media that is only revealed following a review of the literature on the topic. In 1977, Goodell pointed out that public contact with scientists via the media is largely limited to a relatively small group of "visible scientists," whose members display similar traits and outlooks. In 1980, Dunwoody identified the existence of an "inner club" within the ranks of American science writers: a relatively small, collaborative group of journalists who dominate the science coverage made available.

The irony is this: The discourse on science and the media is itself dominated by a comparatively small group of academics who have made the subject their specialty, whose contributions to the literature work cooperatively to establish an agenda, who collaborate often, and who between them have largely fixed the terms in which the problem is to be understood. These individuals publish most frequently on the subject, and account for most of the major studies and most often quoted papers. They are typically attached to a science writing program or a department in which science communication is an emphasis, and hence they educate their students in light of the dominant concern. They organize and attend the meetings and conference sessions devoted to the topic. They are a sufficiently closed group that writers working counter to the dominant concern (e.g. Trachtman) may find their work ignored. In addition, they enjoy extensive links with scientific organizations and other bodies devoted to the advancement of science's interests and the improvement of its public image.

Indeed, much of the work on science and the media has been produced with the financial assistance of scientific bodies. The volume Communicating University Research is based on the proceedings of a conference held in October 1980, and financed by a grant from the Public Understanding of Science program of the National Science Foundation. Gastel's (1983) primer was published by the Institute for Scientific Information. Goodfield's (1981) volume was published by the AAAS. Friedman et al.'s (1986) anthology emerged from a workshop and symposium organized by the editors at the 1982 AAAS meeting, and although published by a division of Macmillan, Inc., the book was prepared under the aegis of the AAAS.

The result has been that the science communication project, in the U.S. at least, has been inextricably allied with the efforts of scientific organizations to engineer a coverage favourable to their own interests, and a public appreciation that will accede to science's claim on rational authority. Athough the champions of improved science writing admit freely that they are devoted to the cause of advancing science, they nonetheless deny that their work has been in the service of political interests, since science itself is taken to be a politically-disinterested endeavour. Because the dominant view has been isolated from developments in other academic disciplines which point to the role of science and scientific rationality in the preservation and management of social order, it has promulgated a view of science which sees the enterprise purely in its guise as objective inquiry -- and, indeed, the overall effort has been to entrench this view in the coverage of the press and in the popular imagination. That is, the dominant concern works precisely to deny the type of arguments about the social labour of science raised in the 1970s by writers such as Habermas and Feyerabend. Even those who call for attention to the "policy" or "politics" of science do so from a sense that current coverage is superficial and inadequate to its object, and not from any interrogation of how science exercises influence in the political realm. (The sense, rather, is that science feels the influence of political and economic pressures, and that this aspect of its performance merits greater scrutiny).

Nevertheless, despite the strength of the prevailing consensus, and despite the fact that efforts over the past 20 years have been devoted to solving the 'problem' of science and the media, the dominant concern comes to an untidy conclusion. It has been enormously successful in fixing the terms in which popular science is to be addressed; it has been instrumental in effecting the expansion of science communication (purely as a field of employment), particularly in the area of science information personnel attached to universities and institutions; and the sheer reiteration of its arguments has been such that no working science journalist can escape their influence. But in the final analysis, the premises on which the dominant concern is based have been assumed, rather than demonstrated; certain elements of the corpus are questionable in their method or authenticity; others acquire their cogency and rhetorical force only if one accepts the tacit assumptions on which they are based; and no definitive program to implement a sound science journalism that will also ignite popular interest has been forthcoming.

Indeed, as staunch as the consensus has been over the past 20 years, it unravels when called upon to elaborate techniques of adequate science writing, or to specify the form an optimal science writing should adopt. The actual suggestions as to how to write about science are either vague and of little practical value, or contradictory in their urgings. What remains, therefore, is a powerful discourse, firmly entrenched in the universities, promoted by scientific organizations and supported by constituencies of journalists and science information personnel, the major thrust of which has been the continual reminder that lay acquaintance with science is insufficient and that press coverage is inadequate. No matter, then, that no agreement exists on how exactly to improve science journalism. As long as these twin convictions persist, the problem of science and the media will remain, and the discourse which supports it will perpetuate itself.

Chapter Five

Demurring Voices

5.1 Elements of an Alternative Concern

Although a number of authors since the late 1970s have addressed the popular representation of science in terms other than those of the traditional problematic, these writings vary widely in their concerns and methods, they share no consistent theoretical terminology, and hence they cannot be said to offer a uniform voice oppositional to the dominant concern. Nonetheless, they are informed by a common theoretical background, which not only lends their inquiries a similarity of character, but directly contests the understanding of science and media action on which the dominant approach is founded. In that sense, these works can be considered together as a diffuse, but alternative concern.

The distinction between the two bodies of work is best illustrated by example. Gardner's and Young's (1981) critique of the representation of science on British television is particularly useful in this respect, not only because it faults the medium for providing precisely the sort of portrayal for which the (primarily North American) lobby for reform agitates, but also because it is so similar to the traditional approach in its construction and sentiment. It is, in fact, a conventional criticism of popular science coverage, followed by a call for its improvement; it merely levels its criticisms using markedly different criteria from those that have been heretofore dominant.

The authors open with the standard reminders that science is an increasingly important element of contemporary society, and that for most of the population information about it is provided by the media. However, they emphasize their rejection of the customary understanding of these facts. It is science as a mode of discourse they find influential in social formation, and they consider television's representations in that light, arguing that TV "constructs" a public image of science that conceals, but promotes, certain political interests. They reject the traditional distinction between science and its subsequent representations ("... it makes little sense to talk of a discrete body of knowledge and set of practices, apart from this representation") as well as the notion that popular science consists of the "innocent transmission of scientific achievement into the public domain (Gardner and Young 1981, 171)." They hold that television works to the advantage of a social order that would close off political intervention in the course of science.

The article therefore begins in the conventional manner, by launching the criticism that the current form of TV science is socially deleterious. Also like the conventional study, the authors acknowledge that much of the public image of science is conveyed via fictional programs, but their analysis nonetheless concentrates on documentary productions. And, above all, like those of the dominant concern, their criticisms are rendered in light of an argument about what media content <u>should</u> contain.

Unlike the conventional study, however, the critique is informed by an understanding that is indebted to developments in the history and philosophy of science (Kuhn and Foucault are included in the bibliography), and an understanding of mass communication which stresses its role in the propagation of "social meaning," rather than the transmission of information -- an understanding influenced by political theory which points to "ideology" as an important element in the administration of social order. Thus the authors see science as a powerful social institution whose claims to objectivity and value-neutrality serve largely as mechanisms to conceal its immediate self-interest and its larger political labour as the guarantor of "rationality."

Given such a view, their analysis of the televisual conventions of science representation ("White coat, test tubes and a 'talking head'") finds that these work to affirm the image of science as politically disinterested and detached from the influence of social affairs. This is in clear contrast to the treatment accorded other topics in public affairs, in which it might be acknowledged that an issue is controversial, and in which there is debate, argument, doubt. Unlike "political" subjects, science is rarely the subject of live panel discussions in which different and antagonistic opinions compete and are challenged. It is most commonly presented in the form of documentaries, carefully constructed to allow scientists to <u>explain</u>. "Stark disagreement is an interruption in the plot line (Gardner and Young 1981, 177-178)."

The voice-over favoured by these documentary programs

> is moderate, assured, reasoned. It is appropriate to a 'community' which is presented as neutral, objective, normally harmonious, disinterested and working for the good of humankind. Humour, irony, paradox and rhetorical questioning are rare, as are invitations to the viewer to dissent, criticise or respond ... It is hegemonic in the precise sense that it induces deference and organises consent by eliciting willingness to be the passive recipient of versions of history organised and presented for our edification (Gardner and Young 1981, 178).

The overall result, the authors argue, is that the conventions of television science are those of the lecture, in which viewers are "educated" in the contents of science and exposed to portrayals of its progress, while being cast in the role of dutiful but slow-witted pupils for whose sake ambiguities are smoothed over.

Horizon, the BBC's long-running (since 1964) science documentary series, is faulted for its impeccable adherence to just this format, and for its steadfast portrayal of science as inherently progressive, beneficial, and rational. By the staff's own admission, the program ignores the "radical science" movement and avoids politicizing science in its documentaries. Its aim, rather, is the explanation of scientific work in a manner that might capture the interest of a sizeable number of viewers (perhaps two million). Gardner and Young see the systematic exclusion of the social and political context within which science operates and makes its influence felt. In particular, they criticize the series for its reliance on establishment figures in science, and for its deference to the scientific community as a whole:

> Significantly, the Horizon team are [sic] very preoccupied with retaining the good will of the scientific community and don't often go in for hard hitting analyses unless the topic is already an established scandal. Even there, in the case of the IQ controversy, they are preoccupied with whether or not it's 'good science', where the real point at issue in this case is the ideological power of a particularly influential form of scientism which legitimates social and racial hierarchies by 'scientific' means (Gardner and Young 1981, 181-182).

The half-hour magazine program Tomorrow's World, also a BBC production, enjoys an audience of some eight to 10 million viewers, partly because it opens prime-time viewing on Thursday evenings and precedes the hugely popular music show Top of the Pops. Presented by a team of young, cheery hosts, the program focuses on inventions and technical developments, and its overall approach, according to Gardner and Young, is to

> dazzle them with the glossy, shiny end-products of science, wrapped up in a wholesome pastel-coloured package, but ensure that they don't have to think much about what they're marvelling at ... It is offering a very straight version of the meritocratic dream to young people awaiting Top of the Pops ... In the current economic climate this borders on the socially obscene (Gardner and Young 1981, 182-183).

The Yorkshire TV offering, Don't Just Sit There, is considered to have its merits, but it too is identified as being in the service of the dominant ideology. An audience-participation program in which a team of amiable experts was called upon[1] to provide "scientific" answers to viewers' questions ("Is it true that dropped toast tends to fall butter-side down?"), the series is congratulated on its democratic trappings and its irreverent atmosphere, which worked to demystify the scientist-as-authority. Nonetheless, Gardner and Young insist that even though the interaction between experts and lay viewers was "less pompous and authoritarian" than is usual, the lay participation was "ersatz, a carefully manufactured glimpse of more democratic possibilities," and that the format precluded "controversial social, industrial and educational issues (Gardner and Young 1981, 184)," concentrating instead on the domestic sphere.

Similar criticisms are levelled at the BBC's historical drama series The Voyage of Charles Darwin and Oppenheimer, which, though lauded for their production values and dramatic competence, are simultaneously faulted for their inattention to the socio-economic and intellectual contexts within which Darwin and Oppenheimer worked. It is noted that while the Darwin production employed maritime and historical advisers to guarantee authenticity in the scripts and on the set, the maritime adviser's advice and injunctions were scrupulously honoured, while many of the historical adviser's objections were sacrificed to dramatic expediency (the demands of American co-producers are cited here in particular). The result was that the program focused on the personal and intellectual antagonism between Darwin and Fitzroy,

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1 The series is no longer in production.

the captain of the Beagle.

> We end up with a dramatically successful, ideologically loaded portrayal of the lone genius pitted against the forces of ignorance and superstition, which no student of science or history could take seriously (Gardner and Young 1981, 186).

Oppenheimer is similarly found lacking, particularly in its concentration on the central persona of Oppenheimer.

> Such a preferred narrative approach as this cannot help but imply -- wrongly -- that individuals are the central agents of history. History, as Marx said, is made by individuals but not under conditions of their own choosing. Its portrayal cannot be reduced to the small change of domestic and workplace tittle-tattle (Gardner and Young 1981, 189).

Like Nelkin and others working in the traditional vein, the authors therefore chide the media for their inattention to the "political" aspects of science in contemporary society. Unlike their American counterparts, however, Gardner and Young are fairly explicit about what they mean by this charge. Further, they offer examples of what a science programming cognizant of the political character of science might look like.

> It is an urgent priority for television to alter its approach to these matters in fundamental ways:
> -- to move from science as cultural consumption to science as critique;
> -- from the content of science as progress to an analysis of the constitution of science, technology and medicine, of their labour processes and of their articulations with other practices;
> -- from the 'impact' of science to the process of constitution of its research programme, opening up to public scrutiny and prioritisation the origination of issues, facts and artifacts (Gardner and Young 1981, 174).

Such an approach would jettison the traditional assumptions that scientific progress is a process internal to science, rather than a part of the larger social tableau; that progress within science is divorced from the "social impact" of scientific knowledge; and that therefore there is a strict demarcation between science on the one hand (operating according to its own methods and priorities) and society on the other (which feels the influence of scientific advance only latterly). In specific, the authors argue that a "radical science programme-making strategy" would deal with the life and work of Charles Darwin by, first, breaking with the chronological, naturalistic narrative favoured by the BBC, since such a format near-inevitably locates historical causality in the person of a "great man." Second, it would reject the priority attached to Darwin's own writings "apart from their appropriation by his reviewers, protagonists, antagonists and a whole series of socio-political, intellectual and cultural discourses in his period and our own (Gardner and Young 1981, 187)."

Put into effect, such suggestions would clearly entail a break with the orthodox conventions of TV drama -- a recommendation made more explicit in the authors' commentary on how it might have been possible to film a "progressive" version of Oppenheimer.

> One could continually shift the point of view within which the audience is positioned so that they [sic] are able to explore the various aspects of this historical dilemma. One could get the audience to examine in Brechtian fashion, as opposed to being forced to

identify with the central persona of Oppenheimer and his own restricted perspective and network of personal relationships (Gardner and Young 1981, 189-190).

In conclusion, the authors agitate for a science coverage that would train attention on the historical forces which constitute the kinds of questions, frameworks and priorities science adopts; on the labour process in science (how, from the division of labour within the laboratory to the relations of production of science, knowledge is actually brought into being); and on "articulations" (how the results of science intersect with the rest of society to exert an influence on social affairs).

Gardner and Young therefore reproduce the format of the traditional "problem" of science and the media, and their article (actually a chapter in an Open University course text) is largely a zealous insistence on the superiority of Marxist history and relativist epistemology (not only because these aid in the analysis of how liberal democracies mask their own means of social control, but also because they are more "true" than their competitors). Their objections rest purely on the argument that current TV science fails to reproduce -- and therefore works to obviate -- Gardner's and Young's own understanding of the nature of science, which the authors hold to be more sophisticated, more accurate, and more politically sensitive than that promulgated at present.[2] Their recommendations, too, make no allowance for how

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[2] The authors are on occasion quite vociferous in their denunciations of broadcasting in this regard. Jonathan Miller's BBC series on medicine, The Body in Question, included a segment in which the program presenter placed himself in a sensory

they could in practice be implemented -- beyond the unlikely prospect that the BBC might be swayed by the strength of the authors' arguments into wilfully abandoning the traditional documentary format.

However, the Gardner and Young critique is quite atypical of work conducted in the alternative vein. Rather than agitate for a more "accurate" depiction of science, effort has been directed toward understanding how, and in response to what considerations, representations of science have been produced, and what social labour these representations may have performed in fixing the terms in which issues have been understood. Much of this work is historical, and although it may imply a critique of the social order being examined, the direct suggestion that current representations should (or could) be changed for the better is limited to Gardner and Young.

The alternative concern, as it has emerged, is therefore not distinguished by mere opposition to the traditional problematic. Rather, the elements which give rise to an alternative -- the elements which separate the Gardner and Young critique from its traditional equivalent -- are the rejection of a positivist understanding of science and the dismissal of a transmission

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deprivation chamber. Gardner and Young fault Miller for his concentration on how the senses work, and his failure to mention the use of sensory deprivation in military and police interrogation. Similarly, Miller is rebuked for failing, in his discussion of blood transfusions, to mention the sale of blood by the poor, alcoholics and drug addicts. "Only the body, as a discrete entity, was in question, not the social relations of the body of medical knowledge, much less the mode of production into which bodies are inserted (Gardner and Young 1981; 191)."

model of media action. The alternative vein is itself a product of a series of developments in intellectual inquiry, a moment identified by Cooter in the preface to his own volume:

> The period ... between 1974 and 1978, was that in which enthusiasm began to mount for the work of Mary Douglas relating patterns of belief to salient characteristics in social structures. At the same time, in the wake of the transatlantic influence of Thomas Kuhn's The Structure of Scientific Revolutions, there reemerged a sociology of knowledge with an emphasis on scientific knowledge. From across the Channel came the histoire des mentalités, structuralism, and the daunting genius of Michel Foucault. With the help of Frankfurt scholars, there blossomed an antidogmatic Marxist tradition willing to look hard at science and culture, while within the latter orbit came the stirrings of a vigorous community of social historians, a part of whose reaching beyond empiricism involved the rediscovery of the insights on ideology and culture of the Italian theorist Antonio Gramsci. All of these events bore upon the creation of this study and upon the way it would treat the problem that lies at its heart -- the problem of the relations between knowledge and power (Cooter 1984, xi).

Cooter describes an intellectual movement which sees "knowledge," even scientific knowledge, not as the transcription of the real, but as the end product of a complex and negotiated relationship with the real. Because it is a human artifact, and because it is the coin of social organization, it cannot but refer to the context of social interests from which it emerges. The task, then, is to understand how it is that certain forms of knowledge come into being -- to relate their contents and their labours to the social and historical circumstances of their production -- and to identify the political interests which benefit. Clearly, this involves peering beyond the claims that (particularly scientific) "knowledge" makes on its own behalf; it might involve undermining such claims. Nonetheless, this is justified on the grounds that a society in which the means of production of knowledge are closed, controlled and mystified is one in which the possibility of democracy is restricted. The critique of science is advanced in an effort to shed light on the hidden political operations of liberal democracy: those obscured by the action of ideology.

By contrast, the problem of the relations of knowledge and power is not the central concern of the dominant tradition and the writers Cooter acknowledges are absent from its bibliographies. When the threat of relativism is recognized by those writing in the traditional vein, however, it is forcefully rebuffed. At the height of the recombinant DNA controversy, for example, "investigative journalist" David Rorvik produced a book titled In His Image: The Cloning of a Man, which purported to document the successful attempt of a millionaire, "Max," to produce a genetic replica of himself as a son. June Goodfield objected to the book in the most strenuous terms because its contents, plainly a fiction, were originally presented as non-fiction and apparently accepted as such by members of the public. The publishers, J.B. Lippincott, defended the position that its truth or falsity was irrelevant: the book had served to arouse public interest in an area of scientific research pregnant with ethical considerations.

Such a defence, in Goodfield's view, is irresponsible. It is to invite anarchy and ignorance.

> If for them "truth" can become relative, then subjective, and finally irrelevant, why not for us, too? .. These are in fact not uncommon attitudes today, and the final result will be a totally cynical society in which personal responsibility is rejected and indifference and apathy are rife. Such a society is ripe for propaganda, exploitation, and manipulation, and perhaps we are nearly at this point (Goodfield 1981, 64).

The traditional approach would therefore sense in the alternative an attack on the rational authority of science; the alternative concern would likely identify its dominant counterpart as itself an element of a larger ideological formation. In fact, however, they rarely address one another. As forms of knowledge themselves, they are born of wholly different circumstances and interests. One is dominated by American media sociologists, and largely propounds the ideology of "scientism" criticised by its counterpart. The other is European in origin, and its concerns lead unavoidably to a disinterest in error rates detected in press coverage of science. Neither has had much to say to or about the other.

Because works in the alternative vein are as yet few and scattered in their intent, they will be considered here according to country of origin. The categorization is not entirely arbitrary: though they share a common analytical bent, the various works pursue their different interests in quite different ways. There is perhaps more pattern revealed by the nationality of the authors than by any other classification.

5.2 Americans

There have been at least three major studies in the alternative vein by American scholars. Of these, two are forcefully argued treatises, explicit in their theoretical grounding and analytical motive. The third is a simple and elegant case study.

The first two are similar in argument and intent, focusing on the efficacy of "scientism" in American culture. They are Robert G. Dunn's (1979) "Science, technology and bureaucratic domination: television and the ideology of scientism," and Michael L. Smith's (1983) "Selling the Moon: The U.S. Manned Space Program and the Triumph of Commodity Scientism." Each seeks to show how popular representation has been crucial to the propagation of ideology, and therefore to the maintenance of social order.

Smith's contribution is a history of the U.S. space effort, but one that seeks to show how the enterprise was "constructed" for public consumption, and what political ends were served. It is published in The Culture of Consumption, an anthology of critical essays in American history produced by the department of American studies at Yale University. The volume as a whole sets out to explore the transformation of American life over the course of the 20th century -- "to discover how consumption became a cultural ideal, a hegemonic 'way of seeing' (Fox and Lears 1983, x)".

From the outset, then, the anthology is "critical" in the sense that it examines the culture of consumption not simply to describe it, but to expose it. As the editors emphasize, their inquiry is indebted to a tradition of dissent that includes the work of Herbert Marcuse, C. Wright Mills and Thorstein Veblen -- a tradition in which the pursuit of commodities is considered small compensation for the silent disenfranchisement of the citizenry. They find democracy, not enriched by the expansion of the marketplace, but demeaned by it, as individuals come to invest their energies and incomes and happiness in consumption, while political power becomes increasingly concentrated in the hands of the few.

> People deserve a more democratic as well as a more affluent way of life. That belief unites the authors of these six essays (Fox and Lears 1983, xii).

Smith seeks to demonstrate that the U.S. manned space program was deliberately designed with the motive of galvanizing national pride by affirming certain national values. The rhetoric of exploration and scientific investigation was used to heighten the significance and the drama of the effort, the astronauts personified heroic qualities, and the media saturated the subject with unprecedented coverage. Promising unparalleled adventure and excitement in return for unbridled attention, the space program, Smith argues, was simply another commodity being sold to the American public -- albeit a particularly grand one. Its significance lay in its ideological labour; in the fact that men went to the moon to deliver, as Peter Collier points out, an

American flag and a television camera (quoted in Smith 1983, 206).

More than merely a vehicle for the celebration of national prowess, however, Smith sees the space program as an agent for the affirmation of scientism. Not only did the project (essentially a technical, engineering effort) appropriate the guise of science in its public portrayal, but it hinged on the generation of pride and euphoria in the masterful solution of a technical problem by an expert caste. It therefore involved the orchestration of popular consent for the notion that the goals of society are technical in character, rewarding this consent with a spectacular demonstration of success.

Smith's treatment is detailed and informative, and there is no need to reproduce his observations here. Suffice to say that he hopes to illuminate the features of the present social organization by examining how it has revealed itself in the past. The traditional 'problem' of science and the media has dissolved. And although it is no doubt possible to take exception with the essay (one might complain, for example, that the notion of the social commodity, when extended to the concept of "commodity scientism," has reached its heuristic limit), it is cogent and convincing in its argument.

Dunn's contribution distinguishes itself from the dominant concern by not only its theoretical posture but also its subject matter. He examines, not media accounts of science, but the dramatic articulation of scientism in media content. As a result, he eschews press and documentary coverage for fictional, prime-time programming.

His analysis is informed most prominently by the work of the Frankfurt school -- Marcuse, Adorno, Horkheimer -- and by Habermas, himself profoundly influenced by the Frankfurt school. The study therefore begins by asserting that 20th century science has been conscripted by an expanding industrial-capitalist system, and is now almost fully conjoined with the interests of those groups which maintain this system.

> The massive economic appropriation of science characteristic of the West has stemmed from and furthered the triumph of science in the bourgeois image, i.e. the science of positivism (Dunn 1979, 343).

The result has been Weber's "rationalization" of society.

