Chapter One

Introduction

1.1 RATIONALE FOR STUDYING POPULAR SCIENTIFIC DISCOURSE

This thesis was inspired by two influences: one cultural and one theoretical. My work as an English instructor teaching 'English for Science and Technology' at a university in Thailand, and the overwhelming number of environmental problems presented in the mass media were the starting points of my interest in environmental issues. The students in my classes were from various disciplines (medicine, nursing, general science, agriculture, business etc.), but they had to take the same foundation English courses. When locating English reading materials, I had to look for subject matter that would not be so specific that the students could not comprehend it. I found that the nature of the subject matter of environmental science is the most suitable. Also, it was not difficult to get access to that kind of writing in environmental issues since the issues are of media interest. Furthermore, environmental science is an interesting subject in its own right, owing to the fact that it is not only interdisciplinary, but of international concern; people everywhere, ranging from politicians or decision-makers to 'the man on the street', talk about the environment based on their individual perspective, which is in turn shaped by their own culture. I spent much time browsing through general English science magazines and news magazines to find articles for my students. Reading those articles, written by writers from a different culture, particularly Western, I felt surprised and concerned at the same time. I found that being a representative of an Asian culture gives me the opportunity to see and understand environmental problems in an Asian way, whereas people from a different culture, particularly those in developed countries, look at environmental problems in Asia from a Western perspective.

Environmental problems are long-term, complex, and multifaceted, but they are often presented to the public in a simplistic manner and treated as if there were short-term solutions to them. Their causes are often underrepresented, for example, by casting all blame for deforestation that has occurred in Thailand on corruption among law enforcement officials. Although this is part of the problem, it is only one among various factors such as Western exploitation, the wood carving industry, a booming economy, or shifting cultivation (Ramitanondh 1989:31-32). Alternatively, high populations in 'over'- populated countries are often presented as the major cause of the depletion of the world's resources. Few articles balance the view by showing that in fact a developed country which has a very low birthrate, such as U.S.A., also makes a great contribution to resource depletion. (For example, *an American child will consume in its lifetime about the same amount of resources as 50 people in Bangladesh*, (Schiotz 1990:33)). We should consider that one of the causes of global warming is due to industrialised countries, which are concerned about their economic growth, attempting to sell as many automobiles as possible to those developing countries, in the name of development. Industrialised countries receive benefits from such sales, but then their media people blame those developing countries for creating pollution. Or companies in those industrialised countries shift heavy industrial factories, which infringe environmental laws in their countries to Asian countries, ignoring the fact that people in those countries also have the right to live in a good environment. There is a moral dilemma here, because the issue is really one of politico-socio-economics for both parties.

A glance at material written on environmental issues in some Thai magazines and newspapers shows also that they are discussed in a similar manner in Thailand, viz. dealing with local, short-term and simplistic aspects. However, similar issues discussed in less popular printed media, both in Thai and in English, are often discussed in depth and more objectively. Given that science is regarded as "politically neutral, value-free, and "above" politics" (Merrifield 1993:66), popular science should reflect the same concept. Sharing the same world, lay readers have the right to know

what specialists know; however a difference lies in the language used in the two domains, not in the way in which knowledge is controlled.

Visuals accompanying those popular articles also provoked my thoughts on issues of balance. The proportion of visuals compared to verbal information is quite high: in some articles, visuals take up half of the entire space. Generally speaking, it is the visuals that seem to have an emotional impact on viewers. For example, approximately seven out of ten articles discussing the population issue contained pictures portraying a disturbing scene in a Third World country. This gives me, and possibly other readers, no alternative to the perception that environmental problems take place only in the Third World countries, never in the other parts of the world. By comparison, only a small number of visuals presented facts and figures about environmental issues. All together both verbal and non-verbal representations of environmental issues presented in the mass media appear as icons or symbols with which people can easily identify. These representations, therefore, fall into the same semantic writing style in presenting environmental issues. It is possible that my view, or those of other lay readers, on the genuine environmental debate may be changed because they are shaped by these ideological constructs through reading the same kinds of popular articles time after time.

Since environmental science ranges over a very large number of issues, it is necessary to be selective in choosing issues as a focus for this particular study. Climate change, population growth, and deforestation were selected not only because they are serious global environmental issues (Anderson 1997:1; Galtung and Vincent 1992:169), but also because they represent the three most serious themes intertwining with "development", which is a key administrative concept of a developing country such as Thailand. Moreover, these three issues have different status in relation to Thailand. That is, deforestation issues have particular relevance for Thailand because Thai people used to depend largely on the forests. Climate change is a comparatively new issue but, one of mounting interest. Thailand, due to its economic boom, is rated as

one of the "highly polluted" countries, which in turn produces greenhouse gases. As for the population growth issue, Thailand is also a developing country with a high population even though the rate of population growth has been slowed.