At the same time, positivist science is seen as "a major ideological force justifying the corporate liberal State," particularly inasmuch as it reconstitutes politics as the administration of technical problems. It is for this that scientism is faulted most forcefully, because it is this that thwarts the performance of democracy:

> Bound exclusively to technical criteria, scientism represents a closed universe of discourse, where alternatives to prevailing societal arrangements are automatically dismissed by restricting definitions of reality to the existing factual order. The hidden nucleus of scientism, however, is manipulation and control, where the domination of people is inseparable from and justified by the 'management of things'. Indeed, the major function of the ideology of scientism is to disguise this domination as a series of technical solutions called for by 'scientific expertise' (Dunn 1979, 344).

His analysis of images of science and technology seeks to show just how the ideology of scientism is propagated. The content he chooses to examine -- prime-time television drama -- reveals that the preferred vehicle for its expression is the police or detective show, in which, typically, science is both a tool and a justification in the state's continuous violent struggle against crime, immorality, and its enemies. It is a means both to define "normality" and to enforce it.

Dunn argues that this is quite unlike the representations of science common from the 1930s to the 1950s, when science was feared as uncontrolled and destructive, and popular images focused on the maniacal, despotic scientist. In the 1960s, he contends, television shifted from the 'Frankenstein' caricature to the depiction of science as integrated with the official apparatus of the state -- an institutionalized effort supporting the public welfare and enforcing social justice (Dunn 1979, 345).

He cites Jack Webb's Dragnet as a progenitor of the programs to follow in the 1960s. In its clockwork plots and fetishization of "the facts," it empiricized drama and human action, and exemplified positivist thought and behaviour. Nevertheless, the major themes of scientism do not penetrate to the content of television programs until the appearance in the mid-1960s of spy dramas -- Mission Impossible, The Man From U.N.C.L.E. -- in which the capacities and mysteries of technology were themselves the dramatic allure. These were complemented by Star Trek, in which superior technology was the preferred means of resolving traditional social conflicts, and The Six Million Dollar Man and Bionic Woman, who exemplified the power and benefit of technical wizardry by being, themselves, partially circuitry and hydraulics.

Dunn devotes most of his attention, however, to the police drama, which he finds not only the most dutiful genre in its adherence to scientism -- the formula itself calls for the triumph of authority and the maintenance of the status quo -- but also the most prominent. In the fall season of 1973, 29 different police shows aired on American television.

Typically, Dunn argues, the programs of the late 1960s (Mannix, The FBI, N.Y.P.D., Ironside, Hawaii Five-O) concentrated their scientistic imagery in the theme of the bureaucracy. The hero would be defined by his functional position within a bureaucratic organization, and crime would be fought with all the technical resources of a vast government machine. Criminals themselves were rendered as rogue elements to be tracked down and confronted using the latest in sophisticated hardware.

> Ideologically, the institutions of social control in these shows represent an almost total integration of the authority of science (not science itself) with official government ... Hence, the crime drama merges the goals of official institutions and the goals of positivist science, reducing the activities and claims of both to a single rationale. Ultimately, this rationale is the preservation of order at almost any cost (Dunn 1979, 348).

By the mid-1970s, however, the resolute, authoritarian organization man had been replaced by the irreverent, rebellious, independent cop who was forced to work outside, or frequently against, the strictures of a unwieldy bureaucracy -- the "system." The protagonists in these programs often adopted the guise and the manner of the community they were policing (Baretta); they might be former criminals themselves (Mod Squad) or have served time unfairly (Rockford Files); they inevitably infuriated their superiors and flaunted social convention (McCloud, Quincy, Kojak, Columbo). As well, there was a shift toward what Dunn calls the "human relations" of police work. Programs such as Police Story, The Rookies, and Streets of San Francisco sought to portray the psychological pressures of the job, and showed the police to be aware of the social and ethical dilemmas their work involved.

Dunn argues that these program developments were a belated but positive response to the climate of debate and unrest that had prevailed in the 1960s. The 'new' crime dramas articulated a countercultural revolt against bureaucratic impersonality, and addressed feelings of alienation and powerlessness in a technocratic environment.

Nonetheless, Dunn finds that they ultimately served the interests of the dominant ideology. Though the cynical and street-smart police hero might resent the system, he still devoted himself to the pursuit of its goals. He made no effort to change the system from within; on the contrary, it accommodated itself to him, tolerating his idiosyncracies because of his professional competence.

> In effect, what was represented was a disguised entrenchment and fortification of scientism. Individualism merely softened and made palatable the prevailing technical and organizational rationales of the agencies of control. Personality only smoothed over the grind of bureaucratic machinery (Dunn 1979, 350).

Dunn argues in conclusion that the media of modern capitalist societies have become a primary focus of legitimation and consensus, and in that regard have become powerful ideological agencies. With the emergence of science as the hierarchically dominant office of legitimation, the media came to delineate the modern authority of science for popular consciousness. He finds this ideological labour fundamentally anti-democratic:

> by reaffirming bureaucratic authority and technical control, and by providing artificial experiences of mastery and control, the symbols of scientism attempt to further weaken opposition to the system of authority and to promote acceptance of the established social reality (Dunn 1979, 353).

His essay is suggestive, and contains a number of illuminating observations. Even on its own terms, however, it is lacking or incomplete, and certain of its assertions are contestable.

It is far from clear, for example, that between 1930 and 1950 science was popularly apprehended as a dangerous and possibly malevolent force, as Dunn contends. Although it no doubt admitted of such representations, as has been noted in Chapter Three this was also the period of Modern Mechanix, the New York World's Fair, and a belief -- with the interruption of the war -- in the world of tomorrow. Every movie depiction of the megalomaniacal scientist would be matched by another in which the scientist was a kindly gentleman whose attractive daughter would at some point be rescued by the rugged protagonist (Flash Gordon, Them, Forbidden Planet[3]). Certainly, if only in the person of Sherlock Holmes, the celebration of "scientism" in police fiction pre-dates television and enjoyed considerable popularity in the 1940s as a result of the Basil Rathbone film adaptations.

Dunn also fails to account for the shift he claims to detect in the representation of science and scientism in the 1960s. Why should science move from "the illegitimate or fantastic fringes of society" to the service of state authority at just that historical juncture? Indeed, since Dunn (following Habermas) points to the coincident rise of industrial science, scientific rationality, and the mass media, the themes of scientism should

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[3] Forbidden Planet (1956) -- essentially Shakespeare's The Tempest in a science-fiction setting -- perhaps best exemplifies the ambivalence toward science in the post-war years. Morbius, the scientist, is a heroic but forbidding figure: supremely rational, dedicated to his work, benign in his intentions, he is nonetheless frighteningly intelligent -- too intelligent, as the film later reveals. His mental faculties have been boosted through the use of an alien technology. Yet for all his intellectual prowess he is powerless to stop the gruesome murders that befall the crew of a visiting spaceship. Indeed, it develops that the lethal monster stalking the crew members is in fact the product of Morbius' own subconscious mind -- it is Morbius himself who is the murderer. Realizing this, and recognizing his inability to control the creation of his nightmares, Morbius kills himself and destroys the planet, so that the terrible alien knowledge that was his might never taint humanity. His daughter and the spaceship crew escape, and watch the planet explode from a safe distance.

presumably have been long central to popular culture.

Nor does the treatment suggest how these themes came to be appropriated by prime-time drama -- that is, how independent television networks came to consistently promote a specific ideology as a matter of entertainment. By what mechanisms do such grandiose social priorities impregnate specific television dramas? How do the programming decisions of producers and network executives -- decisions rendered in terms of program costs, audience demographics, and ratings -- come to embody the principles of scientism in media content? How can these mechanisms be sensitive enough to accommodate changes in popular taste, while remaining rigid in their preservation of the basic elements of a fundamental ideology? And how does one account for the massive popularity of programs which, according to Dunn, celebrate a bureaucratic and antidemocratic authority?

The merit of Dunn's article lies in the sweep of its argument, and yet its very breadth leaves it open to counterexample. Consider the wave of newly "realistic" television dramas popular in the 1980s: programs distinguished by multiple, continuing plots, ensemble casts, and a willful mimicry of techniques of documentary representation (the jostling, hand-held camera characteristic of TV news, extraneous background noise, and so on). Typically, the characters in these series (Hill Street Blues, St. Elsewhere, L.A. Law) do not so much serve the system as endure it. They are trapped in it, dependent upon it and yet brutalized by it. They are invariably overworked and (with the exception of L.A. Law) underpaid, and the system itself is corrupt, underfinanced, ill-designed, and seemingly perpetually on the verge of collapse. Indeed, it is the system itself that most often features as the villain in these dramas, wreaking its damage not only on social services (the quality of health care, the compassion of courts, etc.) but on the personal lives of those who serve.

Not only are individuals powerless to effect lasting change in their conditions, but the dramatic content of the programs documents scars these conditions inflict: the alcoholism, drug addiction, depression, infidelity, marital breakdown, and so on. No less than three hospital employees on St. Elsewhere have been driven mad by their experiences, and one to suicide. The idiosyncracies of character celebrated in the 1970s are rendered anew as insecurities, as pathetic defence mechanisms in the face of a ceaselessly hostile environment. When manifest in figures of some authority (as in Mark Craig, St. Elsewhere's chief of surgery, or Howard Hunter, Hill Street's Emergency Action Team commander) they are neither endearing nor admirable, but merely a burden to others.

Protagonists in these programs are therefore rarely "rational." Their actions are determined as much by circumstances beyond their control as by reason or training. Hence, though there is the clear suggestion that it is only through the heroism of individuals such as Furillo and Davenport that the "system" manages to function at all, even the heroes are seen to wrestle daily with their private demons -- Furillo is a reformed alcoholic, Davenport cannot bear children, both have been scarred by their years of service.

Nor is technical capability accorded much promise as an avenue of solution. Indeed, the latest in hardware and gadgetry, and the foibles of those who are mesmerized by it, was a running joke on Hill Street Blues; and the series studiously avoided the conventional scientific aids to detection. Criminals were apprehended because of police work on the streets, not because a lab analysis of carpet fibers placed the suspect at the scene. On St. Elsewhere, similarly, the technical capacities of medicine are repeatedly shown to do nothing to alleviate -- and frequently much to exacerbate -- the psychological pain of illness.

As a result, it is possible to see these programs as a form of popular resignation to the failure of ideological promises. On L.A. Law, the judicial system is structurally a forum of manipulation and deceit. On Hill Street Blues, crime issues from the economic conditions of the inner city. On St. Elsewhere, it is the shortfall between the promise of medicine -- its prior TV image -- and its actual performance that occupies the narrative. There is no suggestion that conditions might somehow improve. On the contrary, the expectation is that they will steadily continue to deteriorate.[4]

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[4] The single-season series Call to Glory perhaps captured this in its starkest form. Set during the Kennedy presidency, the program focused on a military test pilot and his family as he became embroiled in the political and military affairs of the day -- U-2 reconnaissance missions, the Cuban missile crisis,

One raises these examples at some length only to point to a shortcoming in Dunn's analysis. These programs are as 'obviously' disenchanted with the ideology of scientism as Dunn's examples are participant in it. If the media have been fully integrated as agencies of ideological propagation, then how have these aberrant dramas managed to slip onto the schedules and win popularity? Or, if they are not aberrant, then what political interest is served by television which draws attention to the erosion of living standards and social services? It might be possible to argue that, despite appearances, these programs do in fact promote an ideology of scientism, but it would require some considerable dexterity to do so. Even then, what would secure the claims of an alternative reading over those of the characterization just offered?

While Dunn's analysis is an attempt to specify how television entertainment works to affirm an ideology tied to grand social interests, Reingold's is more modest in its aims and closer to the traditional problem of science and the media in its

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Vietnam. The setting therefore included not only the most advanced, deadly, and symbolic artifacts of American technology -- jet fighters and rocket planes -- but featured as protagonists the most heroic of American characters. And yet the program made the point that these individuals and this machinery were stuck in history -- powerless to avert or prevent what the viewing audience knew was to come. By the end of the series, racial violence had made itself felt, cancer had struck the grandfather, the mother had succumbed to what would become known as the "problem with no name," the children had begun to reject the values of the parents, the father was bewildered by the imminent disintegration of his family, and America was about to escalate her involvement in Vietnam. The final episode was devoted to the assassination of John F. Kennedy.

concerns. It seeks to explore the circumstances of production which lead to the form popular representation of science ultimately adopts. Unlike the traditional concern, however, Reingold is not motivated by a desire to ensure "accuracy" in media portrayals -- indeed, the study demonstrates that any such efforts are invariably naive. Rather, he examines how in one instance the lobby for scientific accuracy interacted with the media to produce a dubious result.

In late 1945, Metro-Goldwyn-Mayer (MGM) decided to produce a film about the invention and deployment of the atomic bomb. It would not be a documentary, but a feature in the scientist-hero historical mold of The Story of Louis Pasteur, Dr. Erlich's Magic Bullet, and Madame Curie. Since the principal actors in the invention of the bomb were still alive and were prominent scientists and senior military officers, the studio had to secure their consent to being depicted. The result was a series of written exchanges between MGM and figures such as J. Robert Oppenheimer, Albert Einstein, Neils Bohr, and others, commenting on the project as a whole and the script in particular. These letters, along with various versions of the script as it moved toward completion, allow Reingold to reconstruct the process of the film's production, and to identify how the eventual picture -- The Beginning or the End, released in 1947 -- reflected the various pressures brought to bear on its content.

In part, what distinguishes the case study is the novel twist it gives the traditional problem of journalistic representation. While there was clearly the onus on the studio to produce a feature accurate to events and to science, it proposed to do so within an essentially fictional format: the conventions of storytelling would be those of the Hollywood melodrama. In the eventual movie, dramatic continuity was provided by two male characters: Matt Cochran, a young physicist, and Jeff Nixon, a young Army Engineer Colonel. Matt was newly married, while Jeff had a girlfriend who worked on the General's staff. Matt would not live to the end of the film.

Equally atypically, the suggestion for a commercial movie about the bomb came initially from the scientific camp -- from a group of younger researchers who were part of the movement which resulted in the creation of the Federation of Atomic Scientists and the Bulletin of the Atomic Scientists. The notion was that such a film would be one means among many of educating the public about the new weapon and its implications for international relations.

These scientists were active in the initial stages of script development, in part because they hoped the film might help to expand research budgets, and at the outset MGM made a great show of the importance of the project beyond mere entertainment. The studio foresaw "a great service to civilization if the right kind of film could be made (quoted in Reingold 1985, 230)."

By early 1946, however, the younger scientists had given up on the film, which they saw as glorifying the military and placing foolish words in the mouths of researchers. They had every expectation that it would never come to fruition, since their more prominent colleagues surely would not agree to such portrayals of themselves. They were unaware that on December 31, 1945 General Leslie R. Groves, the senior military officer on the Manhattan Project, had agreed to his depiction in the film in return for $10,000 and the right to review the script.

From the outset, MGM displayed a sophisticated awareness of the tension between dramatic requirements and the concerns of the most prominent characters, but with no admission that the former should be sacrificed to the latter. As the studio asserted in a memo to Einstein: "It must be realized that dramatic truth is just as compelling a requirement on us as veritable truth is on a scientist (quoted in Reingold 1985, 232-233)."

Accordingly, the original screenplay called for an opening scene that stressed both the veracity of what was to follow and the drama it would entail. Newsreel footage would show a print of The Beginning or the End being buried under a grove of redwood trees so that, 500 years hence, the truth about the atom bomb might be preserved.

The plot itself reproduced various incidents and events in the work on the bomb: Lise Meitner flees the Nazis to join Bohr in Copenhagen. Word of the new work reaches the States. Einstein writes a letter to Roosevelt (in the film, with the aid of young Matt Cochran) alerting the President to the technical possibility of atomic weaponry. Fermi achieves a controlled reaction in Chicago. Matt has qualms about working on such a terrible weapon, but overcomes them. Industry is recruited. The test at Alamagordo is a success.

Matt and Jeff then go to Tinian to prepare the first two bombs for deployment against Japan. While setting up the device one night all by himself, Matt suffers a fatal radiation injury. Hiroshima is devastated, Matt dies, and the film ends with Jeff, his girlfriend, and Matt's expectant widow talking together about how the new world to come will justify Matt's sacrifice.

Although almost all the figures to be depicted in the film objected to the screenplay, eventually most agreed to being portrayed by MGM. Oppenheimer, for example, reacted with hostility to the original script, but was assured by the producer that factual errors would be corrected, that it would be made clear that Oppenheimer, not Groves, was in charge of the Alamagordo test, and that the character of the on-screen Oppenheimer would be benificent and pleasant. Hume Cronyn, who would play the character, wrote to confide: "I gather that simplicity, warmth, and a complete lack of affectation are essential to your character." Oppenheimer signed a release shortly afterward, in May 1946.

> When queried incredulously by a scientist in the atomic scientists' movement, Oppenheimer defended his signing by asserting the main points were satisfactory: "namely scientists were ordinary decent guys, that they worried like hell about the bomb, that it presents a major issue of good and evil to the people of the world." Although the screenplay was not "beautiful, wise, or deep . . . it did not lie in my power to make it so (Reingold 1985, 235)."

Various other figures used the condition of their consent to force changes or additions to the script (Einstein, Groves, Vannevar Bush). Some (only the military) were paid. A few allowed themselves to be placed at the scene of certain events, but refused permission for their character to speak lines. Others (Bohr, Meitner) refused to participate under any circumstances. Each of these individuals exerted some influence or imposed some constraint on the film that was eventually produced.

For example, the intent had been to heighten dramatic tension by suggesting a race against Nazi science, with victory hanging in the balance. Hence the original screenplay called for Bohr to shock Oppenheimer by bringing news that German atomic experts and secrets were on their way to Japan in submarines. Bohr's refusal to sign a release blocked this scene. Objections and calls for revisions were registered from all quarters (including from Walter Lippmann, the columnist) not only over the screenplays, but over the first film version. The eventual release was extensively edited and included a number of newly-shot scenes.

But while the first version had met with an overwhelmingly favourable response from audience members at a sneak preview, the final print was drubbed by critics and ignored by audiences. Time wrote: "The picture seldom rises above cheery imbecility." It died at the box office and faded from circulation.

Reingold notes that it need not have been so: given Hollywood's past success with the genre, the film might have been popular if not for the insistent editorial demands of the real-life actors. His point, however, is not that the research community interfered to thwart the production of a commercially viable film, or even that MGM distorted the truth of matters in its efforts to play up the drama. It is, rather, that popular representation is the product of a complicated process of negotiation, accommodation, and demand; and that the outcome of this process must be considered as such.

> In ways sometimes subtle, sometimes gross, different messages are conveyed not always matching the intentions and needs of the creators of the exposition, their audiences, or the actual participants in the events described (Reingold 1985, 229).

In the short term, Reingold's case study should raise difficulties for those working in the dominant vein. Not only does it appear to show that "accuracy" (as the term is traditionally used) is rendered both irrelevant and impossible in actual media production -- the film or program creates its own "accuracy" -- but it renders highly problematic those studies which appeal to the judgement of scientists as the arbiter of press performance. In the case of The Beginning or the End, at least, the objections of the scientific community did little to enhance the popularity of the film and much to protect propriety and self-perceptions.

In the longer term, the study points to the importance of examining procedures of media production. If the aim is to understand how society's representations of science take shape, and to identify the various interests which contribute, Reingold suggests that inquiry turn to the conditions under which these representations are created.

5.3 Francophone Canadians

As yet, the major Canadian contributions to the literature on science and the media have been two: Bernard Schiele's and Gabriel Larocque's (1981) "Narrativité and scientificité dans le message vulgarisateur scientifique," and Bernard Schiele's (1983) "Les enjeux cachés de la vulgarisation scientifique." The first deals with the televisual representation of science, and argues that the medium is structurally incapable of conveying the realities of scientific inquiry; instead, TV decontextualizes scientific knowledge, offering the viewer the illusion of understanding by manipulating the signs of knowledge. The authors see this not simply as evidence of the shallowness or superficiality of the media, but as a feature of a social order which requires that the laity be assured of the truthfulness of scientific findings, but simultaneously excluded from the processes by which this knowledge is produced.

This study has been mentioned briefly in Chapter Four, and attention in this section will be limited to the more recent paper, which incorporates and builds on the arguments of the earlier work. Both, however, are immediately notable in that they are the products of Quebecois scholarship. As such, although they are aware of the work that has been conducted on science and the media in the English-speaking world, they are not bound by its agenda. Rather, they attack the topic with a view to the social significance of popular science -- a feature shared by other contributions to an alternative concern -- but they do so in an idiom and with an ambition of their own.

That is, while writings in the dominant vein markedly ignore questions of social theory, and while the thrust of an alternative approach is to drive analysis toward the detailed case study, the Quebecois scholars aim to advance a grand argument about the nature of contemporary society via a largely philosophical discussion of the place of science in public life. Schiele (1983) is more explicit and more audacious in this, mounting an attempt to expose "les enjeux cachés" -- the hidden stakes -- of popular science.

He begins by pointing out that the popularization of science is inextricably linked to its actual practice, and that indeed the institutionalization of science in the West entailed sharing the fruits of its inquiry with the larger populace. Although he recognizes the division between the practitioners of science and its popularizers, he nonetheless stresses their past interdependence. Far from being oppositional in aim and character, they have worked in concert to exercise a social authority: science serves as the referent which legitimates its popular coverage, while the project of popularization in turn legitimates scientific inquiry itself. Together, they not only establish the features of the "real," but contribute to the regulation of social relations toward it.

Schiele detects, however, a relatively recent change in the relationship between the two fields. He argues that heretofore popularization has been subordinate to the practice of science, lionizing that which it described; by contrast, popularizers have lately begun to claim dominance in the process of science communication, chastising scientists for their inability to communicate with one another much less with the public, and insisting that the dissemination of scientific information be governed by the rules and logic of popularization, not by scientific demands.

It is this shift which occupies his attention, for it is this that reveals, he contends, what is really at stake in popular science. What guides his analysis is the hypothesis that there has been a radical transformation in the production and diffusion of knowledge, with the result that science is no longer strictly dependent on its public representation. The new autonomy of popular science is not then simply a matter of a contest for supremacy between two camps, but a feature of a larger and more consequential development.

He notes that popularizers see their work as part of the promotion and propagation of scientific culture, but they impose two restrictions on the conduct of this work. First, they reject the pedagogical strategies of school instruction; second, they aim to present science in a manner shorn of its jargon and didactics. Popular science is not therefore an aspect of adult education: there is no progressive, gradual, coherent structure to its contents, as there is in formal schooling.

Rather, popularization is conducted in terms of the effort to reestablish links between the producers and recipients of knowledge -- two communities which, it is argued, otherwise fail to communicate. Popularizers conceive of themselves as intermediaries, publicizing scientific findings, explaining the workings of the research community to the laity, and representing social concerns to scientists so that inquiry might be pursued in light of a larger social project. In that sense, they see themselves as arbiters in the democratization of culture.

> Ce projet n'est pas nouveau, il traverse toute la pensée occidentale. L'équation est simple: science = raison = liberté = démocratie. Savoir que l'on sait libère le choix car il peut être formulé comme un possible parmi les possibles, puis débattu, et enfin retenu ou écarté. Cependant, et c'est là toute la différence, le projet prôné par les vulgarisateurs s'accomplit à partir d'un lieu qui n'est pas celui de l'école ni du laboratoire (Schiele 1983, 163).

Schiele notes that popular science is vulnerable to the criticism that although the media may announce scientific developments, they ignore the processes whereby these results are produced. Such a complaint rests on the fact that popularization presents scientific findings in a manner divorced from concrete experience, offering no means to gauge their validity.

The contention is that to understand a science is to immerse oneself in the rules and terms which constitute it and which define the objects of its analysis. In the vast majority, the laity do not possess this experience, and hence popular science must fall back on the analogy as a means of "explaining" the unfamiliar in terms drawn from everyday life. At best, then, it communicates a fragmented understanding of science, with the result that it accomplishes neither the spread of "knowledge" nor the reconciliation of two exclusive cultures. The work it accomplishes, Schiele argues, lies elsewhere, specifically in the realm of ideology and the management of social relations.

In that sense, he emphasizes that merely to denounce popular science for failing to accomplish its self-proclaimed goals adds little to one's understanding. Similarly, to denigrate it, as do Gardner and Young, as the expression of a conscious political will (an attempt to manipulate popular expectations) is to overestimate direct political power and to underestimate the role of popularization in the realm of socialization. Rather, Schiele insists that popular science must be seen as a product of the media, answerable to their constraints.

Specifically, the media function as agents of the market-place, selling not only merchandise but their own cultural products, and these conditions govern their performance. As a result, Schiele holds that the media occlude what he calls their coercive strategies (Schiele 1983, 171) -- the means by which they assemble and hold audiences. For example, the constant change of theme and subject characteristic of magazine-format science programs, the inevitable dramatization of science, and the superficial treatment of topics are all means by which the media work to assemble the largest possible audiences, by simultaneously enticing interest while avoiding effort or boredom on the part of viewers. These strategies are often the endpoint of academic criticism of popular science -- denunciation settles on the inability of the media to transmit operational knowledge -- and yet Schiele would point out that to pursue such a course is to close off the possibility of a structural critique. He emphasizes, rather, that the ideological significance of popular science derives precisely from its weak cognitive performance.

The structural critique on which he embarks owes a good deal to the work of Jean Baudrillard. He argues that the construction of science in the hands of the media reduces the endeavour to its repertoire of discoveries, and the assimilation of these discoveries to the manner of their use or practical application. What is left is nothing but a simulacrum -- knowledge reduced to a sign of itself, which is then offered for public consumption. That is, just as a society of commodity consumption abstracts and occults relations of production, a society dominated by the logic and operation of the media abstracts and occults not only social relations but the production and relations of knowledge.

The mass media, Schiele suggests, did not by themselves institute this abstraction of knowledge, but they nonetheless contribute to it. It is here that Schiele veers from a simple consideration of the social uses of popular science to a grandiloquent vision of the changing nature of contemporary society. The key, he insists, is technological development, which has not only transformed the production and diffusion of knowledge, but more significantly has revolutionized the means of appropriation of knowledge. It is in this that Schiele locates the true stakes of popular science.

Toward pressing his point, he first distinguishes between knowledge and information. Knowledge, he contends, is composed of the entire set of all that is available to be understood at a given time -- the notion of accessibility is taken to be crucial. Information, by contrast, is defined as a signifying element transmitted by a signal -- it is knowledge in transit, while knowledge is accumulated information.

Further, knowledge distinguishes itself from conventional goods and services in that unlike goods it is inexhaustible (it cannot be worn out) and unlike services it can be stored. The teacher, for example, does not abandon what he or she knows in imparting knowledge to students. The assimilation of knowledge therefore does not involve exclusion; and its reproduction (its sharing) is free and collective.

Nevertheless, the ability to inscribe, transmit and preserve knowledge is said to transform a cultural product into a cultural good. The ability to do so is clearly not new -- it has existed since the invention of symbolic notation. However, Schiele claims that what is new is the power to reproduce knowledge inherent in the development of modern technologies, which extend this possibility to most cultural productions.

Until recently knowledge was exempt from the industrialization of culture simply because of the properties and technical limitations of the available machinery of communications; because of the social demand which their marketing helped to shape; and because of the specific conditions of the valorization of capital which obtained. (That is, although books clearly package knowledge in a form that can be reproduced and offered for sale, as the communication industries developed -- film, radio, television -- they did not deal in the commodification of <u>knowledge</u> as such.)

However, the coupling of computers and telecommunications, Schiele argues, has altered what can and is done with knowledge. By allowing the decomposition of sound and image into discrete units, the computer permits the production and spread of knowledge in a material form that can be readily stored and preserved. It therefore accelerates the insertion of knowledge into the cycle of capital, promoting its further commodification and extending the radius of the cultural industries.

The example Schiele offers is that of book publishing, in which the computer integrates traditionally separate operations into a single process which can be supervised by a manager who need know nothing about books. Hence, workers who had been protected from the ravages of capitalist specialization as a result of their artisanship are now brought into the fold of the modern production process. Book publishing, however, is only the tip of the iceberg; audio-visual techniques extend the process considerably.

The transformation of cultural products into cultural goods means that mastery of the production, conservation, accumulation and circulation of information becomes mastery of the procedures of production and distribution of knowledge. Knowledge becomes privatized as it depends increasingly on the private ownership of the technical means of its production: knowledge must constantly be mediated by technology.

Under these conditions, the scientific ideal -- the requirement of transparency, and hence sharing -- emerges as an obstacle to the expansion of capital. Science and the academy can be constituted as new markets precisely by denouncing them.

Thus, Schiele's overall argument is that scientific popularization (in particular its newfound claims of dominance over science itself) is a transitory phenomenon linked to the current hegemony of the mass media. The media, furthermore, are merely part of the growing cultural industries. Computerization extends the scope of the cultural industries, allowing even knowledge to become a commodity. As such, it is subject to the laws of capital which require that it be marketed. For traditional reasons, the academy had resisted the intrusions of capitalism. Yet new technologies now make resistance impossible, and the attacks of popularizers on the inadequacies of the academy in keeping the populace apprised of scientific developments are really part of capital's strategy in conquering new markets. He predicts, however, that the prominence of the popularizers will pass even as computerization subsumes the traditional cultural industries.

Schiele's contribution must be applauded for its audacity. On the basis of a perceived shift in the balance of power between science and its popularizers he purports to have identified a profound but hidden change in the operations of commodity capitalism and in the very nature of knowledge in contemporary society. His view is both pessimistic and predictive, but it is also open to a number of criticisms.

Schiele insists that popularizers have become the dominant partners in the science communication process, but his examples are less than compelling. He asserts that contemporary society is governed not by the rationality of science but by the performance of the mass media -- indeed, he refers to "la société mass-médiatique (Schiele 1983, 175)" -- yet he fails to specify precisely what he means by this. He claims that the commodification of knowledge is the crucial characteristic of the new and unfolding order, yet he admits that this process is at least as old as the invention of symbolic notation. Finally, in his portrayal of the power of telematics (computer-communications) he claims to have ascertained the essential features of a technology and an industry which are as yet in their infancy and which will develop in response to a complex social context, not by virtue of any inherent property of the machinery.

In short, the merit of Schiele's work lies in its ambition -- in the fact that it has become possible to mount such wide-ranging arguments with regard to the popularization of science -- and in the further possibilities it suggests. Its deficiency resides in the fact that he has not satisfactorily proven his case.

5.4 Anglophone Europeans

Much of the European work in the alternative vein is contained in a single recent volume, Shinn's and Whitley's (1985) anthology Expository Science. In the introductory essay, Whitley confronts the dominant understanding directly, and situates the contents of the volume in opposition to it.

He notes that popularization has been traditionally thought of as the transmission of scientific knowledge to the laity for purposes of education, legitimation and training, and that it is typically seen as a low-status activity subordinate to, and separate from, scientific inquiry itself. He argues that this is a view which embodies a specific understanding of science, its methods and procedures, and its connections to lay knowledge and audiences. Further, he contends that this understanding is flawed, naive, and increasingly inapplicable to contemporary science.

In particular (and in common with early stimulus-response analyses of mass communication), such a view conceives of the lay audience as large, diffuse, undifferentiated and passive. Excluded from the processes of knowledge production and validation, audience members are presumed to be incompetent to judge the status of the information they are acquiring. Scientists, by contrast, are taken to comprise a highly organized community which uses its special skills to arrive at "true" knowledge in isolation from non-scientists.

Whitley notes that since scientific knowledge is not directly accessible to non-scientists, the process of popularization is seen in terms of the translation or transformation of this knowledge into everyday language. Such transformation, it is supposed, cannot alter the truth status of the scientific knowledge, since this is guaranteed by the norms and procedures of the scientific community. It does, however, affect the form in which the knowledge finds expression. Hence:

> The conventional view of the transformation process is to treat it as a technical problem which can be surmounted by increasing the general level of scientific training in the population and to develop new, better ways of communicating complex ideas (Whitley 1985, 7).

As a result, he notes that the conventional view allows no place for the operation of feedback in the communication process. Because the scientific community is presumed to work autonomously from lay society, public acquisition of translated knowledge cannot influence the production of further knowledge.

Whitley finds, however, that the traditional understanding is flawed in all these assumptions. First, the conception of the audience for popular science as undifferentiated and passive is wholly inaccurate. Whitley points out that there are various audiences for popular science: scientists themselves; the educated public, particularly those with some science training; those members of the range of professional occupations which claim legitimacy from science, and who rely on it in their work; secondary school and university students, who may themselves enter science, and will in any case likely go on to support its claims to produce true and stable knowledge; and military and business groups which exert influence on the orientation of much research.

Secondly, he notes that the view of the scientific community as a monolithic elite answerable purely to set procedural requirements has been extensively criticized within the sociology of science, and that a more sophisticated understanding points to the social and historical contingence of scientific "truth."

Thirdly, he holds that the traditional goal of pristine "translation" is chimeric, since any rendition of knowledge in language and concepts alien to those of its production inevitably alters the nature of this knowledge.

> This is not simply a matter of "distortion" of the true message, but is rather an inevitable concomitant of translation from one system of discourse to another (Whitley 1985, 7).

Finally, he emphasizes that any consideration of popular science which neglects its play in scientific affairs -- that is, which ignores the possibility of "feedback" -- is inevitably incomplete. In the social sciences and humanities, lay standards and terms are often present in intellectual debates, and hence what counts as knowledge may well be affected by the contributions of non-scientists. Even in the natural sciences, a great deal of research requires resources from external agencies which must be convinced of the merit of the project under consideration. Applicants therefore must describe their work and aims in terms accessible to lay officials within funding agencies, and to specialists from related fields. In that sense, popularization is necessary to secure financial support and hence affects what work is carried out.

As well, many scientific fields -- e.g. cancer research -- rely on general public support for funds and legitimacy, while in other cases popularization is intended to win wider support for a particular position within a scientific controversy.

Whitley therefore faults the traditional understanding for its inadequate and ahistorical view of the sciences, and presents the work contained in the anthology as the product of an alternative approach -- one which sees audiences as differentiated and empowered; the scientific community as composed of a number of variously organized social groups (whose relations with lay interests and with one another are constantly subject to change); scientific knowledge as a socially-constructed cognitive object established through negotiations and communication among scientists; and popularization as a crucial element of the processes which determine what comes to constitute knowledge in a field at a given time. "Expository practices are not epistemologically neutral (Whitley 1985, 11)."

The major implications of this reappraisal for the analysis of popular science are the abandonment of any programmatic attempt to characterize the essentials of the popularization process, and a shift from the agitation to "improve" scientific representation to the effort to explicate the role of popularization in the entrenchment of scientific knowledge.

> The variability of the organisation and control of research suggests that the relationships between scientists and lay publics are also variable and changeable so that no single type of connection can be assumed to be general. The variability and constructed nature of scientific knowledge suggests that popularisation cannot be separated from knowledge generation and development but needs to be considered as part of the overall process of intellectual change (Whitley 1985, 11-12).

Consequently, the anthology rejects the sweeping and general pronouncements on popularization characteristic of the dominant vein, in favour of specific and detailed case studies, often historical, which seek to show how particular fields or issues were popularized and to what effect. Unlike the dominant concern, then, these papers concentrate on the social and political context of popular science, and are motivated by more than the drive to ensure that the interests of science are well-served by its public portrayals.

Because this realignment of concern focuses attention on the social determinants and political uses of "knowledge," contributors to the Shinn and Whitley volume are able to consider topics which fall outside the purview of the dominant concern. It is neither necessary nor possible to recount the contents of all the contributions to the anthology. One article, however, may be taken as representative: Jeremy Green's analysis of the media handling of the "XYY syndrome" in the 1960s and 1970s.

Green proposes not merely to chronicle this episode, but to attack the "myth" that "Popularisation equals Pollution" -- the dominant contention that popularization corrupts the content of scientific knowledge, and that this is the handiwork of extra-scientific agencies.

> Popularisation, in these terms, is something <u>done to</u> Science, and the distortion and degradation of the scientific content which it entails derives from either the ignorance of the popularisers, or their irresponsibility ... As such, the 'Popularisation equals Pollution' myth can be seen as a component of a greater corporate ideology of scientists (Green 1985, 139).

The XYY chromosome controversy provides an appropriate case study, since it was widely held by many scientists that proper scientific inquiry into the phenomenon was ruined by sensational media attention. It was argued that a false image of the behavioural implications of the genetic condition, and of the criminal tnedencies of men with an extra Y chromosome, was promulgated by the news media, and scientists themselves were not at fault. Green argues to the contrary that this account is both inaccurate and ideological, and that his investigations show, far from an opposition between scientific work and its popularization, a subtle and entrenched collusion. If a false image of the "XYY man" was created, it was not the product of purely journalistic imperatives.

Normally, human females carry two X chromosomes while males carry one X and one Y. The first case of a man with an extra Y chromosome was discovered in Buffalo, N.Y. in 1961. Physicians attributed no clinical significance to the abnormality, and as other cases were reported over the next few years, no specific

XYY phenotype seemed apparent.[6] In 1965, however, Patricia Jacobs and colleagues at the Edinburgh MRC cytogenetics laboratory discovered that there was a statistical excess of XYY males among the inmates of Carstairs, a maximum security hospital for abnormal offenders. Although it was not clear what the "natural" incidence of XYY males in the general population might be (Jacobs et al. estimated one in every 1,300 men), nine of the Carstairs inmates, or 3.5 percent of the population, were found to carry an extra Y chromosome -- seemingly a significant over-representation.

Jacobs' findings were published in Nature at the end of 1965, and prompted further studies of the chromosomal status of criminal offenders. Because the report implied that an extra Y chromosome might predispose its carriers to aggressive behaviour, it also spurred psychological and psychiatric examinations of those identified as XYY. By early 1967, publications such as Science News, World Medicine, and Science Digest had begun to report on the phenomenon, and a brief account appeared in the London Times.

However, in April 1968, Green recounts, there was a dramatic

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6 In geneticists' terms, the genotype is an individual's genetic complement; the phenotype is how this complement is expressed. Thus, the genotype of persons with Down's syndrome includes an extra No. 21 chromosome (the condition is known as trisomy-21); phenotypically, this extra genetic material results in certain physical characteristics, including a thick neck, slanted eyes, and impaired mental faculties. For many years the condition was known as mongolism, since Down's syndrome children seemed to have some facial features reminiscent of Asian populations. In the early 1960s, the XYY genotype appeared to have no such characteristic phenotype.

change in the representation of the condition and in popular awareness of it. On April 21, the New York Times announced in a front-page headline "Genetic abnormality is linked to crime". The accompanying article described the case of David Hugon, a stable boy formerly employed by the Aga Khan, who had been charged with the murder of a Parisian prostitute. While awaiting trial Hugon attempted suicide, and was consequently subjected to a comprehensive medical and psychiatric examination, during the course of which he was revealed to be XYY. The court subsequently appointed a panel of experts to advise on the scientific and legal significance of the chromosomal abnormality.

The opening of the trial therefore provided the occasion for a burst of publicity for the XYY condition. On the following day, it was announced that Richard Speck, the mass murderer awaiting execution, planned to appeal his sentence on the grounds that he too was XYY and was therefore not criminally responsible for his actions. In fact this story was erroneous, and it was not until some five months later that Speck was shown to have the normal complement of chromosomes. In the meantime, however, the story was repeated widely in the press and fuelled the discussion of the "criminal chromosome."

In October, the Hugon trial ended (with a verdict of guilty) and two further "XYY" trials opened. By the early 1970s the concept had penetrated to popular entertainment, giving rise to films, novels and a TV series in which chromosome abnormality compelled individuals to commit crime. In the popular understanding, the Y chromosome was the determinant of 'maleness' and the excessive aggression of XYY individuals could be attributed to their 'double maleness'. The import appeared to be that both the portrayal of crime as the product of social circumstances and the fundamental assumptions of the judicial process regarding "free will" might be in need of revision.

Green points out that this caricature of the XYY syndrome was almost wholly erroneous. The weight of evidence suggested to the contrary that XYY males were not particularly disposed to aggression. They tended to be imprisoned for repeated petty theft rather than for crimes of violence against others, and once incarcerated were less violent than other inmates. Nor had it been shown that all XYY males were criminal; on the contrary, it appeared that those in state institutions were a small minority of the larger XYY population. The "criminal chromosome" hypothesis rested, then, on data that was statistically significant, but in all other respects meaningless. Nor were XYY males the only genetically abnormal group revealed by karyotyping inmates. XXY males (with an extra "female" chromosome) were also over-represented. The notion that the Y chromosome was the repository of anti-social traits was dubious at best.

However, if the popular image of the XYY male bore little relation to the scientific "facts," Green contends it is far from clear that this was the fault of "media sensationalism." Indeed, he points out that the myth of the XYY man enjoyed currency in scientific circles prior to the publicity created by the Hugon trial. (If it had not, why would court medical examiners have bothered to karyotype Hugon's chromosomes in the first place?) In 1966, in fact, long before the Hugon story broke, a research group at Vanderbilt University in Tennesse had sought permission to perform a similar test on Richard Speck. Biochemist Mary Telfer admitted that "if I had to pick anyone who would fit the XYY pattern, I would have chosen Mr. Speck," and later claimed to have diagnosed Speck as XYY from his newspaper descriptions (quoted in Green 1985, 146).

As well, Green refutes the charge that distortions came about as a result of journalistic handling. A review of popular articles reveals that much of the actual explanation was accomplished through the direct quotation of scientists. It is the scientists who refer to the "hereditary affliction" that prevented Hugon from exercising responsibility; who speculate whether "the female sex owes its gentleness to the absence of a Y chromosome"; and who link the discussion of a statistical finding to grand theories of human nature and aggression. Further, a review of "intermediate publications" (Think, Psychology Today, World Medicine) reveals that the articles written by scientists were if anything more strident in their espousal of the XYY hypothesis (and therefore more "sensational") than articles written by journalists in the "popular" press.

Green also takes care to emphasize the various contexts in which this research was conducted and popularly represented. Interest in the XYY phenomenon -- both scientific and public --

was coincident with an apparent surge in the rate of violent crime, and certainly with an increasing public anxiety about crime. In 1968, during the fifth summer in a row of U.S. race riots, a Harris poll found that 81 percent of respondents believed law and order had already broken down. Accordingly, scientific inquiry into aggression (as measured by references in Biological Abstracts), after a long period of quiescence, increased by an order of magnitude annually between 1965 and 1974, as some biomedical scientists sought to demonstrate the relevance of their field to an understanding of the problem of crime (Green 1985, 152-153).

More pointedly, the XYY phenomenon meshed with both the prior findings and the disciplinary aspirations of human medical cytogenetics. Over the course of the 1960s, new techniques accelerated the development of the field, and researchers recorded a series of successes that imbued inquiry with a sense of rapid advance. In the process, they became accustomed to associating genetic abnormalities with profound phenotypical manifestations: Down's, Klinefelter's, cri du chat and other syndromes were all shown to be associated with specific genetic defects. There was every reason to expect that the presence of an extra male sex chromosome would manifest some similar characteristic abnormalities in its carriers.

At the same time, Green points out that cytogenetics was itself a young discipline bidding for status within an established hierarchy in the human and biological sciences. It maintained no specialized journal, and many of its papers were published in the <u>Lancet</u>, which Jacobs complained was a journal "doctors read with their breakfast on Friday mornings." In 1965, when the Jacobs <u>et al</u>. study was published, much of the bio-medical community was still ignorant of cytogenetics, unclear as to the import of these chromosome findings, and -- to the disappointment of the study's authors -- seemingly disinterested in the XYY discovery.

Green emphasizes that the tendency subsequently to present the Carstairs data in criminological terms must be seen in this light.

> Here, in the absence of a clearly defined or securely institutionalized audience, the Edinburgh group were [<u>sic</u>] attempting to address a heterogenous medical community. Thus, they were driven towards an expository strategy, and a particular kind of popularisation, which was especially susceptible to sensationalism (Green 1985, 155).

The prominence of the XYY syndrome in popular attention -- however brief -- can therefore be seen as not only the result of a confluence of circumstances, but as a vehicle for the promotion of a particular branch of scientific inquiry. Furthermore, Green suggests that scientists' denunciation of the press for its shoddy handling of the XYY affair is itself a defence mechanism. Once the baselessness of the various contentions was revealed, the cytogenetic commmunity specifically, and the scientific community generally, could distance themselves from the original hypothesis by pointing to the renowned capacity of the press to overreact and distort.

The point of Green's analysis is not simply that the traditional complaint of media sensationalism is ill-founded, but more broadly that the conventional approach breaks down upon close examination of the actual processes of popular representation. The labour of the press is not exhausted by the mere announcement of scientific developments, and any academic inquiry which examines the issue purely in terms of the accuracy or distortion of media coverage (as determined by the opinion of scientists) is not only misguided, but works to efface the social and political dimensions of popular science.

However, the most detailed case study thus far of journalistic labour in covering science is Roger Silverstone's (1985) Framing Science, an account from conception to fruition of the making of a BBC Horizon episode. Silverstone spent slightly more than two years observing the work of a documentary unit assigned to produce a film on agricultural science, focusing most closely on the producer, Martin Freeth.

The study explicitly distances itself from the traditional approach in its opening pages: although the questions it asks are familiar, as the work's title suggests they are posed within the terms of an alternative concern.

> It is not only a question of what we know [about science], how much or how little, or even necessarily how accurately, but of how what we know is presented to us and framed in a particular way. What kinds of questions are being asked of science by television? What kinds of assumptions are built into the decisions of programme-makers to present science in a given way?

> What are the constraints operating on those who work in television to produce science programmes? What conclusions about the place of science in our culture and in our everyday lives can be drawn from these considerations? (Silverstone 1985, 2-3).

The production process Silverstone documents began in October 1981 when the editor of Horizon suggested to Martin Freeth that Pat Roy Mooney's book Seeds of the Earth might make a suitable subject for a film. The book argues that the widespread adoption of high-yielding varieties of basic food crops has meant the drastic depletion of the planet's genetic resources. Over-reliance on a small number of varieties leaves farming vulnerable to massive crop failure. Further, increasing involvement in the world's seed trade by multinational drug companies has resulted in increased domination of international agriculture by the West. There were therefore two aspects to the story as originally proposed: first, the threat to the world's food supply, and second, the exploitation of the Third World by corporations of the industrialized West.

The film that eventually aired in January 1984, "A New Green Revolution?", bore little relation to the initial tentative concept, and Silverstone's account -- like Reingold's analysis of MGM's The Beginning or the End -- is painstaking in its documentation of the various constraints, demands, intentions, compromises, negotiations, and vicissitudes that led to the finished product. It is impossible to reproduce the rich detail of his observations here, but a few key points are worth mentioning.

First, it becomes clear that the terms of the dominant concern, when considered in light of the realities of documentary production, are hopelessly inadequate as either descriptive or prescriptive tenets. The process of bringing a documentary to fruition is so complex -- particularly in a case such as this, in which the attempt is not simply to document scientific work for popular consumption, but to present an argument about the social uses of research -- that it becomes impossible to legitimately assess the "accuracy" of the eventual film in anything approaching the simplistic manner suggested by many American scholars.