In general, the topic of population growth is important because people want to develop their quality of life by improving economic conditions, believing that economic growth results in wellbeing. However, too great an emphasis on economic growth clearly results in the destruction of important ecological relationships. Farmers, for instance, want higher yields from crops. They therefore add fertilisers to the soil. In the short run, farmers make more money from higher yields, but in the long run the soil loses nutrients and becomes useless. So, the focus on population pressure is chosen because it is so prominent in environmental science writing. It is also a problem to be shared by people in both developed and developing countries because the earth's finite resources cannot provide the needs of an ever increasing population.

Climate change or a global change in climate is another phenomenon affected by "development". The greenhouse effect and, to a lesser degree ozone depletion, are said to contribute to the rise in global temperatures and have received widespread attention over many years. The greenhouse effect is the threatened warming of the Earth due to the accumulation of gases such as carbon dioxide and methane. The greenhouse effect is caused by human activities such as extensive burning of fossil fuels that produce greenhouse gases. The most important of these are carbon dioxide, methane, nitrogen oxides, chlorofluorocarbons (CFCs), ozone and water vapour. Ozone depletion is caused by chlorofluorocarbons (CFCs), chemicals used in refrigerators, air-conditioners and production of foam, for example. So, the issues of the greenhouse effect and ozone depletion are selected because they form a major part of current scientific debate in the literature and could well affect the future of this planet within one or two decades. They are topics about which experts argue extensively within the environmental science literature because scientists are not completely in agreement as to what our future will be if global warming occurs in the near or distant future.

Deforestation is a particularly important issue in the relationship between developed and developing worlds. Timber is exported from developing countries to developed countries. On the one hand, people in a developing country are able to spend income from the sale of timber for their primary needs while those who buy the timber or timber products benefit because they can buy cheap furniture. Since the topic is so controversial, and because people can see a direct immediate impact from deforestation on jobs and local communities, it occurs in news coverage almost daily. Moreover, climate change and deforestation are generally believed to be related to population size.

In examining the popular discourse of an interdisciplinary subject such as environmental science, we should be aware of at least two overlapping communities. For example, climatologists writing to a science magazine about environmental impacts on the global climate abide not only by certain disciplinary conventions in climatology, but also by a complex set of conventions of language of printed mass media. This property of discourse communities is essential for shaping the form and content of the texts (Faigley 1985:239-240 cited in Anson 1988:7). Limiting the range of popular science writing to the issue of development and its three sub-aspects allows me to expect that there ought to be some commonality in the structure of the texts which deal with them. However, semantic variations can be expected as well. The data of this study were selected from general science and news magazines such as *New Scientist*, *Discover*, *Time*, *Populi*, and *Our Planet*. Three sets of ten articles have been selected for examination, each set dealing with one of the three sub-issues of climate change, population growth, and deforestation. This means that a total of thirty texts are analysed.

My initial concern was to seek answers to questions dealing with Western media writing style and ideological constructs inherent in the presentation of environmental issues. Interestingly, what has also emerged from my analysis is the notion of futurism expressed in the articles. I have found during the course of the analysis that there is an

urgency among the writers on environmental issues to stress the future, especially in relation to 'acting' in order to save the environment. In addition, the notion of future is expressed in different ways and reflects semantic variations in the texts.

Based on the issues which I have mentioned above, a large variety of questions could be addressed; however, only the questions listed below are central to my study;

1. Does the writing of popular science, as revealed in environmental texts, constitute a genre?
2. If there is such a genre, or functional variety, to what extent can that genre be specified in its linguistic strategies and meaning potential?
3. Are the articles in popular science influenced by an agenda extraneous to the need to inform readers such as an ideology which leads to misrepresentation of the issues due to bias, cultural or otherwise, or the oversimplification of the complex issues?
4. Are the interactions between the visual semiotics (pictures, graphs etc.) and the verbal semiotics productive and congruent?
5. Does analysis suggest that there are other strategies for producing popular science? To understand this, we partly have to know the options that have been taken up and the gaps that are left by writers and editors.
6. If we were to assume that popular science articles are written with a soundly established understanding of the interests of their readership, what kind of readership could we infer from those articles?

These questions will be discussed in several chapters as follows:

Questions 1 and 3 are discussed in chapters 2-5.

Question 2 is discussed in chapters 3-4.

Question 4 and 5 are discussed in chapter 5.

Question 6 is discussed in chapter 5.