Indeed, Silverstone emphasizes that the problem faced by the program-makers is not how to "translate" the science without sacrificing its veracity, or how to engage the viewer without "sensationalizing", but how to make the film speak a "truth" that will be understandable, arresting, fit into a 50 minute format, and meet with the approval of BBC superiors. It is not a matter of merely transcribing in a TV documentary a truth that has already been divulged by science. The effort of the program, rather, is to construct its own truth -- by an appeal to science, certainly, but also by adherence to certain codes and conventions of journalistic investigation and representation. In short, the dominant approach is infirm because it considers journalistic labour as an imposition which works to degrade scientific findings; it refuses to consider how science and the press interact to establish what will be presented to the laity as knowledge.

Secondly, Silverstone makes clear that the debates over the nature and social place of science that have preoccupied academics -- and that have indeed given rise to an alternative approach to the analysis of popular science -- have also penetrated to program producers, and in doing so have influenced the form and content of the science coverage being made available.

Gardner and Young are correct in that there is a Horizon "style" in science documentaries which tends to be driven by the testimony of scientists: typically, Horizon programs attempt to explicate the contents of scientific research, relying on picturesque location footage, shots of science at work, and the on-camera presence of individual scientists to tell an engaging and informative story. Such programs are vulnerable to Gardner's and Young's criticism that they represent science as unduly heroic, emphasizing the rational, progressive nature of its inquiry at the expense of the social and political context within which it operates.

At the same time, however, Silverstone makes it plain that the Horizon staff are keenly aware of this, and sensitive to the limitations imposed by the series' signature style. Indeed, Gardner's and Young's disparaging characterization of the typical Horizon episode as little more than "white coats and test tubes" has its equivalent within the corridors of Broadcasting House, where even Horizon employees refer to the "argument and wall-paper" construction of their own series. As a consequence, many of the problems faced by Martin Freeth in the production of "A New Green Revolution?" can be traced to his desire to make a film that would not be a "straight" or conventional Horizon -- i.e.

that would forego detailed discussion of the science of crop genetics in order to deal explicitly with how the efforts of agricultural scientists have been greeted by Third World farmers; with the difficulties involved in putting the results of laboratory research into practice on peasant farms; and with the political and economic priorities that have driven research in specific directions.

Ironically, the finished film was more "political" than Freeth himself had planned originally, largely because the executive producer of PBS's Nova series (which often buys Horizon episodes) declined to purchase a penultimate version on the grounds that it was too dull. The re-editing which ensued was, as a consequence, conducted in an effort to strengthen the storyline of the documentary, which meant a greater emphasis on political, economic, and military aspects of agriculture in the Third World. The recut version met with the approval of his superiors, and Freeth himself observed that "My diffidence with the political message of the film comes from my complete misreading of the department's attitudes to political messages (quoted in Silverstone 1985, 153)."

Indeed, once it was complete, he freely discussed his intentions in making the film, and these run counter to the notion that popular representations of science inevitably articulate a latent or explicit scientism. Freeth allowed that, at minimum, he hoped viewers would come to question the assumption that technological solutions to the problems of the Third World are necessarily desirable, even if these solutions should prove sound and profitable for the Western nations. At most, he hoped viewers might agree that although the researchers are well-intentioned, they should receive support only for those projects which might be in the interests of the people of the Third World; that regimes which perpetuate inequality (for example, the now-deposed Marcos dictatorship in the Philippines, with which the film dealt) should not be supported with technical and development aid; and that aid programs must be seen as elements of national and international political and economic systems, rather than as innocently benevolent or humanitarian efforts (Silverstone 1985, 181-182).

Finally, Silverstone makes plain that the reception of the film varied widely amongst audience members. Consequently, any characterization of science communication which sees the process in terms of merely relaying a scientific truth -- such that it will be understood in an identical manner by different audience members -- neglects to consider the realities of mass communication.

The reaction of audiences, the press (whose television critics were generally favourably disposed), and those scientists contacted during the course of the film's production were explored by Silverstone himself, by the BBC Audience Research Department, and by the Broadcasters' Audience Research Board (BARB). Silverstone submitted a questionnaire to consulted scientists who had seen the completed film, and assembled a group of academics in biology, electrical engineering, economics and law, for whom it was screened and whose comments were then invited. The BBC convened four groups of eight men and four of eight women, all between the ages of 20 and 54, to discuss the episode. BARB reported on its daily panel survey.

Silverstone reports that the consulted scientists and biologists were substantially more critical of the film -- both of its presentation of science and its political arguments -- than were their colleagues in the social sciences and engineering. The social scientists appeared to understand the program in terms of the social, political and economic failure of the Green Revolution. They therefore accepted and were sympathetic to the film's arguments, although they generally denied having learned anything new, claiming that its contents were already familiar.

The biologists and engineers, by comparison, identified more closely with the scientists depicted. In particular, the biologists were most resistant to the notion that the Green Revolution had failed, or that its deficiencies were the fault of the research community, although they nonetheless tended to accept the basic political arguments with regard to the Third World. The engineers were most likely to express irritation with the film as a whole.

The discussion group members convened by the BBC and the BARB respondents expressed general satisfaction with the film, although there was some criticism of its construction -- slow, jumpy, repetititive -- and many mentioned that had they not been commissioned to watch it they would not have done so. Not surprisingly, the lay respondents were less inclined to object to its contents on technical grounds than were the academics. Perhaps most revealingly, attitudes appeared to diverge according to the sex of the respondent. Women either detected no bias in the program or agreed with the thrust of its arguments, while men were more likely to recognise the construction of a message in the film and take issue with it, often in terms of the opposition of politics and science. Women were more moved by the depiction of the plight of the people of the Third World -- particularly women and children -- and less inclined to quarrel with the film for its lack of emphasis on the science of crop production. Men, on the other hand, were more dismissive of images of wailing Bangladeshi women and more likely to fault the film for its inattention to hard science.

Few members of either the lay or academic groups saw the political arguments of the film as unacceptable or radical.

It should be mentioned that the opposition between the science and the politics of the issue -- an opposition that structured not only the production of the film, but which was reproduced in respondents' comments on the completed version -- is one which Silverstone rejects in his own heuristic. This does not mean that he in any way dismisses the remarks of audience members and scientists, but merely that he finds it significant that these were the available and common terms in which the program was viewed, understood, discussed and criticized.

> My account in these pages has begun with an assumption that would fundamentally reject the way in which the distinction science:politics is being offered. All documentary statements about reality are political just as all scientific statements about reality -- practitioners' claims notwithstanding -- are political. Both television and science are fundamentally and necessarily about power and control over knowledge. Both have the ability to define the frame for our understanding and acceptance of that knowledge (Silverstone 1985, 161).

Although Silverstone does not himself directly contest the methods and concerns of the dominant approach to popular science, his work nonetheless demonstrates the poverty of such an approach once the complexities of media representation are taken into account. In conclusion, the further research he calls for would shift the emphasis of analysis squarely from the effort to monitor how well the press represents science to the effort to understand how it is that media products are received and used by individuals and collectives. The questions he raises are those of identity: The first, a matter of viewer identity, inquires after how an individual program is understood in terms of an individual's relationship to television as a whole. The second, a matter of personal identity, asks what significance a program has for the viewer's life -- how does the individual use the content to which he or she has been exposed? The third is a matter of cultural identity -- how do media representations "express or contradict, reinforce, or transform the basic dimensions of a given culture -- the culture of a family, of a neighbourhood, of a class, of a nation? (Silverstone 1985, 198)"

These are extraordinarily complex questions, as Silverstone himself recognizes. The very fact that they have begun to be asked, however, portends a profound change in how press attention to science is to be addressed.

Chapter Six

A Week in the Life: Seven Days of Science Coverage

6.1 Notes on Method

What follows is neither a content nor a textual analysis. It is, rather, a commentary based on the most simple of empirical studies: an enumeration. The attempt has been to monitor media output over the course of seven days in the Montréal market, with a view toward constructing an annotated listing of the science coverage made available. The hope is that this brief and crude sampling, despite its limitations, might be used to shed light on the claims and arguments made by academics about popular science.

One should emphasize that even such a rudimentary analysis as this begins with the problem of exclusion: Which media outlets or publications will constitute the sample? What will determine what will count as an item of science reporting?

Montréal is a predominantly French-language city in a predominantly English-language country and a predominantly English-language continent. This lends its media market a distinctive character, dividing it into more than two camps: there are the local anglophone media, the national anglophone media, and the American media; there are the local francophone media, the provincial (national) francophone media, and the French media. Although the francophone population is well served in science reporting, the attempt here is to reproduce the coverage available to a single viewer. Since the anglophone and francophone markets overlap only marginally (anglophones do not tend to watch francophone television or read francophone newspapers with regularity, although the reverse is less true) attention has been paid only to English-language coverage.

As well, a relatively narrow definition of popular coverage of science, medicine and technology has been adopted. The range of computer magazines and television programs (PC World, Academy on Computers, Bits and Bytes), for example, has been excluded on the ground that though these deal with the latest in technological competition, and involve an element of instruction, they do not conform to what has traditionally been thought of as science reporting. Also excluded are those publications which address themselves primarily to a scientific audience (New Scientist, Scientific American), those which address a special interest (Psychology Today, Sky and Telescope), and those which favour the technical over the scientific (High Technology, Popular Science). The concentration instead is on the general science magazines.

Nor has any close attention been paid to the news weeklies, although it might be noted that in the week in question, neither Newsweek nor Maclean's featured any science news, but Time's cover story was devoted to developments in superconductivity.

In broadcasting, no attempt was made to monitor the various newscasts or newsmagazine programs. Suffice to say that all of the major networks employ reporters whose special responsibility is science and/or medicine. CBC's hour-long Mid-day, for example, (Monday-Friday at noon) is a lighter, faster-paced and pocket-sized version of The National/The Journal which relies on its own columnists and on reports from regional CBC newsrooms.[1] Each Thursday Bob Fournier, the program's science commentator, appears via satellite from Halifax. The piece typically takes the form of an interview, in which Valerie Pringle or Peter Downey puts questions to Bob on some aspect of science, such as volcanoes or allergies. Bob appears on a video monitor wearing his signature tweed jacket and flanked by shelves of laboratory glassware. He speaks with the persona of an amiable high school teacher, explaining plate tectonics to an intelligent and eager pupil. In addition, Mid-day also runs the reports of David Mowbray, science reporter for CBOT in Ottawa.

Purely for reasons of management, however, the daily news media are represented here by the two broadsheet English-language newspapers available in Montréal, the Gazette (Southam) and the national edition of the Globe and Mail (Thomson).

As well, the broadcast listing does not include the range of "nature" programs that dot the viewing schedule -- Oceans Alive, Wild Kingdom, Lorne Greene's New Wilderness, Struggle Beneath the Sea, The Untamed World, and so on. These programs, in dealing only with the natural (i.e. non-man-made) world, do not speak explicitly about science. It should be noted, however, that

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[1] The program is, in part, a means of giving regional reporters national exposure: it is a proving ground for talent that might advance to the national newsroom.

their contents -- whether on the aerodynamics of insect flight or the life cycle of the cougar -- have only been made available via the investigations of scientists, and hence they are at least implicitly about science. Their celebrations of the variety and grandeur of nature are also invariably celebrations of what is known about nature, and in showcasing science's observations and explanations they also advertise its capabilities and successes.

Nevertheless, the listing includes only those programs that foreground the contents or investigations of science -- that consider themselves to be "science" programs. Thus the film special Polar Bear! (CBC Friday 9 p.m.) has not been tabulated, despite the fact that it described the international scientific effort to learn more about the polar bear population and showed scientists at work in the field. The program was not really 'about' science or the scientists, and mentioned them only as necessary; rather, it was 'about' the polar bear. On the other hand, PBS's Nature has been included on the grounds that it presents itself as a science program, and invariably places emphasis squarely on the efforts of scientists to study, understand, or preserve the wildlife examined in that week's episode.

It so happened that the week selected for sampling featured no Jacques Cousteau or National Geographic specials, but such programs point up how any definition of popular science coverage begins to blur at its edges: should a Jacques Cousteau film on the sharks of Yucatan be classed as a science program or a nature episode? The point is not only that it is difficult to arrive at an exact and exhaustive definition of popular science, but more accurately that the forms in which science is popularly represented are many and various.

The listings also restrict themselves to non-fictional representations of science, in part because the intention is to review the arguments of the dominant concern in light of actual media performance, and the dominant concern itself does not address dramatic portayal of science. No effort has been made to document the reliance on science or scientific imagery in television advertising, for example, or to enumerate the instances of scientific investigation in hospital or police dramas. However, the scientific biography, dramatized or otherwise, is a common vehicle by which science is presented to public attention, and the single such episode which aired in the week monitored (TV Ontario's broadcast of the BBC's Marie Curie) has been duly noted.

Finally, no effort has been made to document the popular science volumes that would have been available on bookstore shelves in the week under study. Rather, the book review sections of newspapers and magazines, as applicable, were monitored for their attention to such works. It should be noted once again, however, that books by science journalists and by scientists themselves are a prominent and under-examined medium whereby science is communicated to the public.

Like the design of the study itself, its aims are extremely simple: by documenting the amount of science coverage available to a hypothetical media consumer in a single week, it seeks to show that there is a pattern to media attention to science. The task will be to account for this pattern in light of the academic and popular discourse on the problem of popular science.

It should be recognized, of course, that the device of enumerating the contents of media science over a single seven day period is more a convenient means to espouse an argument than any attempt to mimic a scientific method. The observations that follow are based on long experience with the forms of popular science, and the week's contents merely provide examples and support for these observations. One is not here constituting a limited sample and attempting to induce a larger pattern solely on that basis.

It should also be mentioned that, partly for convenience, partly in the interest of accuracy, the 'week' in question was actually composed of two seven-day periods. The print media were monitored from Monday, May 11, 1987 to Sunday May 17. Magazines and weekly tabloids were purchased on Monday, May 11 -- although, as is customary, this means that the weeklies carry the date May 19. The broadcast media received full attention from Sunday, May 24 to Saturday May 30. Not only would it have been difficult to keep track of all the media content in a single week, but in the earlier period the Stanley Cup playoffs were pre-empting much of the CBC's regularly scheduled programming. Even by May 24, as the series was concluding, the network's schedule was still not quite typical of its year-round performance. Thus, although PBS aired an episode of the CBC's <u>The Nature of Things</u>, the CBC itself did not.

The complete listings for the weeks' coverage are appended. For broadcasting, the full listings provide the title and duration of programs, the production company or network, time-slots, contents, and advertising or other support. For the science magazines, an account of the editorial and advertising contents of each is offered. For the broadsheets, the headline, length, placement and source of stories are provided.

The pattern revealed by this sampling is sufficiently obvious, however, that it should not be necessary in the comments to follow to call on the detail contained in the appendices, except indirectly. Rather, the results of the weeks' monitoring are represented in this chapter via the schematic representation or bald statement of their most salient features.

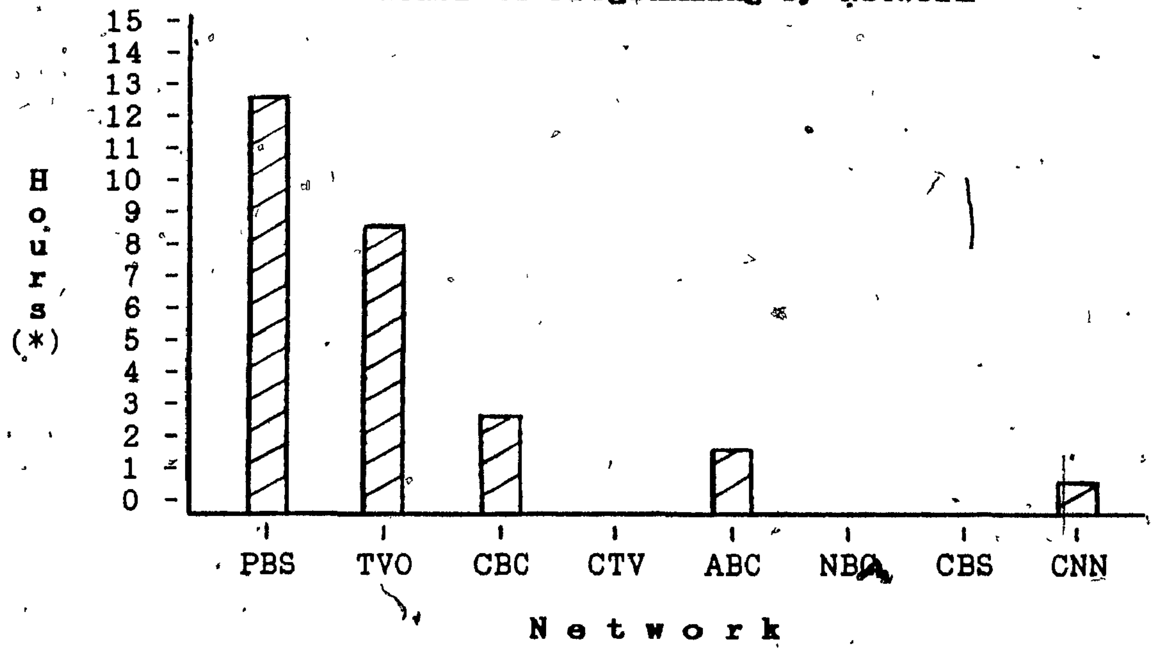
6.2 Television Without Advertising: Science in the Broadcast Media

Excluding the service channels (Super-Ecran, Home Shopping, etc.) and the entertainment pay channels (First Choice, Arts and Entertainment, etc.) there are 10 English-language television channels available over the Vidéotron cable network in Montréal, five American and five Canadian: WCAX (CBS), WPTZ (NBC), CBMT (CBC), WMTW (ABC), CJOH (CTV), CFCF (CTV), WVNY (ABC), CICO (TV Ontario), WETK (PBS) and the pay channel Cable News Network. All of these are commercial undertakings with the exception of TV Ontario, the Public Broadcasting System, and the CBC.

In total, 32 different programs devoted to some aspect of science aired during this week, the shortest being five minutes and the longest 90. All save Marie Curie and certain dramatized segments of the childrens' programming were rendered in the journalistic or documentary format.

By far the majority were aired by the three public networks, and by far the majority were produced by these or other public broadcasters. Of the 32 programs, only three aired on commercial stations. One of these was a news special in which the science was being used to make a case about an issue that has already captured considerable media attention (ABC's The Secret of Addiction). One was the all-news channel's 20-minute Science and Technology Week. And the third was ABC's The Health Show, carried by only one of the two ABC affiliates. CBS, NBC, and CTV

Table 1
Hours of Programming by Network



(*) Excludes repeat broadcasts.

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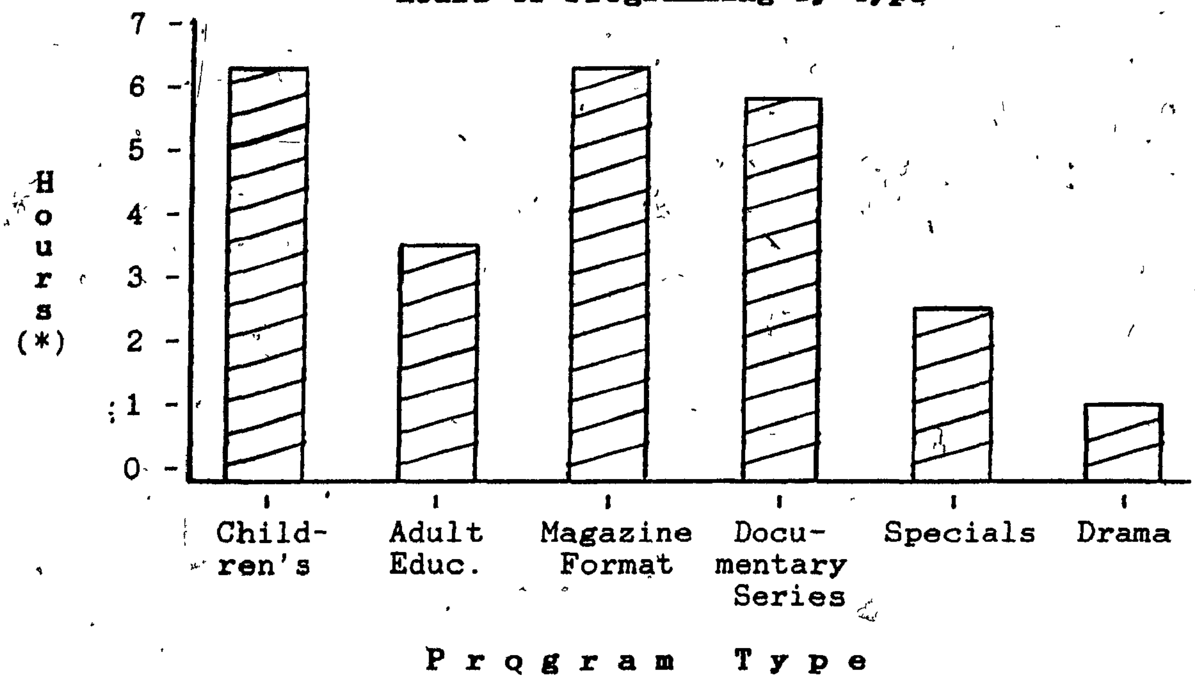
carried no programs devoted specifically to science or technology. The result is that the bulk of science programming carries little or no advertising, and finds financial support from philanthropic organizations, government agencies, or corporate sponsors.

Almost half of the programs (14) were rendered in a magazine format, typically featuring a number of different items in a half-hour time slot. Seven programs were aimed at various ages of children from elementary school level to pre-adolescents.

Eight programs can be said to have aired during prime-time. Two of these are radio programs: CBC's The Medicine Show (which follows the popular As It Happens on Wednesdays) and Quirks and

Table 2
Hours of Programming by Type

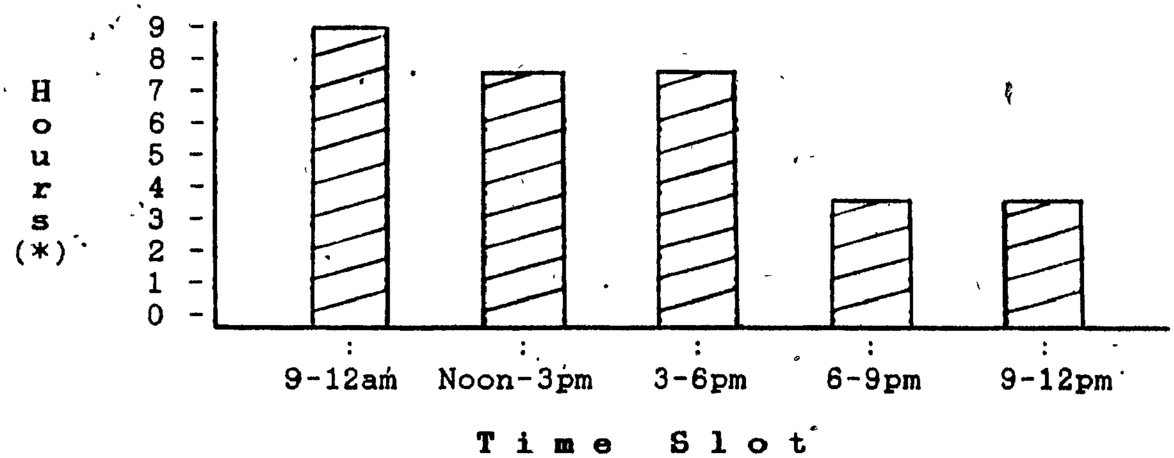


(*) Excludes repeat broadcasts.

Quarks (which airs shortly after noon on Saturday, a prime slot for information radio). The others tend to be 60 minute documentary series, and amongst the most expensively produced of the science programs: PBS's Nova and Nature, TV Ontario's Vista and the BBC's Marie Curie. Most science programming is scheduled in the morning and early afternoon, and much of it is concentrated on the weekend.

Seven of the programs aired as part of continuing education courses, and perhaps these should not be included since they presume a wholly different relationship with their audiences. However, one need not have been following a course of study in

Table 3
Programming by Time Slot



(*) Includes repeat broadcasts.

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order to understand or enjoy the individual episodes; they are largely rendered as documentary films, and even the most straightforwardly pedagogical (Sociology, or Understanding Human Behaviour) adopt the standard conventions of television journalism. A host narrates; authorities are interviewed; visually arresting footage accompanies the explanatory voice-over; effort is made to buoy the interest of the viewer. Indeed, one of the "instructional" programs, The Brain, originally aired as a documentary series during prime time on PBS, and although offered as part of a TVO learning course, has been counted here as a "documentary series" episode. The division between "journalistic" and "educational" science reporting is not as evident as some might insist.

Finally, even if one eliminates the children's programming, the instructional series, and the free-standing specials, this leaves a total of 12 hours of adult science programming available per week on a regular basis. Almost all of this content is stamped by the technically-competent and journalistically-responsible handling of the public networks.

6.3 Satisfying a General Special Interest: The Science Magazines

The story of the magazine industry in North America after the Second World War can be traced relatively straightforwardly. The first half of the century had witnessed the rise of the general interest magazine -- Collier's, Cosmopolitan, the Saturday Evening Post, Look and Life -- which provided a monthly compendium of features and articles, which made some appeal to each member of the household, and which prospered by promoting the rise of national brandname consumer goods. Soon after the end of the war, however, television emerged as both a more tantalizing general interest magazine and as a more cost efficient vehicle for advertisers. One by one, the general interest publications, expensive to produce and unprofitable to maintain, folded their operations or changed marketing strategy. Collier's was the first to close, in 1956. The Saturday Evening Post followed in 1969, Look in 1971, and the original incarnation of Life in 1973.

It developed that magazines could not compete with television as a general interest medium, but that television's universal appeal left a host of special interest markets available for exploitation. Television might be perfectly suited for promoting the sales of kitchen cleanser -- everyone who owned a television set also owned a kitchen -- but its economics and its demographics prohibited, for example, advertising music albums to teenagers.

The result has been the fragmentation of the magazine industry into a myriad special interest publications, addressing consumers in a particular guise -- Ski, Runner's World, Teenbeat, Soldier of Fortune, Gourmet -- and tailoring their advertising accordingly.

Although general interest periodicals continue to exist -- Reader's Digest being the most prominent example -- most magazines now address some special interest, and the most successful are those which have tied advertising revenue to the most widespread special interests. TV Guide, for example, is of interest only to those who own televisions; the reality is such that almost everyone owns a television.

Apart from TV Guide, the two most striking examples of the general-special interest magazine have been Playboy and the revamped Cosmopolitan under Helen Gurley Brown. These are magazines which address what Barbara Ehrenreich calls "singles culture," in both their editorial content and their advertising. They sell, as is commonly said, both a way of life and a range of goods which constitute it, prospering as vehicles for the promotion of a certain form of consumer culture.[2]

The vagaries of such a market have proven difficult for the publication of magazines catering to a special interest in science. Although the avid science reader might be of a certain type, it is not clear that the readership as a whole presents an

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[2] See Barbara Ehrenreich, "Playboy Joins the Battle of the Sexes," The Hearts of Men: American Dreams and the Flight from Commitment (New York: Anchor Books, 1984).

attractive or coherent target for specific advertisers. In a sense, interest in science is too general, in that it is spread across a range of incomes, occupations, and inclinations -- it entails no specific purchasing pattern. In another sense, interest is not general enough, in that readers may not be sufficiently numerous to make the venture acceptably profitable.

This is particularly pronounced in Canada, where as usual a small population and huge distribution costs inhibit the production of national magazines. In the 1970s, Canada's only English-laguage national science journalism magazine was Science Forum, published by the University of Toronto Press and distributed internationally by the Canadian International Development Agency. In 1978, the magazine left the university press and attempted to establish itself on the newsstands as a commercial publication. It folded shortly afterwards.

Until recently, the sole English-language science magazine was Dimensions (actually bilingual) published by the National Research Council, and available via subscription (although free of charge), in government offices, or in public libraries. In 1986, however, as part of its effort to encourage entrepreneurial ventures, the Conservative government "privatized" Dimensions. Essentially, the operation was closed and a $540,000 loan was issued to the Montréal publisher of Science et Technologie, a moderately successful French-language science magazine, who was given the contract to publish two new magazines: the English-language Science and Technology DIMENSIONS and the French-language Dimensions SCIENCE ET TECHNOLOGIE. If, in three years, the magazines were not commercially viable, the loan would be forgiven. In June 1987, it was announced that the publication of the two magazines would be suspended after only four issues each and an expenditure of some $324,000 of public funds.

The situation in the United States is no less tenuous. The boom that was proclaimed in science magazine publishing in the early 1980s would appear to be over. In 1986, both Science Digest and Science '86 (published by the AAAS) disappeared from newsstands, the advertising accounts and mailing lists of Science '86 being subsumed by Time Inc.'s Discover. On May 22, 1987, Time announced that after seven years and a total investment of $30 million (U.S.), including annual operating losses, Discover was being sold to Family Media for $26 million.

In the week under survey, there were four English-language general science magazines on newsstands: Science and Technology DIMENSIONS, The Sciences, Discover, and Omni. None of these is a truly "autonomous" science journalism magazine -- each is in its own way indebted to a larger agency for its survival.

Discover has been able to survive only because it has had the support of Time Inc., and indeed Discover's advertising content resembles that of Time magazine itself.

The Sciences carries little advertising and must be supported by the New York Academy of the Sciences and by its hefty newsstand price of $4.00 -- it is in that regard an equivalent of public broadcasting.

Table 4
Science Magazines

	Dimensions	The Sciences	Discover	Omni
Issue	May 1987 Vol.2/No.2	May/June 87 Vol.23/No.3	May 1987 Vol.8 No.5	May 87 Vol.9 No.8
Frequency	11 issues per year(*)	bimonthly	monthly	monthly
Publisher	Science & Technology Mondex Inc. & National Research Council of Canada	New York Academy of Sciences	Time, Inc.	Omni Publications International
Circulation	22,000	65,000	954,000	865,000
Price	$2.95	$4.00	$2.50	$3.00
Pages	62	72	104	138
Advertising (pages)	10.5	16	43	63.5
Paid Advertising Percentage	13%	20%	40%	46%

(*) Suspended June 1987.

<u>Science and Technology DIMENSIONS</u>, available in both official languages and with a minimum of advertising, exists by the grace of a government grant. It is an alternative version of public broadcasting.

<u>Omni</u> is part of the Penthouse publishing empire, its editor-in-chief and design director is Bob Guccione, and its advertising

content resembles that of its parent publication -- the magazine is fat with the products of the good life, particularly those which cannot legally be advertised on television: alcohol and tobacco products. Indeed, Omni resembles Penthouse in almost every respect. Both magazines open with one-page departments written by regular columnists. Both contain a general news section. Both feature an interview with a prominent personality, humorous cartoons, and lavish pictorials. Both carry journalistic features and appropriate short fiction.

It is not an oversimplification to suggest that Omni is Penthouse with the sex removed and science inserted in its place. The magazine is vulnerable to all manner of criticisms, but the fact remains that its appeal resides in its ability to make science and technology "sexy." Indeed, its very format distinguishes it from its competitors. While DIMENSIONS and Discover mimic the layout of newsmagazines, and The Sciences signals its non-commercial character with a coffee table design, Omni reproduces the look of the general-special interest magazines -- signalled most prominently by the mixture of fiction and journalism, but perhaps most significantly by the fact that Omni, alone of the four, commonly "turns" stories within an issue, so that readers are forced to flip past the advertisements.

The specific treatment accorded science by Omni meshes with its portfolio of advertising accounts. While Discover and DIMENSIONS are more stolid in their adherence to a journalistic priority, treating science as a beat to be covered, Omni unabashedly constructs science as an exciting, progressive endeavour, and an interest in science as an attribute of an exciting, progressive individual. The products advertised in its pages similarly complement the overall appeal.

Of the four magazines on the market in the week surveyed, only <u>Omni</u> has thus far sustained a commercially successful general interest in science.

6.4 The Prestige of the Science Reporter, The Convenience of the Wire Service: The Daily Press

In the repertoire of "beats" that a metropolitan daily newspaper might maintain, science occupies a distinctive, though ambivalent place. From the journalist's point of view it is acknowledged as a serious and relatively senior assignment. It endows the reporter with a specialty and an expertise. It also bestows something of the status of the feature writer: the science writer largely controls his or her own assignments; there is the luxury of time to develop stories, since science follows no daily schedule; there is an assured space for lengthy features set aside in the paper in the form of the weekly science section.

As well, the science writer enjoys a job that involves regular contact with leading researchers, and offers intellectual and material gratifications accordingly. Travel to conferences and research centres is permitted as necessary. One has the benefit of being apprised of the latest important developments in science by the authors of these developments -- a first-hand experience even scientists themselves do not possess.

For all its advantages, however, the science beat is generally not seen as a political beat, and it is therefore not widely regarded as an exciting or choice assignment (although it might be fair to suggest that every science writer believes he or she will be the one to establish the beat as an integral and interesting part of the paper). In many ways the science desk is viewed as too similar to the travel desk: both enjoy a measure of editorial freedom, but little critical distance. The travel writer is confined by the genre to write for a readership of tourists, while the science writer must presume a readership of enthusiasts.[3] Neither position is eyed by ambitious reporters as an obvious step on a route upward.

Inseperable from the character of the science beat therefore is the editorial decision as to whether to maintain one. Not all metropolitan dailies employ a science and technology writer, and although the absence of such a specialized reporter does not mean the absence of science coverage, no single factor so influences the form which a newspaper's science reporting adopts.

The most striking difference between the science coverage of the Gazette and the Globe and Mail, therefore, is not its quantity -- both carry roughly the same amount of science copy -- but its source. Excluding the bird-watching and computer columns (which, although placed in the Science/Medicine section, are not typical of science coverage), the Gazette ran 21 stories of more than five paragraphs during the week. Three were written by Gazette reporters, while 18 were supplied by wire services or from other publications.

The figures are almost perfectly reversed in the case of the Globe and Mail, which ran a total of 19 science stories of more than five paragraphs. Three were supplied by wire services, while 16 were written by the paper's own reporters, or by

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[3] Indeed, the Globe and Mail's current travel writer, Wallace Immen, was formerly the paper's science writer.

freelancers on assignment.

Doubtless these figures fluctuate from week to week. On this particular Saturday, the Science/Medicine section of the Gazette was filled with wire copy, but the paper often runs science articles by its own staff or by freelancers in this section. Nevertheless, the ratio of staff-to-wire copy in the science coverage of each newspaper is likely relatively stable. The difference derives from the staff each paper assigns to cover science and medicine.

The science staff of the Globe and Mail currently consists of a science editor, a science writer, a medical writer, and a reporter whose assignment is to cover AIDS. The paper also maintains two environment reporters, one full-time and one half-time, who may write on science-related topics (ozone depletion, toxic rain studies, etc.), and the Report on Business section employs both a reporter who follows the computer industry and one who reports on technology and biotechnology. As well, David Suzuki writes a weekly column and scientist Derek York is a frequent contributor to the science page.

The Gazette, by comparison, employs no science writer, and its science pages are assembled by a copy editor. The staff does include a medical reporter, an environment reporter (on leave of absence 1986-87), and a feature writer (a former medical reporter for the Globe and Mail) who often deals with health-related matters. The absence of a full-time science writer, however, stamps the Gazette's coverage indelibly.

The Globe and Mail's weekly Science/Medicine section runs prominently in the paper, appearing in the Saturday Focus section along with columns from national and international bureaus, editorials, and letters to the editor. The science page itself is a mini-version of the general science magazines: typically it is dominated by a large, illustrated feature (the cover story); often but not always there is a smaller feature lower on the page; there is the Eureka cartoon -- an amusing look at the foibles of science; there is a round-up of short items gleaned from the important journals; and there is Suzuki's column.

The Gazette's equivalent is buried deep within the paper, typically on the inside of section J. Without the staff to generate regular science copy, the pages are dominated by wire stories. There is little sense of the design evident in the Globe and Mail's science section. On the contrary, the Gazette's has the air of a dumping ground for columns that do not properly belong, and advertising that has little to do with science.

Both papers covered the Ottawa deliberations that week on irradiation as a means of food preservation, and although the Gazette responded more slowly than the Globe and Mail, it eventually flagged the story as an "Extra" on the front page, and devoted considerable space to it inside the front section.

Apart from the food irradiation story, however, the Globe and Mail was far more likely to cover science in its political aspects, or to link it to political issues, than was the Gazette. Thus the story "Researchers will leave if money not available, latest study reveals" dealt with the migration of Canadian scientists to better-financed institutions in the United States. "MDs singles club tests its members for AIDS antibody" presented information on both the disease and social reaction to it, in the context of the ethical and sexual issues it has raised. "Thinking the unthinkable" -- on brain tissue transplants -- ran as the cover feature for the Focus section, not the science page itself, and as such concentrated as much on the ethical/political aspects of the research as on the explication of the science it involves.

By comparison, the Gazette's wire service science copy stressed new facts and technical developments ("discoveries"), and was linked less to politics than to individual well-being. Thus the major features: "Fat widely condemned at Canadian Cancer Society conference" (which ran on the front of the Food section) and "Why we lose weight at different rates -- Your body may defeat your diet" (which ran on the front of the Health and Fitness section).

As well, much of the Gazette's science coverage took the form of medium-length reports (10 to 15 paragraphs) which ran in horizontal strips across the top of inside pages dominated by advertising. Usually these stories offered some new finding -- "NASA finds atmosphere, making it official: Pluto can stay a planet" -- or some startling development. In "Boy meets chimpanzee, and anthropoid makes three" scientists in Rome denounced experiments in the fertilization of a chimpanzee egg with human sperm, although they admitted they did not know whether such experiments were being conducted.

The point is not to insist that the science coverage of the Globe and Mail is somehow superior to that of the Gazette. The copy on which the Gazette relies is supplied from some of North America's most prominent newspapers, and is therefore as reliable and as competent as any available. The point, rather, is that these two newspapers cover science in response to wholly different criteria.

For the Gazette, the decision is dictated predominantly by economic considerations. The newspaper enjoys a virtual monopoly on English-language Montréal. Although the Globe and Mail is also available, it is a national newspaper which does not carry the local TV and movie listings, local sports, classified and restaurant advertising, city and neighbourhood news, and so on. For residents of the city, it is a paper one takes in addition to the Gazette, rarely instead of it. Alone in the market, there is little the Gazette can do to boost its circulation.

The addition of a science and technology reporter, then, would cost the paper at least $40,000 a year in salary alone (the annual salary for a reporter with at least five years experience is currently on the order of $45,000). It is unlikely that the expense would generate appreciable circulation gains. Nor is it likely that a staff science writer would attract substantial new advertising. Science is therefore cost-inefficient as a topic of coverage given the current market conditions.

Were the beat considered local -- if the readership cared about "its" science in the way that it cares about "its" hockey team -- the Gazette might well maintain a full-time science writer. But science has precisely denied such territorial claims: its methods are universal and its community international. If there is a parochial interest in science, it is in science on the national level. Since success is adjudged by an international forum, triumphs by Canadian scientists are invariably taken as triumphs of a national science. By the same token, worries over opportunities and financing for Canadian researchers are equally invariably articulated as concern for the perpetuation of such a national science. From the point of view of the Gazette, as a national and international story science is best covered by the wire services to which the paper already subscribes.

Alternatively, were the beat considered political -- if it were viewed as an area in which various interests clashed, with perhaps subtle but nonetheless profound consequences for the direction of social affairs -- again, the Gazette might well employ a science writer. And indeed, in the case of food irradiation, in which science took on a political aspect, the paper accorded the story prominent play. But science generally has precisely denied any such political nature: its inquiries are conducted via methods that exclude political considerations and thereby guarantee the reliability of findings. As a consequence, there is little incentive for the Gazette to engage its own full-time science writer.

However, the paper operates in a context in which the necessity of press attention to science is commonly recognized. As a consequence, science does feature regularly in its pages; the copy is merely supplied by the convenient and cost-efficient wire services.

The Globe and Mail, by contrast, maintains a science staff despite the fact that the science page itself generates no advertising directly. One must recognize, however, that the Globe and Mail occupies a market position vastly different from that of the Gazette.

The Globe and Mail sells itself not only as a national newspaper, but as an elite or prestige journal (unlike, for example, USA Today, which sells itself as a national, but populist paper). The combination of the two ensures that science will be a prominent and regular topic, and that it will be covered in something other than the scientists-make-discovery mold.

As a national paper, there is the onus to cover science in its guise as a national story. Indeed, Stephen Strauss, current science writer for the Globe and Mail, suggests that his paper's science page be understood in terms of its appeal to a sense of national identity.[4] It is not simply about science, he notes, but about Canadian science. It is a forum both for the announcement of the ability of Canadian researchers to perform on an internationally-competitive stage, and for the expression of

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[4] Personal communication.

anxiety about their ability to so perform. Indeed, many scientists have shared with him their conviction that, as national science correspondent, it is his responsibility to defend, promote and speak on behalf of Canadian science.

Strauss goes on to suggest that at least part of the sensitivity to the "politics" of science on the part of the Globe and Mail derives from the impulse to distinguish Canadian science from its American counterpart. Since the two hardly differ detectably at the level of method or procedure, the demarcation is made in terms of government regulation and financing. Thus much of the political content of the Globe and Mail's science coverage deals with rule-making by officials and government agencies. Strauss insists that a truly "political" story -- one in which the objective gloss of scientific inquiry is challenged; in which factors such as ambition, expediency or pragmatism are seen to influence the research conducted and therefore the knowledge produced -- is still comparatively difficult to place in the paper. Superior editors do not readily conceive of science in such terms: "They want to know why the dinosaurs died."

Secondly, as a prestige newspaper, the Globe and Mail is expected to provide coverage shunned as cost-inefficient by its more profit-sensitive competitors. In news, as in everything else, the readers of the Globe and Mail have expensive tastes. Thus the paper signals its stature by maintaining eight foreign bureaus. The science desk, similarly, is an expense by which the

Globe and Mail announces its commitment to socially-responsible coverage. In an environment in which the inadequacy of most science reporting is widely accepted, a full-time science writer is a necessity for any prestige journal. It is one means among many by which the newspaper signals its distinction from the local, populist press.

In short, in the case of the Globe and Mail, the science beat has been rendered indispensable by cultural pressures; in the case of the Gazette, it has been rendered unlikely by economic realities.

6.5 Amazon Tribe Worships A-bomb: The Tabloid Press

There are six English-language weekly tabloids currently available in the Montréal market: the Sun and National Examiner (both published out of Rouses Pt. N.Y.), the Globe (which divides its operations between Rouses Pt. and Boca Raton Fla.), the Star (of Tarrytown N.Y. and Clearwater Fla.), the Weekly World News and the National Enquirer (both of Lantana Fla.).[5] These publications deserve some attention, if only because they are so frequently denounced for their portrayal of science, yet so seldom examined.[6]

For reasons that will become apparent, it makes little sense to construct a listing, annotated or otherwise, of the tabloids' science coverage. Nonetheless, science is proportionally a good deal more prominent in their pages than in those of the broadsheet press, and given their enormous continent-wide circulations it would be remiss to ignore them.

To begin with, it should be recognized that the tabloids themselves represent a spectrum of journalistic style. Clearly, it is a style that rejects the broadsheet criteria of "newsworthiness," but otherwise it reproduces the conventional forms

[5] The Globe, Sun, and National Examiner are owned by Mike Rosenbloom through Montréal-based Globe International Inc. See Edward Greenspon, "Flash + Trash = Cash," Report on Business Magazine, Globe and Mail, Vol. 4 No. 1 (July, 1987).

[6] In the literature, the sole citation is Donald N. Leff's "Four Wondrous Weeks of Science and Medicine in the Amazing, Incredible Supermarket Press," NASW Newsletter, (January 1980).

of objective journalism. The tabloids merely abandon the documentation of government and institutional affairs in favour of the view that what is newsworthy is necessarily shocking, salacious, amazing, heartwarming, directly beneficial, or otherwise of keen interest. The aim, as the genre's title suggests, is to excite the "sensations" of the reader. Toward that aim, the tabloids all adopt the major conventions of news presentation -- the inverted pyramid story construction, a reliance on attribution, the effacement of the reporter, and so on -- and therefore work to establish an authoritative, objective voice that will guarantee the veracity of their contents. For the more outrageous items (Giant UFO emerges from the ocean and stalks a freighter! -- Weekly World News) this voice engineers the suspension of disbelief that is essential if the story is to be at all entertaining.

The concerns and styles of the individual tabloids, however, differ recognizably. The cheapest, literally, is also the most "sensational," in the sense that it favours stories most likely to offend mainstream sensibilities: it uses its journalistic authority to sanction a belief in the supernatural, alien visitors, impossible cures, parapsychology, mythical beasts, and a host of other phenomena official culture insists do not exist. At 60 cents per issue, the Weekly World News is printed in black and white on newsprint.

At the other end of the spectrum are the National Enquirer and the Star, both 75 cents, both with numerous colour pages, and both printed on glossier, higher quality paper than most broadsheets. They are less interested in amazing their readers with outlandish yarns than in titillating them with inside gossip about the private lives of celebrities. Occupying the middle ground are the Globe, Examiner and Sun, all 69 cents and with fewer colour pages on a less glossy paper. Although these include astonishing tales of an impossible nature as well as celebrity gossip, they also draw on more real-life oddities than their competitors (Choirboy, 13, runs off with preacher's wife, 45 -- Examiner; Blind news vendor beaten by clients who spotted him driving a car -- Sun).

A common feature of each of the tabloids, however, is information that will be directly relevant to the reader -- immediately applicable in his or her life. Consequently, all devote considerable space to diet plans, marital relationships, and disease -- in particular, how to prevent cancer (or AIDS) and how to alleviate arthritis.

It is hardly surprising, then, that science should be so prominent in the tabloids' coverage. First, it provides a source of credible, authoritative information on medical and psychological matters. Second, its technical advances provide a steady source of tantalizing copy. Third, the very nature of its inquiries lends itself to tales of the odd, the intriguing, the wondrous (indeed, scientists often function much as the psychics and authorities on the paranormal). And fourth, therefore, its legitimacy bolsters the claim to credibility made by the tabloids themselves.

These last two can be seen most vividly in the Weekly World News, which mentions science largely as a means to anchor otherwise dubious revelations.

> **Cave explorers find alien mummy!**
>
> Scientists investigating an unexplored cave in Turkey have unearthed a crystalline coffin dating back to the Ice Age -- containing the mummified corpse of an alien being from another world! (Weekly World News)

> **Amazon tribe worships A-bomb**
> Scientific expedition makes mind-boggling discovery....
>
> A world-renowned scientist claims to have found a tribe of South American savages that worships an atomic bomb as its living god! (Weekly World News)

The fact that these discoveries were made by scientists, and that scientists can be quoted throughout, serves to add a dimension of verisimilitude to the reports. These are not in any conventional sense "science" stories -- in fact, they are not actually about science. Nonetheless, they invoke the credibility of science in order to secure what would otherwise be incredible tales.