Given that writing is a social process and product, linguistic approaches that do not take into account social aspects may not be able to shed light on all of the problems raised above. Among several linguistic approaches offered for analysis of texts, I have found that Hasan's (1984, 1985) model of genre analysis is very useful in the exploration of what is going on in the texts because it is the one that combines social context with language. It works on the principle that language construes and is construed by social context. Since environmental issues encompass several sub-issues, each of which can be deemed one genre, Halliday's (1991) and Matthiessen's (1993) notion of a 'cline of instantiation' is one of the main tools employed in the analysis of the thirty texts under the three sub-issues. (These will be discussed in chapter two).

In fact, most crucially for my language students, the investigation has given me the opportunity to test the linguistic notions underlying the concept of genre/register in functional theory. The thesis, therefore, constitutes an exploration of discourse theory and the tools of textual analysis. In particular, it brings out a number of currently topical linguistic issues: for example;

1. the number of distinct strata required in a model;
2. the role of "purpose" in textual theory; and
3. the way in which ideological consistencies can be argued for through generic analysis.

1.2 RELEVANT WORKS ON SCIENTIFIC DISCOURSE ANALYSIS

There has been a substantial amount of research on scientific discourse aiming at applying discourse analysis to characterise textual properties of written discourse in professional and popular scientific discourse. These studies can be divided into three main categories. Studies that fall into the first category emphasise the grammatical features or vocabulary that occur frequently in scientific texts (Selinker and Trimble

1972; Gosden 1993). These studies aim at giving guidelines for second or foreign language learners.

The second type of research attends to discoursal patterns of texts but does not show how these discoursal patterns are realised in actual wordings. Most of the studies tend to focus on certain parts of the text. For example Swales (1981) examined only the introductory section of articles, Dudley-Evans (1986) the introduction and discussion section of MSc dissertations, and Mirador (1995) only the conclusions in medical articles. Bazerman (1981, 1985) concentrated on whole articles across three academic disciplines (molecular biology, sociology, and social science). His work relates context and text, that is, he gives insights into how the context drives the form of the text but does not systematically show the relationship between the language and the context.

The problem with these two categories of study is that their focus is either on grammatical features or vocabulary or on discoursal level alone. They do not look systematically at the connection between these different levels, that is, the contextual configuration (*field*, *tenor*, and *mode*), semantics (the three metafunctions), and grammar.

The third category of research in scientific discourse is one that integrates grammar and discourse. Even though these studies attend to both grammatical features and discoursal patterns, they tend to concentrate on certain aspects of grammar and certain parts of the text. Very little work concentrates on all three aspects of grammar and complete texts. For example, Hunston (1989) studied the evaluation component in scientific discourse and focussed on a good deal of interpersonal wordings. Conduit & Modesto (1990) studied the 'Generic Structure Potential' only of the material/methods section of scientific reports with special attention to textual and experiential metafunctions. Paltridge (1993) examined the 'Generic Structure Potential' of the introduction section in environmental scientific research articles. Some researchers in

this group have attempted to compare the organisation of discourse of complete texts in professional and popular science (Nwogu 1990).

There appears to have been very little work in this area which takes up a three stratal perspective; that is, which includes the lexicogrammar at one level (where relevant), the relationship between semantic consistencies and generic shape, and the relationship between the generic shape and the contextual variables. A systematic picture has not typically been available. The present study attempts to examine popular scientific discourse with respect to the questions raised on page six by looking systematically at relations between the three strata.

The approach used in this study is the one proposed by Hasan (1984, 1985). In her 'nursery tale as a genre', she identifies how semantic elements can be seen as a basis for distinguishing elements in the genre and she has also developed tools for examining all three strata, Generic Structure Potential, and semantic options which look both to the grammar and back to the semantic consistencies which underpin the structure of generic unfolding.

1.3 THE EMERGENCE OF POPULAR SCIENTIFIC DISCOURSE

The need to popularise science began towards the end of the seventeenth century when the introduction of a quantitative, mathematical approach to knowledge of physical science was incomprehensible to the majority of educated readers (Meadows 1987:341- 346). Hence, it became necessary to present scientific knowledge in a popular form to reach a wider range of non-scientists. By the nineteenth century, publications in journals gradually replaced publication in book form for different branches of science. This shift from publications in book form to that in research journals can be seen as a "sign of the growing professionalization and specialization of science, which can, in turn, be related to the increasing difficulty of the subject for non-scientists."(Meadows 1987:341-342). Correspondingly, the need to popularise

science for the general public has become much stronger. Meadows (1987:342) stated that "Not only do books popularising scientific ideas begin to appear in increasing number; so, for the first time, do authors who devote most of their time to such popularization". In the twentieth century, science popularisation has become wider in scope due to advances in technological communication and not only is it scientists who popularise scientific knowledge but also science communicators or science journalists.

Science has become more and more important in our contemporary social life for it is one factor which is changing the world and the conditions of society. Scientific information has become part of our general consciousness because our lives are affected by the impacts of science and technology and by policy decisions determined by technical expertise. Scientific knowledge is becoming a survival skill involved in our day-to-day existence from the personal to the global scale (Nelkin 1987:22). For example, at the personal level, people regularly encounter choices that require some understanding of scientific facts: whether to use sunblock, to eat high-fibre cereals or to use fluoridated toothpaste. Similar choices must be made at the community level: what would happen if the government allows the construction of a toxic waste disposal dump or allows people with AIDS to work in public spaces. Because scientific knowledge is very important in society now, many people such as experts and scientists, as well as journalists, deem it necessary to provide the public with enhanced scientific information. One way of communicating scientific knowledge is through varieties of mass media, one of which is 'the periodical'. As a consequence, there is increasing interest in how to disseminate scientific knowledge to reach the general public.

Up to the present time, a problem for such dissemination has been that science and technology are understood by a limited number of people, due to two major factors, content and language. Specialists take control of scientific knowledge and make the content impenetrable to outsiders. Moreover, writers may adopt a particular language

that is unintelligible even to educated non-specialist readers. As a result, science is considered more and more authoritarian; it seems to be the enemy of the people rather than a means of survival. This phenomenon is articulated in Beer's work (1983:6-7), where she comments that,

> In our own century scientific ideas tend to reach us by a process of extrapolation and translation. Non-scientists do not expect to be able to follow the mathematical condensations of meaning in scientific journals, and major theories are more often presented as theorems than as discourse.

Scientists have begun to acknowledge the magnitude of these problems and there is now a concern among scientists about how to popularise scientific and technical facts, explanations and ideas. An immediate constraint of which science writers must take account is the diversity of readership of popular periodicals; who the readership is, what area of interest they have, what form of writing they are familiar with, the level of technicality they are able to manage and the existing degree of familiarity with the scientific field. The readership may be one factor that makes popular writing especially difficult. For example, the popular science writer may write being aware of a wide range of readership which can include specialists in a certain field, enthusiast specialists in other fields, and ordinary educated readers. These readers read with different purposes. The specialist may read in order to judge how information is presented, while ordinary readers may want to read an informative, entertaining scientific article as long as it has relevance for them. Hence, the popular writer has to adopt writing strategies to suit the needs of the audience. This complicated combination necessarily contributes to making popular scientific texts different from academic or professional texts such as specialist journal articles.

The informational purpose of science writing appears as the most obvious starting point for characterising my selected texts. However, we should not consider writing purpose as a simple assumption to follow from the beginning to the end of the analysis, since I will come to argue that a deeper, underlying purpose of the texts has

emerged during the course of my own analysis. (The theory behind the discussion of purpose is discussed in chapter two.)

1.4 SCIENTIFIC DISCOURSE: POPULAR OR NON-POPULAR

Scientific discourse is a broad term referring to any kind of writing that is produced by the scientific community and a small number of journalists who have also adopted the convention of scientific discussions. The transferring of scientific knowledge from scientists or journalists to the lay public may be referred to as popular, as opposed to non-popular or academic scientific writing (Farago 1976:6; Whitley 1985:3; Ziman 1976:112). The distinction between popular and non-popular scientific writing can be difficult to establish as it is not easy to locate where the boundaries lie. It may be due to the diversity of readership and the complex roles a reader performs. For example, Rowan (1989:161) defined 'professional scientific discourse' as writing about scientific topics addressed to expert members of the scientific community and popular scientific discourse as writing about scientific topics for students or lay audiences. Myers (1991:1) used the term 'non-specialist readers' to refer to students, language teachers, translators, journalists, administrators and politicians. Fuller (1995:22) maintains that "popular science is science for non-experts, but unlike science textbooks it is not a stepping stone to the specific discursive practices of science".

From the above definitions, complications arise. There is a fuzzy border between the terms "expert" and "non-expert"; an expert in one field can be a non-expert in others. When one looks at readers and their roles, for instance, a person with chemistry expertise who may read a specialist science article in order to catch up with scientific advances in chemistry is labelled an expert in chemistry. This expert may also read a biological text with the purpose of catching up with new knowledge. In this case, the expert is considered a science enthusiast but when the same expert reads an article on how to maintain his car, then the expert is regarded as a lay reader. Therefore, considering the readership does not necessarily enable appropriate categorisation of

the writing. Writing and reading purposes should also be taken into account. All of the factors together affect the choices of how the knowledge is presented, which includes linguistic and non-linguistic presentation. A mismatch of the factors can otherwise create an undesirable outcome. For example, *A Brief History of Time* (Hawking, 1988), a book praised for its success in the clear and accessible popularisation of science, turns out to be difficult to follow. Despite the fact that the writer uses analogies, the gap between everyday and scientific understanding of the phenomena is still very wide, and that seems to make the book difficult (Busbridge 1996).