However, this is not a technique generally practiced by the other tabloids. For them, science is more commonly a source of new products and treatments, or an authority that divides fact from myth, revealing truths about everyday life.

Thus, under the headline "Bye, bye baldness?" (and accompanied by a doctored photograph of Gavin MacLeod, skipper of the Love Boat, in which the bald actor was given Rod Stewart's hair) the Star informed its readers of the UpJohn company's plans to market the topical drug minoxidil, which has been shown to promote hair growth in almost half of the subjects tested. This is a story that has also featured in the broadsheet press.

In the alternative vein, the Enquirer instructed its readers in "How to Beat Dangerous Household Mold":

> Molds release microscopic spores which can trigger allergic reactions that include runny noses, watery eyes, headaches, fatique, fever, chills and respiratory problems, say experts.
> And in people with weakened immune systems, such as AIDS patients, mold spores can actually destroy the lungs and cause death, said Dr. James Day, professor of medicine at Queens University [sic] in Kingston, Ont. Canada.
> Added Yehiel Sobol, who studied the problem for Canada's government: "About 10 to 15 percent of residential buildings have very high spore concentrations!"

These two stories can be taken as typical. The topics are generally innocuous, the contents of the reporting essentially correct, and on the whole the coverage is far from the inflammatory copy that is so often denounced.

It is true that much of the tabloids' attention is captured by health and disease -- and often the charge is laid that they exploit illness for dramatic effect and circulation gains, irresponsibly raising the hopes of cancer victims or playing on common fears. Certainly, some items could be accused of encouraging hypochondria:

> "Thunderclap headaches" -- sudden, incredibly intense blasts of head pain -- can warn of potential deadly brain aneurysms, say experts. (National Enquirer)

The advice offered in the headline, however, is not likely to trigger dispute from the medical community: "Sudden, Sharp Headaches? Don't Ignore Pain, See Your Doctor".

Indeed, on even the most sensitive subjects -- i.e. those diseases which continue to defy medical technology -- the information offered is usually sound and at least harmless, and the advice dispensed is typically sensible. As the Globe itself put it in "20 way-out ways to cure ARTHRITIS":

> ... a prominent university professor has collected nearly 800 folk remedies -- and, he says, many of them really work.
> Dr. Varro Tyler, the executive vice president for academic affairs at Purdue University, in West Layette, Indiana, compiled the treatments in the book Hoosier Home Remedies (Purdue University Press).
> Most of them are harmless, many are very logical, and some actually have a scientific basis, he says.

The report lists 20 folk remedies for arthritis and rheumatism -- ranging from a high-asparagus diet to an elixir made by steeping a dried rattlesnake in corn whiskey -- although it fails to mention which, if any, have the approval of the medical establishment.

The Enquirer goes so far as to remind readers of the veracity of its reports -- if some seem far fetched, this is only because the Enquirer has beaten the mainstream press to the story. Hence, in "You Read It Here First ... " the reporter points to a item in the New York Times of March 24 on the use of surgical glue by researchers in cases where sutures cannot be used:

-- but ENQUIRER readers had heard it all before.
Over three years ago, in March 1984, The ENQUIRER reported: "A new surgical super glue -- made from a patient's own blood -- is dramatically improving surgery results, say medical experts."

By the same token, the Weekly World News reproduces the overly-ambitious claims of a Soviet cosmetic surgeon in part to ridicule them as sensational. The headline announces "Top plastic surgeon claims: 'I can make this look like this'". On the left is a photograph of a profoundly obese middle-aged woman dressed in a smock. On the right is a curveacous brunette in corsette and stockings. The text asks: "Will every woman in Russia soon look like the model at right?"

The story recounts the claims made by Dr. Vladimir Beglov at a Brussels conference, where he announced his progress toward the perfection of a fat-suction device which would remove 75 pounds in a single afternoon. The item ends, however, by quoting Dr. Wiliiam Betts, of Sydney, Australia, one of a number who walked out on Beglov's presentation.

"Everything the man does is unnecessarily drastic and highly experimental," said Dr. Betts.
"There are people who will live in agony for the rest of their lives all because of the things Beglov has -- or hasn't -- done. Medical science must thoroughly test all of these unpredictable techniques -- before they are used on patients!
"We cannot allow the quest for beauty to turn us into gamblers!"

Furthermore, much of the information on serious illness is supplied by the quasi-governmental agencies which preside as the official voices of research. Hence:

> Prayer, laughter, hypnosis and mental pictures of pleasant scenes are all excellent "medicines" for helping beat arthritis pain, reveals the Arthritis Foundation. (National Enquirer)

> They can't get to sleep at night or to work in the morning because they have to check every few minutes to make sure the stove is turned off.
>
> Or they spend up to eight hours a day in the shower, even washing their hair strand by strand.
>
> They're victims of a newly recognized illness, obsessive compulsive disorder (OCD) ...
>
> OCD afflicts 2.4 million Americans, or 1.5% of the population, according to a survey by the National Insitute of Mental Health. (National Examiner).

Cancer is similarly treated in the manner prescribed by official agencies. While the headline "Doomed by docs 17 years ago ... Gutsy guy beats cancer & death" might seem to contest the authority of the medical establishment, the story which follows is about Roger Unwin, recipient of the Canadian Cancer Society's Medal of Courage (Sun).

In the wake of the publicity accorded laetrile in the 1970s, however, the most sesational motif in the tabloids' coverage is taken to be the cancer cure. Yet such stories are relatively infrequent, and when they do appear they are amongst the most careful in their adherence to the preferred model of science writing. Thus the Examiner's feature "Incredible new research reveals ... Garlic can fight cancer" provides precisely the sort of experimental detail that is often said to be lacking in popular science.

White blood cells taken from people who ate garlic or took garlic capsules daily for three weeks killed up to 165% more cancer cells than those taken from non-garlic eaters ...
Three test subjects were fed 0.5 grams of raw garlic daily, and another three were given 1,800 milligrams of garlic capsules every day.
"Their killer white cells killed 140 to 165 times more cancerous lymphoma cells in a test tube than the cells of people in the study who didn't eat garlic or take garlic capsules," Dr. Abdullah told the EXAMINER.

Nor does the story anywhere suggest that garlic might be of use as a remedy for cancer. At most, there is the vaguest of suggestions that a garlic-rich diet might help to prevent its occurrence. In form and content, the item is almost identical to the Montréal Gazette's "Calcium wards off colon cancer, study suggests" (Saturday, May 16/87).

Not surprisingly, AIDS has joined cancer as a prominent topic of concern, and the manner of its coverage indicates a population frightened and confused by the disease.

Hollywood in panic as top stars' babysitter dies of AIDS (Globe).

The biggest sex fear haunting women today -- Is your mate bisexual? (Examiner)

Did mom give her son killer disease? Tragic case may be first where AIDS was passed on through casual contact (Weekly World News)

Nevertheless, the advice dispensed by the tabloids is not likely to incite public hysteria, and indeed typically recommends that readers seek qualified counsel. When C.O. wrote to Bryce Bond, the Globe's psychic, confiding that his or her partner had developed AIDS Related Complex and wondering "Am I doomed to die?", the reply was aimed at calming an obviously distraught individual.

> Dear C.O.: Abstain from sexual relations at this time. Rid yourself of destructive thoughts of doom. Instead, strengthen yourself with positive thinking. Remember that a healthy attitude helps strengthen the immune system within our bodies and helps to fight off this plague. Seek out the best medical help as well. Release your fears -- you will live a long life.

Similarly, Sarah, the Globe's agony columnist, sought to reassure a woman who had been unfaithful to her husband in the late 1970s, and now worries that she might have been exposed to the AIDS virus.

> Dear Anonymous: Call your local health department. You won't have to give your name to get information. If they advise you to get tested, don't panic. Go out of town for the test.

Overall, then, it is far from clear that the tabloids can be as roundly and as quickly denounced for their exploitation of science as many would suggest. In fact, with the exception of the Weekly World News, they are more likely than not to repeat legitimate scientific findings, to share the stance of established scientific agencies, and in their own way to portray science as an inherently rational and trustworthy endeavour. Once again, it would seem that the charges of the dominant concern owe more to rhetorical expediency than to a careful consideration of the press' performance.

6.6 Profitability and Social Responsibility: Two Key Determinants

The lobby for reform in press attention to science -- the dominant concern -- is motivated by the twin convictions that the amount of science coverage made available by the popular media is insufficient, and that what is available is all too often inadequate in quality. However, a simple enumeration of the science coverage offered in a single market in a single week would appear to belie both contentions.

First, a considerable amount of science news makes its way into the public realm each week -- so much that it would be impossible for a single individual to comfortably consume it all. It is not clear on what grounds one might insist that this amount is insufficient.

Nor is the quality of this material at issue. Generally, its responsibility and competence are beyond reproach. Few would argue that the CBC, the <u>Globe and Mail</u>, or TV Ontario does science or its public a disservice. The inflammatory and exploitative copy so forcefully denounced in the arguments of the dominant concern is not immediately evident, even in the pages of the tabloid press. On the contrary, most coverage would appear to conform to exactly what is called for by the advocates of an improved science writing.

On the face of it, the complaints of the dominant concern cannot be sustained. However, one must consider their import given the pattern science coverage currently displays. Popular science is clearly concentrated in a) magazines, b) prestige newspapers, and c) broadcasting networks bound by mandates of public service. By comparison, coverage is sparing on commercial television and radio, and cost-efficient in newspapers whose commercial motives are relatively unconstrained by considerations of prestige. That is, those media operations which feel duty bound to serve the public interest over the interests of profit account for the bulk of science coverage.

There are two reasons why this should be so. The first has to do with the market for science news. The second has to do with the long agitation for a certain type of science reporting.

In order to be vigorously pursued by the commercial press, science would have to demonstrate both that it is of interest to a sufficiently sizeable number of readers, and that its coverage can generate more revenue in advertising than it costs to produce. The first condition is occasionally satisfied, the second less so.

The obstacle in marketing science news is this: although there may be considerable public interest in the subject, it is rarely sufficient to compensate for the fact that science reporting itself attracts little advertising. Unlike other genres or topics of news, no industry naturally attaches itself to science. Whereas the travel section generates airline and travel agency advertising, and the entertainment section generates movie, concert, and artistic listings, there is no consumer market in "science" as such.

In advertising, science is a useful and freely-available prop for buttressing product claims. If a marketing strategy demands that a good be presented in a scientific light, this can be effectively accomplished without buying advertising space on newspaper science pages or having to commercially support a television science program.

As a consequence, science reporting lacks a ready advertising constituency, and is therefore infrequently pursued by the commercial media. Two exceptions in broadcasting -- the ABC News Close-Up on cocaine and alcohol addiction and ABC's weekly The Health Show -- demonstrate the rule. The News Close-Up dealt with science only inasmuch as it touched on an issue of apparently rampant interest, and only as a means to anchor the affirmation that drug addiction is an extremely serious problem in American society -- indeed, more serious than had been previously thought.

The program argued that new research has shown, first, that there is a physiological or biochemical predeliction for addiction, such that some individuals become drug-dependent much more rapidly than others; second, that this susceptibility is genetic in origin, and therefore is passed on from generation to generation, most profoundly from father to son; and third, that continued use of alcohol and cocaine destroys large amounts of brain tissue.

The lesson of the research was stated explicitly: since addiction may be a biochemical condition over which the "will" of an individual is powerless, and since the disposition for this condition might be set in motion by the very first drink, drug consumption of any kind is a dangerous and foolish activity. The moral component conjoined to the urgency of the issue was likely judged by the network sufficient to generate the necessary ratings for the time slot.

The advertising which the program carried, however, bore little connection to science or research. Although a few commercials emphasized the scientific sheen of their products or services -- Clear eyes eyedrops, Unisys computers, Prudential-Bache, Hartz Blockade -- most were products which simply found a convenient prime-time audience in a news special on the drug problem which happened to have a science angle.

The Health Show, by contrast, is a weekly magazine program designed precisely to capitalize on both a presumed audience and a portfolio of advertisers. The health care focus of the program provides an appropriate advertising vehicle for products from pharmaceuticals to dental cleansers to cereals insistent on their nutritional benefits.

It is not often, however, that science proves commercially viable as a topic of coverage, as the general science magazines attest. Without their own natural advertising constituency, they have had to sell the characteristics of their readers to a range of advertisers. In the case of Omni, which benefits from access to the mailing lists and advertising accounts of Penthouse, the effort would appear to be a success. The Sciences and (as yet)

Science and Technology DIMENSIONS are barely commercial enterprises. The other magazines have been unable to continue.

The demise of the general science magazines is most thoroughly dissected by Lewenstein (1987a). He notes that a welter of factors contributed to the folding of Science Digest and the purchase of Science '86 by Time Inc., in the summer of 1986. These included boardroom politics and financial considerations at the AAAS, which published Science '86; the likelihood that each of the magazines had inflated its circulation figures with costly give-aways and cut-rate subscriptions; and the fact that in editorial content the three major competitors (the third being Time's Discover) were too similar, with the result that little distinguished them from one another on the newsstand.

Lewenstein emphasizes, however, that the single most significant factor in the collapse of two mass circulation magazines (and, by extension, the recent sale of a third) was a lack of advertising. From the beginning of what would become known as the "science boom" in journalism in the early 1980s, publishers had been convinced that there was an appetite for news about science -- indeed, that science and technology magazines were the next hot vehicle for advertisers wishing to reach young, educated readers with sizeable discretionary incomes. And yet, "few publishers considered precisely what products might be sold uniquely to the readers of science magazines (Lewenstein 1987, 31)."

An obvious source of advertising was the computer industry.

Fragmented, fiercely competitive, and with apparently secure financial bases, Science '86, Science Digest, Omni and Discover survived largely on the revenue supplied by the major PC competitors. In 1984, however, the computer field began to experience a general industry slump, and companies cut back their advertising expenditures accordingly. Both Science Digest and Science '86 lost 50 percent of their advertising support between 1985 and 1986 (Lewenstein 1987a, 34).[6]

The announcement in March 1986 that the venerable Scientific American would be sold served to shake advertiser confidence in the entire science publishing venture, and consumer advertisers also began to desert the magazines. The collapse of the "science boom" followed in short order.

One belabours the issue of advertising support for commercial science writing only because it is so steadfastly ignored by the dominant concern. What prevents a vigorous press attention to science in the dominant view is the ignorance of editors, who do not value the worth and the appeal of science news. The newshole is limited, the argument runs, and if science is to win prominent coverage it must be written in a superior and arresting manner, and editors must be educated to appreciate its merits.

In fact, however, the newshole is not limited: it expands and contracts according to the advertising available. And what prevents a robust commercial science coverage is not the ignor-

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6 Indeed, note how little computer industry advertising is carried by the magazines sampled in May 1987.

ance of editors but their awareness that science promises little in the way of additional revenue.

Thus the form which science coverage currently adopts owes a great deal to the performance of the media market. Commercial television shuns science because it is unprofitable; the mainstream local press is lax in its attention, relying largely on wire copy about new discoveries; and the general science magazines would appear to have drastically overestimated the market for their product. Only the tabloids pursue science with journalistic zeal.

The complaints of the dominant concern can therefore be understood. It is not that science is absent from the popular media that gives cause for concern -- since it clearly is not -- but that it is excluded from the commercial mainstream, marginalized in the low-rating ghettoes of public broadcasting or confined to the attentive public which subscribes to prestige journals. It is neither impossible nor difficult to ignore such coverage, with the result that there is no guarantee that the bulk of the population is receiving the requisite exposure to science. Until science has been taken up by the commercial media as a prominent theme or subject of coverage, the dominant concern will not be satisfied that the public communication of science has been undertaken in earnest.

However, the mere persistence of the argument that science should receive more and better attention in the media has not by itself been sufficient to alter the economic realities to which the commercial media are answerable, and therefore it has had only limited influence on the performance of these media. Nor has the repetition that it is important to be kept apprised of scientific developments succeeded in generating a truly mass interest in science news. The constituency for popular science is large enough to support a small number of magazines, and to justify the production of science programs by networks which can tolerate smaller audiences than would be commercially necessary, but it is insufficient to satisfy purely commercial requirements.

Rather, the dominant concern has exerted its greatest influence by establishing the public communication of science -- and the need for a scientifically literate laity -- as a social responsibility, and therefore compelling coverage by those media outlets appointed or self-appointed to serve the public interest. It is PBS, the CBC, TV Ontario, the BBC, the Globe and Mail, the New York Times, and so on -- organizations charged with serving something other than commercial motives -- which devote themselves most assiduously to science.

Clearly, science also offers itself as an appropriate candidate for coverage. For public television, it provides the type of serious subject matter needed if the service is to distinguish itself from the triviality of much of commercial television.. Yet it also provides topics that can be explored in an enjoyable and visually arresting way, employing the technical powers of the medium to their fullest advantage. In that sense, the science documentaries lend important support to the claim of excellence in public television, as opposed to the mediocrity characteristic of much commercial programming.

As well, cast in the magazine format, with a host and brief filmed reports, science offers a relatively cheap source of programming. Indeed, with their cheery hosts, their corporate sponsors, often with the involvement of a studio audience, and slated in early morning or afternoon timeslots, the magazine science shows are in many ways the public television equivalent of the game show: a workhorse in the ongoing labour.

For newspapers such as the Globe and Mail and the New York Times, which make some claim to national status, science provides a ready source of "national" copy. Though the research that receives coverage might be conducted predominantly in central Canada or the eastern seabord, respectively, it can nonetheless be presented as the product of a Canadian, or an American, science.

Nevertheless, it is not the mere convenience of science as an appropriate subject that accounts for its prominence on public television and in prestige newspapers. More than any other single factor, the sustained call for a dutiful attention to science in the public interest has been responsible. It has been the agitation of the dominant concern that has produced a science coverage attentive to the progress of academic research and insistent upon the importance and delight of scientific inquiry. The failure of the commercial media to pursue science wholeheartedly has merely served to underscore the public service merit of the science communication project.

In short, the science coverage currently available owes certainly much of its form and likely much of its content to an accompanying and ongoing discourse which, in the context of a prevailing media market, has worked to advocate just such coverage. By its emphasis on the dangers of translation and sensationalism, the dominant concern encourages a science writing preoccupied with technical accuracy and restricted in its narrative technique. Personalizing or politicing science becomes an impossibility, with the consequence that the subject does not automatically constitute a beat in every newsroom. By its further demand that science journalism concentrate on the progress of academic researchers, the dominant concern renders the genre limited in its commercial viability, since advertising support will not readily attach itself to stories about university laboratories. But by its insistence that the public must be kept informed about science, and by the willingness of various public-spirited granting agencies to finance the effort, the discourse has produced a distinctive science journalism under the rubric of social responsibility.

No doubt the scientific illiteracy of the majority persists, along with the anxieties of those who view the public communication of science as a project meriting redoubled effort, but in many respects the concern over the problem of science and the media has been extremely successful in attaining its professed goals. Science is a regular topic of media attention. It is portrayed overall as a beneficial, progressive and rational endeavour. *It is not a topic of sustained critical scrutiny, nor is its epistemology open to dispute.*

As work in the alternative vein has argued, it is the type of coverage that serves a social order in which the objectivity and rationality of science are essential to the management of public affairs.

Chapter Seven

Ideology as Science:
The Argument in Summation

This study began by considering certain works by Habermas and Feyerabend in an effort to characterize what might be termed the critical reappraisal of science.

Over the course of the past three centuries, by virtue of a series of spectacular theoretical and technical advances, science has steadily entrenched itself in the cultural life of Western societies, as an institution, as a productive force, and as the custodian of a necessary rationality. Since Bacon, the claim of science has been that it makes possible an avenue of access to the truth of things, purging inquiry of the delusions of the Idols of the Mind. Autonomous from political or theological dictates, the pronouncements of science are answerable only to the reality of that which they seek to explain. The knowledge thus generated therefore provides an objective and assured basis on which to direct social affairs.

Briefly, then, the traditional view has been both celebratory and prescriptive: One acts only in accordance with what one knows to be true; science presents itself as the sole source of truth about the structure and workings of the natural world. In these terms, the rise of science is seen as a triumphant Western development, freeing collective behaviour from the bonds of ignorance or the tyranny of myth. In the name of the greater good, therefore, its efforts are to be encouraged, its knowledge disseminated, and resistance or indifference to its findings eradicated.

The critical reappraisal embarks from a dispute with the grandiose claims made by the received view for the status of scientific knowledge. Neither Habermas nor Feyerabend contests that science does indeed bring knowledge into being, each merely takes issue with the contention that scientific knowledge is guaranteed by a method that permits pristine access to the real. The critical theorists see in science an engine of inquiry without equal in the production of reliable and technically-applicable knowledge about inanimate things, but they argue that the mere reliability of its findings does not and cannot bespeak their absolute objectivity; nor does it legislate the hierarchical dominance of scientific rationality in the social sphere.

They press the case, rather, that science has always been bound to the very context it casts as "external" to its inquiries; its special ideological significance resides precisely in the effacement of its connections to that which it purports to exclude; and it is this, in conjunction with the allure of its technical innovations, that has powered the rise of science in the 19th and 20th centuries.

The critical reappraisal does not culminate, therefore, in the simple complaint that the heroic portrayal of science is erroneous. Instead, it identifies the traditional portrayal as itself crucial to the social labour of science in the contemporary West. The specificity of the modern condition has been the conscription of science by a concert of interests, both as the motor force of a continually expanding economy and as an ideology which will legitimate political decisions. The rationalist dictum -- one acts in accordance with what one knows (scientifically) to be true -- far from being the credo of an emancipated society, is criticized for the manner in which it has been used to constrain open debate, promote existing (and inegalitarian) structures of power, and therefore undermine the possibility of democratic governance, even as it promises to guarantee such a possibility.

In short, the traditional view argues that only in a "rational" society -- a society in which the voice of science is both audible and observed -- is democracy possible. The critical reappraisal, by contrast, identifies the entrenchment of just such a view as a chief mechanism by which the constriction of democracy is obscured.

In opening the study with an examination of the contributions of two prominent critical theorists, the intention was, first, to point to the fact that similar arguments have been mounted in very different disciplines, suggesting the development of a common and broadly-based rethinking of the social labour of science. More importantly, however, the attempt was to delineate such a position so that it might inform an analysis of the range of writings on science and the media produced by academics and intellectuals. Although neither Habermas nor Feyerabend mentions the popular representation of science specifically, in their emphasis on the ideological import of contemporary science they clearly invite scrutiny of the means by which this ideology is perpetuated.

Examination of the corpus of writings on science and the media in the post-war years reveals a division between two major camps.

The larger, primarily American in origin and influence, adheres to the largely positivist understanding of science so characteristic of the United States, both reproducing and promoting the traditional view of science as heroic, objective, and stolidly rational. It worries that society cannot function as it should because the masses are both ignorant of science and dangerously susceptible to anti- or pseudo-scientific sentiment. In large part, it faults the media for this, charging that the press is either inattentive to science or irresponsible in its coverage. It seeks to repair a deleterious situation by lobbying for a redoubled and improved science journalism, and by encouraging greater scientist involvement in and control over the communication process.

The other camp, more recent in its appearance and indebted to European influences, has emerged in light of precisely the type of critical argument formulated by Habermas, Feyerabend and others. Given the recognition that the performance of science on the social stage is inextricably linked to its apprehension in the popular imagination, effort has been directed toward exposing how the endeavour has been constructed by the media for public consumption. Generally, the finding has been that popular accounts have affirmed the view of science as progressive and politically disinterested (at the expense of alternative views made possible by the critical reappraisal itself), and in so doing have worked to advance those social interests which benefit from such a portrayal.