For the purpose of this study, distinctions between popular and non-popular scientific discourse are desirable and necessary. We must start with the assumption that they belong to different genres. Table 1.1 below is an attempt to illustrate the continuum of specialist and popular scientific discourse. The criteria for categorisation are the audiences' reading interests and the level of their expertise or sophistication. The present study is restricted to an analysis of the characteristics of the popular scientific writing category indicated by the grey area.

	Audiences	**Language Level**	**Descriptions**
Popular readers	Introductory novices, reference seekers	General	Low degree of abstraction of language, introductory, requiring little prior knowledge
	Students, apprentices in certain fields, enthusiasts acquainted with the genre	Moderate	A higher degree of abstraction of language and a moderate level of knowledge concerning the field
	Experts in certain fields expanding their knowledge in a new field	Advanced	Not highly technical language but dealing with advanced concepts specific to the field
Non-popular or trained readers	Experts in certain fields expanding and contesting their knowledge	Technical	High expertise in dealing with advanced technical language and a high level of scientific knowledge

Table 1.1 The Continuum of Popular/Non-Popular Scientific Discourse.

Some examples of popular and non-popular print media (not specific to science literature) which are presented in a graphical form in Figure 1.1 may give a picture of what I mean by popular and non/popular.

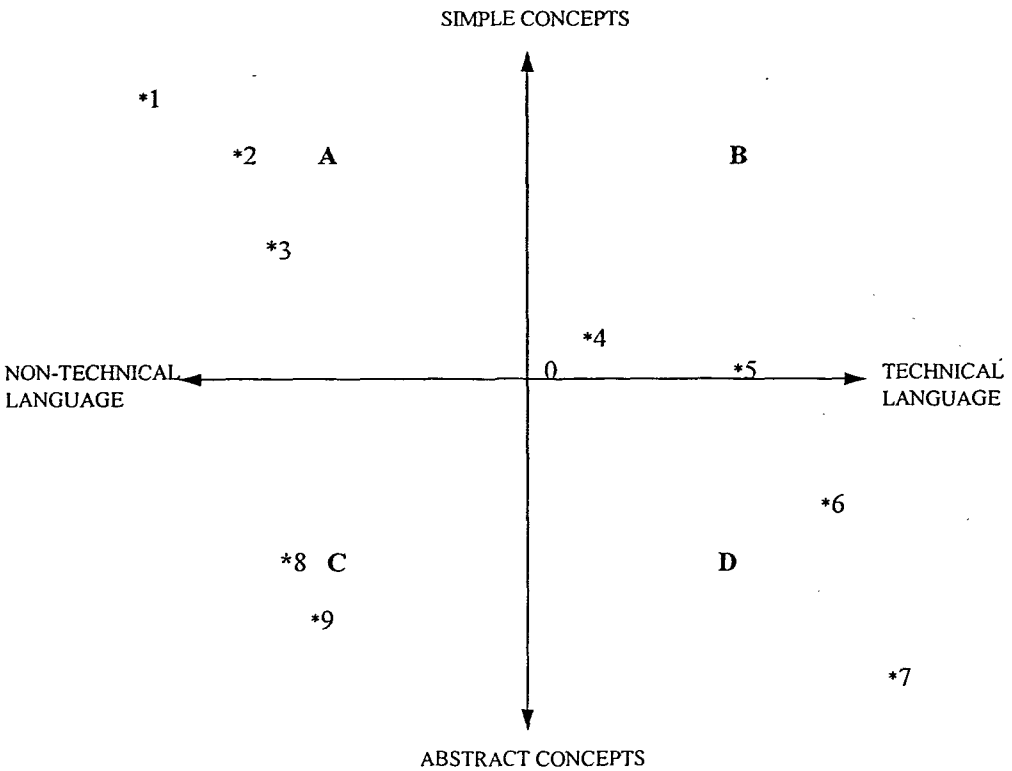

Figure 1.1 Chart Representing the Degree of Popularity of a Range of Print Media.

As shown in Figure 1.1 on the popularity continuum, group 1 texts in quadrant A have the highest degree of popularity while group 7 texts in quadrant D have the lowest degree of popularity. Texts in group 1 use the most non-technical language whereas texts in group 7 use the most technical language. Thus texts in group 1 may be the most popular because they contain the most non-technical language and the most simple/concrete concepts. On the contrary, texts in group 7 can be assumed to be the least popular as they contain the highest degree of technical language and abstract concepts. Below are listed examples of texts located in each quadrant.

Group 1

* Windows 3.11 for Dummies (Rathbone, A. 1995)
* The Complete Idiot's Guide to Trouble-Free Car Care (Ramsey, D. 1996)

* You Can Reduce Your Blood Pressure (Jennings, G. & Vale, S. 1994)
* Popular Science
* National Geographic

Group 2

* Time
* Discover

Group 3

* Ever Since Darwin : Reflection in Natural History (Gould, S. 1977)
* It's a Matter of Survival (Suzuki, D.)
* Our Ecological Footprint (Wackernagel, M. & Mand, R. 1996)
* Wittgenstein for Beginners (Heaton, J. & Groves, J. 1994)
* New Scientist

Group 4

* Nature
* Scientific American

Group 5

* The Mind of God: Science and the Search for Ultimate Meaning (Davies, P. 1992)
* Minds, Brains, & Science (Searle, J. 1984)

Group 6

* An Introduction to Functional Grammar (Halliday, M.A.K. 1994)

Group 7

* The Logical Structure of Linguistic Theory (Chomsky, N. 1975)

Group 8

* Chaos (Gleick, J. 1987)

Group 9

* A Brief History of Time (Hawking, S. 1988)

A finer distinction within popular science itself is drawn by Fuller (1995:24-27) in her study of how science popularists (Stephen J. Gould and David Suzuki) mediate scientific concepts. She offers two types of popular science: reporting and reflective. Reporting popular science focuses on certain scientific events whereas reflective popular science is issue-based. The texts that I analysed appear superficially to fall

into the category of "reporting" in that they dealt with events and experiments related to human experiences. However, it became more difficult to differentiate them as either "reporting" or "reflective" at deeper levels of my analysis.

Although Fuller's observation of the distinction between "reporting" and "reflecting" is insightful, I found that the semantic topological framework which she uses to establish the distinction cannot be utilised in my study. That is because she locates clauses in one of the four semantic regions (representation, probabilisation, relativisation, and assimilation) in isolation and does not look at clauses as components of a semantic element. My analysis, on the other hand, will analyse clauses in relation to one another within the same semantic element.

Also relevant here is a general methodological issue which I used as a criterion for inclusion when I was considering the literature and its critical tools. The issue is the question of replicability and reliability in analysis. This is not, of course, a criterion which is special to my own study. Despite reading and hearing Fuller's approach, it was not clear how I could adjudicate the semantics in her method. While my own approach, using Hasan's Generic Structure Potential theory and Halliday's Functional Grammar, can be debated in principle and in detail, my analysis can be followed and defended in a public way. At least, that has been my aim.

1.5 PURPOSES OF SPECIALIST JOURNAL ARTICLES

Linguistics works on comparing and contrasting in order to arrive at certain characteristics of a particular linguistic activity. To characterise popular science articles, we need to look at the characteristics of other kinds of science writing as a point of comparison. As briefly reviewed in 1.2, there have been some studies concerning the characteristics of academic or professional science writing. I will mention those already established (accepted) works on specialist journal articles as a point of reference.

The basic aim of both specialist and popular science writing is to disseminate scientific information to the public (Whitley 1985:1, Ziman 1968:95, 1984:58). However, when we put the aim of science writing itself under the microscope, we find a complex of goals in science writing. We will consider the aim of specialist science writing first. The reasons why scientists publish their works are not straightforward. Among scientists themselves, publications are constituted by a mutual relationship between contribution to, and recognition received from, the scientific community. That is, scientists publish their work in a science journal in order to contribute their scientific knowledge to the community, and this will in turn receive recognition from their peers. To receive recognition, the work or the report of the experiment must be accurate. The need to be accurate has two aspects. First, the work is reviewed and checked carefully by scientists who are in authority to approve it. Once the work is published, other scientists may read it with different purposes. One may want to replicate it for further information, and in this case the work or the result must be tested also. On the other hand, other scientists (both from the same or other disciplines) may want to update their scientific knowledge only (Ziman 1968:95, 1984:58-78).

Further, the scientists compete with time in terms of getting their work published as soon as possible in order to stake their claims to the development of a subject area, and they may want a further grant or funding. They therefore have to develop certain kinds of progress reports, and conjecture about the possible outcomes as a result or extension of their work. This point is directly related to the 'Generic Structure Potential' (GSP) because there are some instances of the 'irrealis': extension, and conjecture about future findings.