Accordingly, the two camps also divide themselves along lines internal to media or communication studies. Once again, it is the larger, American body of work that is associated with the traditional vein, while the more recent studies are allied with a European-influenced "critical" tendency.

The former is steeped in a heuristic itself forged from positivist influence. It sees mass communication essentially as a special form of transmission, in which announcements are relayed to the public domain. It holds that the goal of such communication should be accurate dissemination -- messages should be received and understood in the manner in which they were intended. It claims to be able to detect and quantify distortions in the communication process, and blames these on the interference of outside agencies or handling parties. It makes no special appeal to social or political theory in its conception of mass communication, and instead relies heavily on "scientific" investigation to secure the veracity of its findings -- thereby further participating in that which it promotes.

The latter, by contrast, abandons the attempt to document and correct instances of distortion in press content, reformulating the concerns of media studies in light of developments in political and social philosophy. It accepts that in liberal democracies the engineering of consensus is the primary means by which social order is maintained and regulated, and holds that such consensus is achieved via control over the very terms in which reality is perceived and understood by members of the polity. It therefore identifies ideology as a vehicle crucial to the processes by which assent for prevailing social configurations is organized, and takes as its object of analysis the role of agencies of public communication in the propagation of specific ideologies. The overall effort has been to lay bare the mechanisms by which specific versions of reality have been installed as necessary and correct at the expense of alternatives -- the notion being that this type of critical exposé might demystify or disempower the dominant ideologies, thereby opening the space for a more adequate understanding of one's own society, if not a more meaningful public debate over social priorities.

Both camps therefore pursue their inquiries in light of respective political concerns. The traditional vein agitates for a certain coverage of science because its adherents believe that without it the performance of democracy is impaired. While the alternative approach is less programmatic in its insistence that media performance be altered, and is more concerned with explicating their current performance, it nonetheless ultimately seeks to show how the common media portrayal of science buttresses an ideology that has become essential to the maintenance of a social order it finds unjust and distasteful.

Briefly, but not incorrectly, the opposition is the following:

-- **The dominant camp** advocates the portrayal of science as a sober, objective enterprise that is autonomous from political considerations or influence, yet essential to the public good.

-- **The alternative** finds that, overall, the media portray science as a sober, objective enterprise that is autonomous from political considerations or influence, yet essential to the public good.

-- **The dominant camp** demands this type of coverage on grounds of accuracy: it holds that science is indeed just such an enterprise.

-- **The alternative** interprets this coverage as an ideological artifact: a particular version of scientific labour that plays to specific social ends.

-- **The dominant camp** blames the press for a popular misapprehension of science, and seeks to improve its performance by campaigning for a more dutiful portrayal.

-- **The alternative** attempts to specify how media representations have encouraged a certain popular apprehension of science, and to elaborate the circumstances which bring such representations about.

It should be clear that in general the present study allies itself with the alternative vein over its more traditional counterpart. Certainly, the assessment of the dominant concern has not been favourable.

The intention has not been to condemn work conducted in the American tradition -- rather, the hope has been that the problem of science and the media might be placed in the context in which it arose -- but it demands to be said that this work displays a number of shortcomings.

Not a few of its central contentions are straightforwardly assumed and then used to propel elaborate arguments or studies; these contentions are not difficult to contest (e.g. Trachtman 1982), but no defence or justification of them has been thought necessary.

The view of mass communication favoured by wo: in the dominant tradition -- essentially a variant on the "hypodermic" model -- is one that has been amply criticized within the field of media studies. Thirty years after Lazarsfeld, Berelson, and Gaudet first pointed to the importance of audience constitution in the reception of media messages, the received position on science and the media has strayed little from the conception of the audience as a homogenous and passive mass. At its most sophisticated, it divides the audience for popular science into only three groups: the attentive public, the interested public, and the non-attentive public.

Despite a reliance on objective, quantitative techniques of investigation, many studies incorporate subjective assessments as elements of the methodology. Most install scientists as the sole arbiters of media performance. Findings have a marked tendency to confirm the obvious -- or the already assumed. And quite unlike the scientific model which they imitate, few of these studies are repeated so as to ensure reliability, except perhaps by the same investigators.

In part, this is because the dominant concern is itself dominated by a relatively small but prolific coterie whose members share much the same heuristic and who together largely set the agenda for academic analysis, thereby causing no occasion for internal debate. As a result, much of the corpus consists of the mere reiteration of previous assertions, while at the same time certain inherent contradictions in the problem of science and the media remain not only unresolved, but largely unnoticed.

Thus the press is pilloried for its handling of science and for the distortions which ensue, while at the same time it is conceded that what is required is a more lively journalistic attention to science that will galvanize popular interest. Science coverage is simultaneously chided for being dull and deplored for being sensational. On the one hand, the demand is that the customary narrative artifice of the press be suspended in science coverage in the interests of accuracy; on the other, the call is for an appropriate narrative artifice in the interests of cultivating greater awareness and appreciation of science.

Finally, it is far from obvious that the fundamental complaints which constitute the problem of science and the media are indeed legitimate. The dominant concern has insisted that press coverage of science is inadequate in both quantity and quality, and its efforts have been directed overwhelmingly to redressing these deficiencies. Yet even the most cursory examination of media performance (such as that carried out in Chapter Six) would appear to reveal, first, that there is a wealth of science coverage available, and second, that this coverage generally adheres to the canons of "correct" treatment defended by the lobby for an improved science journalism -- even the coverage made available by the tabloid press.

Given, then, that certain of its basic assertions are never explored, much less proven; that its methods are often suspect; and that its major arguments do not seem to readily fit the evidence, the adequacy of the dominant concern to its object of analysis is questionable, at the least. Indeed, it is the suggestion of this study that the work of the dominant vein has been in the final analysis less significant for the manner in which it has advanced understanding of the issues associated with the popular representation of science, than for its success in fixing the terms in which popular science is to be both conceived and conducted.

Such a suggestion becomes more credible, perhaps, following a reading of the work which can be said to constitute an alternative to the received approach. This work is as yet fragmented in that it follows no common or explicitly-stated agenda. It is uneven in its quality and certain of its assertions are contentious. In particular, it is at its shrillest when the critical perspective is used to denounce the media and to insist upon what is deemed a more progressive, enlightened, or accurate coverage (i.e. a Marxist-informed coverage). Its weaknesses notwithstanding, however, this work has been most fruitful in advancing an oppositional interpretation by which media representations of science might be understood.

That is, if one accepts the critical reassessment of science's social labours, then analysis is directed toward, first, establishing that media portrayals do indeed serve an essential ideological interest; and second, specifying the means by which this comes about -- how the work of media organizations becomes articulated with select social and political interests. As a result, much of the effort of the alternative concern has been historical in nature, not only because such cultural analysis becomes easier with hindsight, but because appeal to historical evidence offers itself as a strategy appropriate to securing the larger arguments. It is as an explanatory discourse, then, that the alternative concern has been most valuable: not as a call to intercede in media performance in the name of "better" coverage, but as a means to illuminate how and why science is represented as it is.

In that regard, this study is submitted in the hope that it will advance just such a project. In particular, it calls attention to two aspects of the 'problem' of science and the media that have heretofore gone largely without comment. One is the influence of the dominant concern itself. The other is the economic pragmatics of a free press under liberal democracy.

Clearly, part of the problem for the alternative concern -- as it is for "critical" communication studies in general -- is the need to detail how the production of media content comes to internalize the dominant ideology to the exclusion of demurring views. It is one thing to scrutinize media content and to "read" ideological constructions off its text -- to expose how what seems natural and straighforward is in fact partial and contingent -- but it is quite another to account for how these ideological constructions came to be adopted by the vast apparatus of media organizations whose primary motive is profit and whose keenest sensitivity is to public whim.

This study holds that the oppositional interpretation, on the whole, has been convincing: there is more to the social labour of science than the traditional view would have it, and as a consequence there is more to the issues associated with its media portrayal than mere accuracy; press coverage tends overwhelmingly toward articles and programs which explain the investigations of scientists to non-scientists, and this type of coverage cannot help but reproduce scientists' own understanding of their work; this portrayal helps to secure a larger background ideology which has become essential to the operations of a "rational" society. In addition, however, the present study submits that chief amongst the considerations that have led to the production of this distinctive media coverage has been the incessant agitation of the dominant concern in the academic discourse on popular science. It is as an appendage to the grander ideology it serves that the dominant vein has been most efficacious.

Its concerns have captured the curricula of science communication courses and programs across the United States (there are few such programs in Canada or the United Kingdom), and indeed played no small part in the creation of these curricula. The steady reiteration of its arguments constructs an environment to which all science coverage must be answerable. Its basis in universities and scientific associations has fostered the rise of the "public information officer" -- the professional science communicator who accounts for a vast proportion of the coverage that reaches the popular domain. Although the members of the coterie who command the output of the dominant concern may be few, they exert a profound influence, in part because of their institutional placement, in part because they give voice to a seemingly-compelling, albeit paternalistic argument.

The dominant concern, therefore, has in effect functioned as the vehicle whereby media science coverage has been charged with its duty and instructed as to its method. It is via its agitations that the heroic view of science has been buttressed and maintained for popular consumption, and attention has been distracted from the ideological role of science.

That this is so is made more evident by the fact that the hegemony of the dominant concern is not complete. As theorists have submitted the social labour of science to a critical review, so the number of studies of science and the media conducted in an oppositional vein has increased. And, as Roger Silverstone's detailed analysis of the production of a single BBC documentary makes plain, the emergence of such an oppositional view has not been without influence at the level of media practice. Within the Horizon production unit at least, media workers are now able to contrast a coverage sensitive to the political context in which science operates against the traditional portrayal which they recognize is the still-dominant media fare.

As important as the influence of the dominant concern has been, however, it has been exercised in the context of a media environment answerable to economic dictates, and it is these two factors in conjunction which have more than any others determined the form which science coverage has assumed. Without a ready advertising constituency attached to science reporting, the commercial media have been understandably reluctant to pursue science as a subject of vigorous coverage. Given, then, what is seen as the absence of suitable coverage in the news columns and broadcast schedules of the commercial media, the pleas for a socially-responsible attention to science have had their greatest influence on media organizations whose mandates extend beyond mere profitability. The result has been a science coverage concentrated in public broadcasting networks, prestige newspapers, and monthly magazines which enjoy the support and resources of powerful publishing entities.

One should also note that this pattern of coverage, and the circumstances of its production, clearly serve the interests of science in a manner consistent with the arguments of the critical reappraisal. Science receives dutiful and regular media attention, the bulk of coverage being devoted to explaining the contents of scientific work to lay readers: the overall image is of a progressive and rational endeavour, steadily advancing the frontiers of knowledge. Yet this coverage is not so prominent as to establish science as a subject matter impossible to ignore, with the result that it is pursued in the context of an insistence that the laity is insufficiently versed in the methods and findings of science. Indeed, the whole of the popular science effort may be read as a continual reminder that the general population should be familiar with the contents of science, but lamentably knows far too little -- a means, not to enhance public participation in the direction of science, but to close it off. What we cannot speak about, Wittgenstein suggested, we must pass over in silence; similarly, the ignorant are not entitled to be critical of that which they do not understand.

Obviously, the agitations of the dominant concern are founded on the notion that, given sufficient media attention to science, sufficient public interest in the coverage, and the passage of sufficient time, the end result will be a newfound scientific literacy which might provide the basis for a meaningful public involvement in the affairs of science. Such a vision, however, is unlikely to come to pass, if only because it is doubtful that the popular media are suited to the role of supplementary schoolmarm, it is doubtful that the laity can be coerced or cajoled into embracing science as a topic of heightened interest, and it is doubtful that the mere passage of time would be sufficient to markedly enhance public acquaintance with the inner workings of science. The likelihood, rather, is that the so-called "scientific illiteracy" will persist, and along with it the reiteration of the public's woeful ignorance.

In that sense, the ideology of science benefits directly from the dominant academic discourse on science and the media, since the latter works continually to affirm that science is inherently rational, essentially objective, and unfortunately ill-understood.

Finally, however, one should note that the press, too, benefits from its own portrayal of science. One has already pointed to a number of practical advantages that accrue from the pattern of science coverage currently available: The science magazine (Wonderstruck, Newton's Apple) provides a cheap and ready source of programming for public networks; the science special or documentary series (The Body in Question, A Planet for the Taking) provides the type of prestige programming by which the public networks signal their quality and civic responsibility. The wire services make available a cheap source of science news for the mainstream press. Science provides an appropriate subject matter for prestige newspapers and a ready-made source of "national" news.

Less tangible are the benefits that accrue from the continual depiction of science as an essentially rational endeavour, yet these are no less significant. In documenting the affairs of science, the press not only apprises its readers and viewers of scientific developments, but describes the processes by which 'reality' is to be apprehended and described. It is no coincidence that the methods of science, as portrayed by the press, are reminiscent of the methods the press itself employs to guarantee the veracity and objectivity of its accounts.

That is, as others have pointed out (notably Schudson (1978), Smith (1978) and Hackett (1983)), the ideal of objectivity in the performance of the Western press was modelled explicitly on the example provided by science. The epistemology of the press -- how it conceives of its own efforts in ascertaining and recounting the truth of social affairs -- was formed originally from the appropriation of a positivist understanding of how truth might be arrived at: namely, via the ruthless exclusion of all but the honest testimony of the senses. It is only by virtue of the material and ideological successes of science, therefore, that the claims of the press to objectivity have been sustained.

As a consequence, it is not surprising that the press should represent science as isolated from social and political influence, and hence as a source of reliable and uncontaminated knowledge: science <u>must</u> be so represented if the press itself is to be understood as autonomous from social and political influence, and therefore, equally, a source of reliable and uncontaminated information. The depiction of science by the press provides an exemplar which buttresses the labours of an 'objective' journalism -- it is not only the tabloids which rely on science to assist in orchestrating the confidence of their readers. For any journalistic endeavour, to break with the dominant conventions by contesting the ability of science to be wholly objective would be to undermine the basis on which the press itself secures its own accounts as non-fiction.

Having said all this, however, it will be evident that much work remains undone. The effort in this study has been to show how attention to the popular representation of science has been constituted, and to argue that the corpus thus produced is not without significance for the performance of the media. The focus on this corpus means, however, that other aspects of the larger topic of science and the media remain undeveloped. Thus, although the work makes an appeal to history (specifically, to that period in which the 'problem' of science and the media makes its debut), the full history of the development of science journalism in the post-war years remains to be written. While it assesses (and, in certain cases, relies on) the analysis of popular science texts carried out by others, the scope of the study does not include its own close reading of specific media products. Despite the fact that it points to the import of economic constraints on media performance, its own consideration of these factors is as yet halting and tentative. And although it suggests in conclusion that Western journalism and Western science support one another's labours in ways not immediately obvious, the relation between the rise of science in the 20th century and the transformation of the press during the same period is one that demands to be explored in considerably greater detail.

In one's own defence, however, one might mention that others are engaged in the study of some of the areas left underdeveloped by the present work. At Simon Fraser University, Rowan Shirkie (1987) has begun an analysis of how the construction of popular science texts works to induce in the reader a deference to the rational authority of science. At the University of Pennsylvania, Bruce Lewenstein (1987) is nearing the completion of his doctoral thesis, a history of American science writing from the end of the Second World War, considered in light of the circumstances and interests which gave it shape.

As well, the announcement that the publication of the magazines Science and Technology DIMENSIONS and DIMENSIONS Science et Technologie has been suspended would seem to portend their imminent closing. Although at this writing the publisher is negotiating with the NRC and soliciting private investment to restore publication, it is likely that the magazines are destined to fold. The episode therefore provides an excellent opportunity for a case study of the economics of science publishing, so as to supplement the general arguments of the present thesis with specific detail.

Its various weaknesses, limitations, and absences notwithstanding, however, it is hoped that this thesis might be received as a useful contribution to the corpus of work on science and the media in specific, and on media studies in general.

Appendices

Appendix 1: BROADCASTING

SUNDAY

Bodywatch (30 minutes) PBS 9:30 a.m.

Production: WGBH/Boston in association with American Health magazine.

Host: Dr. James H. "Red" Duke, Jr.

Advertising: none.

Sponsorship: NutraSweet.

Contents: A report on the nature and causes of osteoporesis; research on the disease; and the debate over calcium dietary supplements as a means of prevention.

***

Math Patrol (15 minutes) TV Ontario 10:15 a.m.

Production: TV Ontario.

Advertising: none.

Sponsorship: none.

Contents: Arithmetic for children ("How would you share eight cookies between two people?) using puppetry, animation and songs.

***

Owl TV (30 minutes) TV Ontario 10:30 a.m.

Production: Telefilm Canada, CBC, and WNET/New York (PBS).

Advertising: none.

Sponsorship: The Public Awareness Program for Science and Technology, Ministry of State for Science and Technology, Government of Canada.

Contents: A science magazine program for children, the episode's theme was animals. Segments included the horses of the RCMP musical ride, the life of the hermit crab, rabies, and papier maché construction of animal heads.

***

Sunday (cont.)

A Fine Science (30 minutes) CBC 11:30 a.m.

Production: CBC-TV (Saskatchewan) and the Saskatchewan Department of Education.

Host: Holly Preston.

Advertising:

1. Mail order commercial for the Gut Buster, an exercise device.
2. Mail order commercial for a country music album.
3. Promo for CBC-TV's Country Canada.
4. Public service announcement for the Canadian Cystic Fibrosis Foundation.

Sponsorship: Saskatchewan Department of Science and Technology.

Contents: Forest inventory techniques; growing and storing trees in nurseries for forest planting; improvements in forest replenishment through biotechnology; forest fire fighting developments.

***

Innovation (30 minutes), PBS noon, and Wednesday 12:30 a.m.

Production: WNET/Newark.

Host: Jim Hartz.

Advertising: none.

Sponsorship: Johnson & Johnson, Canon cameras.

Contents: Developments in contraceptive research: a monthly pill; an anti-pregnancy vaccine; birth control pills for men.

***

Sunday (cont.)

The Nature of Things (45 minutes) PBS 2:00 p.m.

Production: CBC-TV.

Host: David Suzuki

Advertising: none.

Sponsorship: none.

Contents: "Women of Kerala". A report on the most densely populated state of India, which since 1970 has cut its birth rate in half. Education is seen as the key, particularly among women.

"Vortex". A report on vortices, from the air flow over wing surfaces to vortices created by buildings to black holes,

***

Eureka (5 minutes) PBS 2:45 p.m.

Production: TV Ontario.

Advertising: none.

Sponsorship: none.

Contents: "Molecules in Liquids". An animated explanation of why material melts from the solid to the liquid state.

***

Short Takes (5 minutes) PBS 2:50 p.m.

Production: PBS.

Advertising: none.

Sponsorship: Digital Corporation.

Contents: "The Measure of Performance". A report on the use of computers by the Stars and Stripes syndicate in its successful bid for the 1987 America's Cup.

***

Sunday (cont.)

Nature (60 minutes) PBS 8:00 p.m. and 11:00 p.m.

Production: WGBH/Boston.

Advertising: none.

Sponsorship: American Gas.

Contents: "The Masked Monkeys". A documentary on the investigation of the behaviour of primates in Uganda's Kibale forest.

*****

MONDAY

Knowzone (30 minutes) PBS 9:30 a.m. and Saturday 9:30 a.m.

Production: WGBH/Boston.

Host: David Morse.

Advertising: none.

Sponsorship: George D. Smith Fund.

Contents: Filmed reports on the problems of the profoundly deaf; attempts to teach deaf students to sign, lipread, and speak; technical aids to improve hearing.

***

Newton's Apple (30 minutes) PBS 10:00 a.m. and Saturday 11:00 a.m.

Production: KTCA/Minneapolis-St. Paul.

Host: Ira Flatow.

Advertising: none.

Sponsorship: Dupont Corporation.

Contents: In-studio discussion by experts and researchers of questions from the studio audience and from viewers. This week's episode featured hypothermia and the effects of cold on the human body; the phases of the moon; why adolescent boys' voices break; and the yak.

Newton's Apple is recommended as viewing by the U.S. National Education Association and the American Federation of Teachers.

Monday (cont.)

Discover: The World of Science (60 minutes) PBS 10:30 a.m.

Production: Chedd-Angier, in association with Discover magazine.

Host: Peter Graves.

Advertising: none.

Sponsorship: GTE Corporation, the New York Foundation for the Arts.

Contents: Filmed reports on a Princeton biologist's studies of a population of wild horses; new treatments for premature babies; the efforts of Frito Lay food scientists to produce a new snack food; sports scientists working with young figure skaters to improve performance.

***

The Creation of the Universe (90 minutes) PBS 11:30 a.m.

Production: Northstar Associates.

Presenter: Timothy Ferris.

Advertising: none.

Sponsorship: Texas Instruments.

Contents: Science writer Timothy Ferris, through interviews with prominent scientists and the use of sophisticated graphic animation, presents the origin and history of the universe, focusing on elementary particle physics and cosmology. A free-standing film.

***

Square One Television (30 minutes) PBS 5:00 p.m. Monday-Friday.

Production: Children's Television Workshop.

Advertising: none.

Sponsorship: The National Science Foundation, the U.S. Department of Education, the Andrew Mellon Foundation, the Carnegie Corporation, IBM.

Contents: Mathematics for children, presented via comedy skits and songs.

Monday (cont.)

3-2-1 Contact (30 minutes) PBS 5:30 p.m. and 10:30 a.m. Monday-Friday.

Production: Children's Television Workshop.

Advertising: none.

Sponsorship: The National Science Foundation, the U.S. Department of Education, the Arthur Vinning Davis Foundations.

Contents: Filmed reports on a science theme. Monday's theme was "Building materials," and segments included the nest activity of African termites, the construction of New York City, traditional Navaho homes, and raising the roof of a domed stadium. The program also features "The Bloodhound Gang," a team of three children who use their powers of observation and deduction to solve mysteries.

3-2-1 Contact is recommended as viewing by the U.S. National Science Teachers Association and the National Education Association.

***

Vista Presents (60 minutes) TV Ontario 8:00 p.m.

Production: TV Ontario

Advertising: none.

Sponsorship: none.

Contents: "The New Magicians". A documentary film on "the science of movie making" -- special effects technology in the Hollywood film industry.

*****

TUESDAY

The Brain (60 minutes) TV Ontario 7:00 a.m.

Production: WNET/Newark and Antenne 2 TV France, in association with Nippon Hoso Kyokai (NHK), Societe de Radio-Television du Quebec, Kastel Enterprises Ltd.

Advertising: none.

Sponsorship: CIBA-GEIGY Canada Ltd.

Contents: "Stress and the Emotions". One of eight episodes in the series, using historical reenactment and interviews with researchers and patients to explore the relations between environmental stress, emotional balance, and brain states.

The Brain is offered as a TV Ontario course.

***

Nova (60 minutes) PBS 8:00 p.m. and Thursday 2:30 p.m.

Production: WGBH/Boston

Advertising: none.

Sponsorship: Johnson and Johnson, Allied Signal.

Contents: "Can AIDS be Stopped?" A documentary film on three strategies in the fight against AIDS: drug treatment for victims of the disease, the search for a vaccine, and altering behaviour patterns as a means of prevention.

***

Marie Curie (60 minutes) TV Ontario 9:00 p.m.

Production: BBC.

Advertising: none.

Sponsorship: none.

Contents: Episode One in the dramatized account of the life of the Nobel laureate. Marya Sklodowska leaves Poland to study physics in Paris.

***

Tuesday (cont.)

Dimensions in Science (30 minutes) TV Ontario 10:30 p.m.

Production: TV Ontario.

Advertising: none.

Sponsorship: none.

Contents: An examination of the biosphere, the layer of life that surrounds the earth. Part of TV Ontario's instructional schedule.

*****

WEDNESDAY

Wonderstruck (30 minutes) CBC-TV 4:30 p.m. and Saturday 12:30 p.m.

Production: CBC-TV.

Host: Bob McDonald.

Advertising: none.

Sponsorship: none.

Contents: A magazine program for children, segments included the dangers of poisonous household plants; why birds fly into buildings; the mining, refining and uses of gold; the possibility of finding fossils on Mars; and making batteries from water and metal.

***

The Medicine Show (30 minutes) CBC Radio (AM) 7:30 p.m.

Production: CBC Radio (Winnipeg).

Host: Agatha Moir.

Advertising: none.

Sponsorship: none.

Contents: Items on the greater incidence of automobile deaths and injuries in rural areas; a discussion with Rick Hansen on how to reduce spinal injuries; what to do if a child swallows a "button" battery; and short segments on Canadian transplant recipients competing in the Sixth World Transplant Olympics, the dangers of reusing cooking oil, and cancer and metastasis.

THURSDAY

*****

FRIDAY

ABC News Closeup **Alcohol and Cocaine: The Secret of Addiction**
(60 minutes) ABC 10:00 p.m.

Production: ABC News

Host: Bill Blakemore.

Advertising:

1. Rice a Roni.
2. Clear eyes eyedrops.
3. Speed Stick deoderant.

4. Unisys computers.
5. Prudential Bache high-technology market portfolios.
6. Kellog's Corn Flakes.
7. Promos: ABC Wide World of Sports/O'Hara/Spenser For Hire.

8. Travelodge motels.
9. Aspercreme pain reliever.
10. Hefty Cinch Sak garbage bags.
11. Promos: Disney Sunday Movie/Riviera/Nightline/ The Health Show.
12. Country Kitchen rolls.
13. Promo: Local news.
14. Volkswagen.
15. Promo: Different Strokes.

16. Cannon Sure Shot camera.
17. Massengill douche.
18. AT&T long distance.
19. Hartz Blockade flea and tick collar.
20. Promo: ABC Monday Night Baseball.

Contents: A report on evidence that drug addiction may be primarily genetic in origin, rather than psychological, and therefore hereditary.

*****

SATURDAY

The Body in Question (60 minutes) TV Ontario 11:00 a.m.

Production: British Broadcasting Corporation, in association with KCET (PBS), ABC (Australia), CBC, and OECA (Ontario).

Presenter: Jonathan Miller.

Advertising: none.

Sponsorship: none.

Contents: A review of historical and contemporary understanding of the human blood system.

***

Science and Technology Week (20 minutes) CNN 11:10 a.m. and Sunday 4:10 p.m.

Production: Cable News Network (Turner Broadcasting).

Host: Charles Crawford

Advertising: 1. AT&T tele-conferencing.

2. AT&T toll-free service for businesses.

3. AT&T tele-conferencing.

Sponsorship: AT&T

Contents: Science and technology reports aired by CNN in the previous week, assembled in a 20 minute package: turning old tires into fuel, genetic engineering for a tastier oyster in the off-season, the successful test by Morton Thiokold of NASA's shuttle booster rockets. CNN is a pay-TV service.

***

Saturday (cont.)

Project Universe (60 minutes) TV Ontario noon.

Production: KOCE/Hungtingdon Beach, for the Southern California Consortium for Community Television and the Coast Community College District.

Advertising: none.

Sponsorship: none.

Contents: Two episodes of an introduction to astronomy, the first dealing with Mars, the second with Jupiter. Project Universe is offered as a TV Ontario course.

***

Quirks and Quarks (50 minutes) CBC-Radio (AM) 12:08 p.m.

Production: CBC-Radio (Toronto).

Host: Jay Ingram.

Advertising: none.

Sponsorship: none.

Contents: Items on the discovery of a new species of bird in Brazil that may already be threatened with extinction; improving the chances of pregnancy via artificial insemination by mixing the husband's sperm with that of a donor; the development of chemical sensors to detect toxic spills; butterfly survival strategies; the development of a hardier knife to cut oboe reeds; the physics and statistics of randomness; the history of the clock; spiders which lure and capture moths using sex attractant scents; reconstructing the sound of the harpsichord in the 18th century.

***

The Health Show (30 minutes) ABC 12:30 p.m. (Carried by only one of the two ABC affiliates available in the Montreal market, WMTW Auburn, Maine).

Production: ABC News.

Host: Kathleen Sullivan.

Advertising:
1. Nuprin headache remedy.
2. Betty Crocker Twice Baked potatoes.
3. Hefty Cinch Sak garbage bags.

Saturday The Health Show (cont.)

4. Cardi-Omega 3 fish oil concentrate.
5. Final Net hairspray.
6. Lean Cuisine frozen dinners.
7. Deering Ice Cream.

8. Betty Crocker Twice Baked potatoes.
9. Clear eyes eyedrops.
10. Nabisco Shredded Wheat.
11. Caladryl topical antihistamine for itch.
12. Betty Crocker Twice Baked potatoes.
13. Promo: ABC Nightline special episode on AIDS.

14. Fleishmann's margarine.
15. Excedrin headache remedy.
16. Ban deoderant.

Contents: Health headlines, followed by reports on: a meeting of top AIDS researchers; a New England Journal of Medicine study showing rural automobile deaths and injuries to be markedly higher than those in urban areas; new techniques in the study of how the body burns calories; the identification of the gene for "Elephant man's disease; using hyperbaric chambers (oxygen under high pressure) to treat a range of ailments; talking exercise machines.

***

Sociology (30 minutes) TV Ontario 1:00 p.m.

Production: TV Ontario, in cooperation with Wilfred Laurier University and Laurentian University.

Advertising: none.

Sponsorship: none.

Contents: An exploration of different sociological perspectives on crime and deviance. Sociology is offered as a TV Ontario course.

***

Saturday (cont.)

Understanding Human Behaviour (60 minutes) TV Ontario 1:30 p.m.

Production: KOCE/Huntingdon Beach for the Coast Community College District.

Advertising: none.

Sponsorship: none.

Contents: Two episodes of an introduction to psychology, the first on sensory deprivation, the second on visual perception. Understanding Human Behaviour is offered as a TV Ontario course.

***

The Planet of Man (30 minutes) TV Ontario 3:30 p.m.

Production: OECA, in association with the University of Toronto and Erindale College.

Host: Tuzo Wilson.

Advertising: none.

Sponsorship: none.

Contents: "The Fire Within". An examination of the formation and behaviour of volcanoes.

***

Understanding the Earth (30 minutes) TV Ontario 4:00 p.m.

Production: OECA, Laurentian University, TV Ontario.

Advertising: none.

Sponsorship: Ontario Universities' Program for Instructional Development.

Contents: An introduction to geology. Program Five: volcanoes.

*****

Appendix 2: MAGAZINES

Science and Technology DIMENSIONS

May 1987, Vol. 2 No. 3 62 pp. $2.95

Publishers: Science and Technology Mondex Inc. (Montréal) and the National Research Council of Canada (Ottawa). Published 11 times a year.

Contents:

Cover story

Strike Three! The Impossible Job of Hitting (8 pp.)

Sports psychologists reveal how complicated and difficult it is to hit a baseball.

Features

Will Kaons TRIUMF? (8 pp.)

The need to upgrade the tri-university meson facility in Victoria if Canada is to remain a player in subatomic physics.

Posthumous Portraits (8 pp.)

Advances made by anthropologists in the reconstruction of human and ancestral faces from skulls.

Geotextiles: A New Stitch in Time (4 pp.)

The varied applications of geotextiles, a spinoff of the plastics industry.

Articles

Desperately Seeking E.T. (2 pp.)

A dedicated amateur hunts for signs of extraterrestrial intelligence.

Sweet News (2 pp.)

Developments in research on diabetes.

To Be or Not to Be (2 pp.)

Myths and misconceptions about suicide.

DIMENSIONS (cont.)

Of Mice and Men / Needless Cruelty Must End (2 pp.)

Debate on the use of animals in research.

Bad Medicine / Paying the Piper (3 pp.)

Debate over British Columbia's proposal to limit billing numbers for physicians in certain markets.

The Little Engine that Could (3 pp.)

A Kingston, Ont. company produces a plastic engine.

The Antibody Shop (3 pp.)

Profile of Vancouver's Quadra Logic Technologies, a biotechnology firm.

Departments

Editor's Note (1 p.)

Letters (1 p.)

Opinion (1 p.)

One Fine Spring Day. The publisher comments on how young researchers become middle-aged technocrats.

Canadian Science News (2 pp.).

Short items supplied by Canadian Science News Service.

International Trends (2 pp.)

Short items supplied by Canadian Science News Service.

Comments (1 p.)

Exponential Growth. Dr. David Suzuki uses an explanation of exponential growth to argue for negative industrial growth in order to preserve the environment. A regular column.

DIMENSIONS (cont.)

Advertising:

(Alcohol)

Johnnie Walker Black Label Scotch (back cover, 1 p.)

(Companies/products)

Northern Telecom (centrespread, 2 pp.)
Apple computers (inside front, 2 pp.)
CAE Industries Ltd. (1 p.)
Zeiss microscopes (black and white, inside back, 1 p.)

(Miscellaneous)
CANMET (branch of Energy Mines and Resources Canada) (1 p.)
Science and Technology DIMENSIONS promo (2 pp.)
Science and Technology DIMENSIONS promo (1/2 p.)

Paid advertising percentage: 13.

*****

The Sciences

May/June 1987, Vol. 27 No. 3 72 pp. $4.00

Publishers: New York Academy of Sciences. Published bimonthly.

Contents:

Cover story

Romancing the Dinosaurs (8 pp.)

A book review, dealing with new theories of dinosaur extinction.

Features

Things Fall Apart (7 pp.)

An essay on Ludwig Boltzmann's H-theorem, which describes the irreversibility of entropy.

Who Wrote the Dead Sea Scrolls? (10 pp.)

A critique of the accepted theory on the authorship of the scrolls.

Chemical Cross Talk (6 pp.)

A discussion of the "unifying theory of intercellular communication," which aims to explain why chemicals derived from plants have medicinal and other properties for animals.

But is it Science? (3 pp.)

An essay on Randy Dudley's comic-critical paintings of laboratory science.

The Nine Lives of Discredited Data (5 pp.)

Outmoded findings continue to be preserved and taught in science textbooks.

Departments

On Human Nature (3 pp.)

Why the Reckless Survive. Why individuals persist in damaging or life-threatening behaviour, such as smoking.

The Sciences (cont.)

Field Notes (3 pp.)

When a Snail Leaves Home. One scientist's work on the behaviour of the limpet snail.

Anecdotal Evidence (2 pp.)

A Helpful Hoax. How at least one scientific hoax actually advanced the cause of science.

Letters (3 pp.)

Books in Brief (2 pp.)

Academy Affairs (3 pp.)

New York Academy of Sciences listings.

Cartoon (1 p.)

Advertising:

(Reading/listening material)

W.H. Freeman (B&W, inside front, 1 p.)
Oxford University Press (B&W, 1 p.)
Technomic Publishing (B&W, 1 p.)
Library of Science publishing (B&W, 1 p.)
The Genius of China, Science News Books (1 p.)
The Mozart Collection, Time-Life Music (2 pp.)
Top Hits Clearinghouse (record album sale) (B&W, inside back, 1 p.)

(Financial)

Business Opportunities Seekers' Loans Manual (B&W, 1 p.)
Touche Ross Guide to Personal Financial Management (B&W, 1 p.)
15 financial success manuals, Success Business Publishers (B&W, 1 p.)

(Products)

Hewlett Packard HP-28C calculator (B&W, 1 p.)
Lumicon telescopes (B&W, 1/2 p.)
Survivor (radiation contamination detector), Threshold Technical Products (B&W, 1 p.)

The Sciences (cont:)

(Companies)

Searle (medical research corporation) (back cover, 1 p.)
Pfizer Pharmaceuticals (B&W, 1 p.)

(Miscellanous)

Dreamscapes promo (New York Academy of Sciences art exhibition) (1/2 p)

Paid advertising percentage: 20.

*****

Discover

May 1987, Vol. 8, No. 5 104 pp. $2.50

Publishers: Time, Inc. Published monthly.

Contents:

Discover (cont.)

Vital Signs (2 pp.)

Treating babies who never will be well.

Light Elements (2 pp.)

An essay on fear -- and its absence -- in the animal world.

Letters (1 p.)

Brain Bogglers (1 1/2 pp.)

Advertising:

(Tobacco)

Marlboro cigarettes (back cover, 1 p.)
Vantage cigarettes (inside front, 1 p.)
Merit cigarettes (2 pp.)

(Automotive)

Ford (inside back, 1 p.)
Chevy trucks (centrespread, 2 pp.)
Goodwrench General Motors parts (1 p.)
Nissan Stanza (1 p.)
Honda Accord (2 pp.)
Plymouth Sundance (1 p.)
Dodge Daytona Pacifica (1 p.)

(Alcohol)

Bacardi rum (1 p.)

(Consumer technologies)

Olympus camaras (1 p.)
Hamilton watches (1 p.)
Interplak home plaque removal instrument (1 p.)
CompuServe (computer information service) (1 p.)
Kreepy Krauly (pool cleaning system) (1 p.)
Haverhills Power Failure Light (B&W 2/3 p.)
Smith Corona typewriters (B&W, 1 p.)
COMB liquidation-priced VCRs (B&W, 1/3 p.)
JS&A Blu-Blocker vision-enhancing glasses (1 p.)

Discover (cont.)

(Reading material)

Roger Tory Peterson Fieldguides (2 pp.)
Science Fiction Book Club (2 pp.)
Franklin Library of Mystery Masterpieces (2 pp.)
Quality Paperback Book Club (B&W, 1 p.)
Kodak-Time-Life Library of Creative Photography (1 p.)
The 3-Pound Universe -- The Brain (Dell paperback) (B&W, 1/3 p.)
The Search for Extraterrestrial Intelligence, John Wiley and Sons (B&W, 1/6 p.)
Mastery of Life, the Rosicrucians (B&W, 1/3 p.)
Discover subscriptions (B&W, 1/6 p.)

(Self-improvement)

NRI School of Electronics (home TV repair course) (B&W, 1 p.)
The Stomach Eliminator (exercise device) (B&W, 2/3 p.)
Fitness Master (exercise device) (B&W, 1/3 p.)

(Financial)

Fidelity USA Investments (B&W, 1 p.)
Prudential life insurance (1 p.)

(Miscellaneous)

Hughes Aircraft (1 p.)
Moshier Technologies (VTOL aircraft) (B&W, 2/3 p.)
National Historical Society civil war chess set (2 pp.)
U.S. Army (1 p.)
Foster Parents Plan (B&W, 1 p.)
Vital Records Storage of Emporia, Inc. (B&W, 1/3 p.)
Discover Product and Service Information (free information on products advertised in the issue) (1 p.)
Classifieds (B&W, 1 1/3 pp.)

Paid advertising percentage: 40.

Omni

May 1987, Vol. 9 No. 8 138 pp. $3.00

Publishers: Omni Publications International Ltd. Published monthly.

Contents:

Omni (cont.)

Forum (1 p.)

Results of an Omni readers' survey on the sense of smell.

Stars (1 p.)

The movement of galaxies.

Mind (1 p.)

The physiological effects of loneliness.

Explorations (1 p.)

The search for a $14.7 million (U.S.) cache of gold, silver, and jewels, supposedly buried somewhere in Virginia 150 years ago.

Space (1 p.)

Designing escape systems for shuttle astronauts.

Body (1 p.)

Applying NASA technology to earthbound medical care.

Continuum (8 pp.)

Short science news items.

Anti-Matter (4 pp.)

Short items on UFOs and the paranormal.

Star Tech (3 pp.)

Short items on new consumer technologies.

Games (2 pp.)

Last Word (1 p.)

Humour.

Omni (cont.)

Advertising:

(Tobacco)

Winston Lights cigarettes (inside back, 1 p.)
Merit cigarettes (inside front, 2 pp.)
Salem cigarettes (1 p.)
Lucky Strike Lights cigarettes (1 p.)
Marlboro cigarettes (1 p.)
Vantage cigarettes (1 p.)

(Automotive)

Mercury Tracer (centre spread, 2 pp.)
Chevy trucks (2 pp.)
Ford Mustang GT (2 pp.)
Nissan 300 ZX (1 p.)
Honda scooters (2 pp.)
Dodge Daytona (1 p.)
Camaro IROC-Z (2 pp.)
Hyundai (1 p.)
Chrysler-Plymouth and Dodge Colt (1 p.)
Jeep Wrangler (1 p.)
Plymouth Sundance (1 p.)
Michelin Sport EP-X tires (1 p.)

(Alcohol)

Smirnoff vodka (1 p.)
Bacardi rum (1 p.)
Finlandia vodka (1 p.)
Beefeater gin (2 pp.)
Cuervo tequila (1 p.)
Myers's rum (2/3 p.)
Hot Shot schnapps (1 p.)
Wild Turkey bourbon (1/2 p.)
Tanqueray gin (1/3 p.)

(Consumer technology)

Maxell computer discs (back cover, 1 p.)
Olympus cameras (1 p.)
Kodak VR 35 camera (1 p.)
Clarion car stereos (1 p.)
Casio watches (1 p.)
Memorex dBS audiotape (1 p.)

Omni (cont.)

(Consumer technology)

Whistler speed radar detector (1 p.)
Micro Eye Quantum speed radar detector (1 p.)
ACS IBM-compatible PCs (B&W, 1 p.)
Bose stereo speakers (1 p.)
Toshiba portable tape player (B&W, 1/3 p.)

(Reading/viewing material)

Science Fiction Book Club (2 pp.)
Franklin Library of Mystery Masterpieces (2 pp.)
NASA history videocassettes (1 p.)
Espionage magazine (1 p.)
Newsweek magazine (2 pp.)
Four Wheeler magazine (1 p.)
Longevity magazine (1 p.)
Mastery of Life, the Rosicrucians (B&W, 1/3 p.)

(Self-improvement)

NRI School of Electronics (B&W, 1 p.)
NRI Schools (build your own home) (B&W, 1 p.)
Whole-Brain Learning, John-David Learning Institute (B&W, 1/3 p.)
Stomach Trimmer (B&W, 1 p.)

(Miscellaneous)

Franklin Mint model cars (1 p.)
U.S. Committee for Energy Awareness (nuclear power lobby group) (1 p.)
Foster Parents Plan (B&W, 1 p.)
Fruit & Fibre cereal (1 p.)
Diamond rings (1 p.)
Forbes Lake of the Ozarks (1 p.)
U.S. Army reserve (1 p.)

Paid advertising percentage: 46.

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Appendix 3: BROADSHEETS

(G&M)= Globe and Mail; (G) = Gazette; (CP) = Canadian Press; (NYT) = New York Times; (AP) = Associated Press.

Globe and Mail

Monday

Food fight warming up over irradiation study (G&M) [A-1, A-4] 40 paras.

Suggestion for labelling of food called attempt to fool consumers (CP) [A-4] 11 paras.

AIDS research finds clue to reduced risk in inherited protein (NYT) [A-1, A-2] 1 para.

Canada lagging in high-tech race (CP) [A-5] 1 para.

Women face tough road in sciences, experts say (G&M) [A-23] 18 paras.

Maybe parasite could tell snails: Crawl off and die (Economist) [B-5] 7 paras.

Tuesday

Researchers will leave if money not available, latest study discovers (G&M) [A-3] 12 paras.

Research needed into causes of psychopathy, inquest told (G&M) [A-11] 15 paras.

More virus carriers will develop AIDS, new research says (G&M) [A-12] 18 paras.

Wednesday

Brain-drain registry aims to lure scientists (G&M) [A-4] 9 paras.

MD's singles club tests its members for AIDS antibody (G&M0 [A-4] 21 paras.

Bottled water is not safer, study says (G&M) [A-4] 8 paras.

CIDA backs food irradiation in Third World (G&M) [A-5] 31 paras.

Globe and Mail (cont.)

Thursday

MPs urge more study of irradiated food (G&M) [A-6] 15 paras.

Friday

Too many questions remain on irradiation, MPs decide (G&M) [A-3] 9 paras.

Saturday

Eclectic Crusader -- Pauling known for vitamins, peace efforts (G&M) [A-8] 22 paras.

Fight for immunity (G&M, review of Body Defences: Marvels and Mysteries of the Immune System) [C-19] 7 paras.

Thinking the unthinkable (G&M, feature on the future of brain tissue transplants) [D-1, D-8, Focus] 51 paras.

Science/Medicine Section [D-4, Focus]

Neural network: teaching computer to think (G&M, special) 32 paras.

Why technology needs close watch (column, David Suzuki) 20 paras.

Eureka (G&M, cartoon strip)

Fetal mouse cells made 'immortal' (NYT) 4 paras.

Getting high scores on IQ tests is a tall job for short students (Los Angeles Times) 3 paras.

Genetics and interior design to be taught at summer camp (G&M) 3 paras.

Doctors link use of steroids to psychosis in two patients (Lancet) 1 para.

Montréal Gazette

Monday

Key to tackling superbugs is found (CP) [A-8] 8 paras.

Tuesday

Wednesday

Fat widely condemned at Canadian Cancer Society conference (G) [E-1, Food] 28 paras.

I won't eat salmon from Lake Ontario -- specialist (AP) [E-14] 12 paras.

Mood may be linked to illnesses: MDs (AP) [E-15] 11 paras.

Thursday

Boy meets chimpanzee, and anthropoid makes three (Chicago Tribune) [A-15] 12 paras.

Depression drug helps addicts beat cocaine, researchers say (AP) [A-17] 6 paras.

NASA finds atmosphere, making it official: Pluto can stay a planet (AP) [A-20] 14 paras.

Friday

Debate over zapped food: it'll keep, but is it safe? (G) [A-1, A-5] 83 paras.

Mangoes à la gamma ray are more popular than most might think (G) [A-5] 18 paras.

Committee rejects idea of treating food with low-level radiation (CP, Southam News) [A-1] 13 paras.

Discovery of AIDS virus 'weak spots' may help find vaccine, scientists say (AP, Deutsche Presse-Agentur) [A-11] 11 paras.

Why we lose weight at different rates -- your body may defeat your diet (Shape magazine) [A-13, Fitness & Health] 40 paras.

Keep away from those fat calories (Shape) [A-13, Fitness & Health] 12 paras.

Hormone balance determines if fat is retained or released (Shape) [A-13] 12 paras.

Saturday

Science/Medicine section [J-18, 19]

Lookalike kin give B.C. researchers genetic key to schizophrenia (AP) 22 paras.

Canadians study 58-year-old undersea slide (CP) 21 paras.

New blood test may identify teens prone to suicide (Chicago Tribune) 17 paras.

Quartz grains confirm how dinosaurs died (Washington Post, AP) 10 paras.

Calcium wards off colon cancer, study suggests (Chicago Tribune) 10 paras.

Milky Way being attracted by massive 'supercluster' (San Francisco Examiner) 13 paras.

West coast may be due for huge quake (NYT) 13 paras.

Personal Computers (G, column) 21 paras.

Bird's Eye View (G, birdwatching column) 18 paras.

Science/medicine section advertising

* edith serei International School of Haute Esthetique
* Kells Academy summer school (a division of Westmount Learning Centre)
* Westmount Learning Centre summer school
* London School of Business
* Protestant School Board office specialist program
* Dawson College language courses
* Gazette travel section

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