The same scientific information may also be of concern to people other than scientists, for example, the heads of large industries and government departments, or politicians. For these people, the level of their scientific background may vary from very little to substantial; however they require some scientific information when policy-making is

involved. Consequently, specialist publications may need interpretation and mediation for a second group of those who may need to act on the scientific results.

1.6 PURPOSES OF POPULAR SCIENTIFIC DISCOURSE

For popular science writing, the most general core writing aim is the same as that for specialist articles, disseminating scientific information. However, that may be the only similarity between them. Other differences may begin with the fact that the writers are not necessarily scientists. They may be journalists who have no formal scientific education, but who are interested in scientific issues or have some formal scientific background and have become science journalists. For them, the mutual relationship between contribution to, and recognition received from, the scientific community cannot be applied. The person who reviews and approves their writing is the editor of a journal. The approval is made on the basis of generating interest, whether it can get the reader's attention. It should, as well, have an enduring sense of deeper entertainment (Hennessy 1997), which ensures that people will continue to buy the journal. Further, popular science writers do not write to gain recognition from the scientific community, but instead write for readers who read popular science articles to catch up with scientific advances and to survive in this "fast changing world". Popular magazines, which have more frequent publication, for example, weekly or fortnightly, are not subject to peer reviews the way research journals are. Time pressures may be the reason that restrict the practicality of peer reviews in this case. However, there is a forum in popular magazines in which the reader can write to the editor and debate the issues discussed in a previous publication.

When talking about scientific research article writing and popular scientific writing, we are dealing with two different contextual pressures. The criterion of success in the former tends to be the replication of relevant results while that in the latter tends to be the coherence of conclusions or scientific findings, specifically the coherence of various scientific findings that mesh with social processes. This is clearly seen in

relation to environmental issues where popular articles tend to emphasise and influence the interaction between the coherent issues and the way they mesh with social processes. Almost everybody has a chance to act on the issues politically when they vote, or personally when they buy products.

1.7 DIFFERENTIATING SPECIALIST AND POPULAR SCIENTIFIC DISCOURSE

Linguistic organisation consists of different dimensions; such dimensions, first expressed by Saussure, are created by the syntagm/paradigm relation. Hasan (1996:107) also maintains that the paradigm and syntagm are "two different perspectives on the same phenomenon: the system of features, that is the paradigm specifies the potential; a specific syntagm represents one actual (deemed possible in light of the potential)." The concept of genre is built upon these two axes; one aspect of the genre is "How does the text unfold?". In other words, how does the text appear to us from the point of view of its linearity and sequence? This is the syntagmatic relation. On the other hand, a general question we ask about the paradigmatic perspective is what kind of choices are available to the writers? Thus, the statement of similarities and differences between the two kinds of scientific writing should be organised around these two axes.

Even though the paradigm and syntagm are mutually dependent, it is easier to look at the paradigmatic perspective of the text first. What kind of choices are available to specialist scientific writers that are not available to popular scientific writers, and vice versa? In the former case, one major component of research articles is the section dealing with an experiment in which the researchers present their work in a highly technical language, including equations and scientific formulae. Therefore, it is clear that the researchers can involve themselves in a high order of representation with technical languages, that is, mathematical or quasi-mathematical languages which become the mode of reasoning in their discourse (Halliday 1993:54-68; Myers

1991:1-25). By comparison, these choices are not available for popular scientific writers because as soon as the technical language is introduced, the text is made exclusive. It demands specific training. The popular science writers do, however, have opportunities to make certain choices that the specialist writers do not. The popular writers can present topics with human interest features rather than with their formal discussion, an opinion, or propositions. For example, they can personalise scientific experiences or dramatise the debates between different points of view. In fact, if the propositions and formal opinions of scientists have to be included, the popular writers translate them into a more accessible form for popular science readers. For example, the result of a climate computer modelling which says that the temperature at the north pole will be increased by 2-4°C is interpreted by popular science writers to mean that the ice cap will melt. Similarly, that there will be eight billion people in the world by the year 2020 and there may not be enough food is translated by popular science writers as that by the year 2020 the world population will starve to death. Furthermore, not all propositions or opinions are translated. The popular writers select only the aspects in relation to which their readers can see a direct impact.

When we move to a metafunctional perspective, we can look at the fact that the representation may be very different. The ideational meaning may be different because the idea dealt with in scientific journals may be mainly abstract, and thus may be inaccessible for popular readers. Popular writers have to turn to the choices that are more accessible. The comprehension of abstract ideas may be enhanced by the analogies or concrete examples most relevant to ordinary readers' perceptions, such as, analogies concerned with everyday life experiences. Research articles and popular articles may also differ in their use of attributional strategies. For example, "X has the following characteristics" may be more common in research articles (Halliday 1993:54-68; Martin 1993: 166-220) while "X is like....." is more common in popular scientific articles.

Interpersonally, the two types of scientific discourse are very different. One fundamental aspect of the interpersonal metafunction is the way in which judgments are expressed. Judgment or evaluation is important in both specialist and popular scientific writing. There are different reasons why evaluative comments are included in the two types of discourse depending on writing purposes already discussed in 1.5-6. Therefore, the way they are expressed will differ. Driven by such purposes, what counts as strong and formal judgments in research articles may have to be turned into moderate, indirect, and less formal judgments in popular articles. The popular scientific writers may attempt to raise people's consciousness, for example, about reducing the use of chlorofluorocarbons. Consequently, the writer follows his/her judgemental language with advice on appropriate action. Evaluations in research articles are made in order to prove the case. We can see the shift from modality ("This may be the case." in research articles) to modulation: obligation ("What ought to be done."). Modulation may be one of the examples of deep semantic principle by which we can characterise popular articles, particularly in environmental science, because there is an urgent need to improve the deteriorated conditions of our planet.

To consider textual metafunction, the texts have to be thought of in terms of their textual differences. For example, we may find that research articles have greater intensification in thematic patterns, that is, the accumulation of thematisation (Halliday 1993: 54-68). On the contrary, popular articles may contain a large amount of scientific explanation. The writers may consistently add an explanation when they come to a new phase of a topic which needs some (additional) background; therefore there exists a kind of recursion loop in textual organisation. This characteristic is unlikely to be found in research articles.

We can consider the writer's 'explanation' in terms of the paradigm/syntagm axes. Paradigmatically, the explanation is one of the choices that the writers can adopt at a particular point. The explanation can be characterised paradigmatically because it makes certain choices of meaning. For example, it gives the readers background

knowledge. It can be characterised syntagmatically because it arises at certain points where the readers need to be carried over from one specific concept to another.

Texts can be similar or different depending on which level (and which rank in that level) we examine first. Each level, or degree of abstraction (contextual, semantic, grammatical) may relate to one another in different ways. For example, we can predict a lot more about the actual wording or grammar of a particular text in research articles than in popular ones. The systematic relationship between the levels (context, semantics and grammar) may be easier to predict within a particular discipline because the context does not allow the researchers to go far beyond its scope. This is not the case in popular articles because the context of popular articles can vary greatly depending on the angle the writers adopt. Whether we pursue it at the clause rank, clause complex rank, or the group rank, we get a slightly different picture. This is where 'rank' is important. Similarly, if we look at the 'rank' in the semantics (text; rhetorical unit; message; text radical: Hasan 1996:117), we might say that there is something fundamental about the rhetorical units or strategies in the text.

We already know the answers to these questions to a certain extent. Basically, if we focus on the grammar, we know that specialist scientific writing is more lexically dense (Halliday and Martin 1993). Furthermore, one can predict certain words in a research article on concentration of sulphate aerosols in a tropical city. Verbs are centred around a narrow range of Process types such as Relational processes. For example, some mental processes such as *suggest* and *imply* are common. Certain words such as *temperate*, *atmospheric pollutants*, *acid rain*, *oxidation*, *meteorological conditions*, *emission,* and *sampling point,* can also be expected. Conversely, it is quite difficult to predict what words we will come across while reading a popular scientific article on the 'parasol effect' which is caused by sulphate aerosols in the air, for example. We may find words such as *cheeping*, *well-fed geese, munching*, *tablecloth*, *Bavarian castle,* and *a neatly trimmed man.* These words are unexpected and appear to have no connection with the text discussing the 'parasol effect'.

The same phenomenon holds true for specialist journal articles on population growth where one can find such terms as *projection*, *transition stage*, *exponential growth*, *ratio* etc. By comparison, in popular articles, words such as *nag*, *miracles*, *mosquitoes*, *checkerspot butterflies* etc. can be found. These words will probably never appear in a research article but it is possible to have this enormous range of general world lexicon in a popular article. This is because the writer wants to stimulate the reader's attention by describing the scenario leading to a more serious discussion on the parasol effect or on population growth. By bringing in a more general world, it is believed to be less challenging (ideationally) for most people. It should be noted, however, that this generalising of experience means the text is more difficult for foreign language learners because they do not have such a predictable localised lexicon. While it may not take a long time for someone to learn enough English to read a text in a specialised field, if a person wants to learn enough English to read popular articles, it may take a comparatively long time. This means that for popular articles the predictability of the words from the semantics, and of the semantics from the context is in a different relationship from the predictability of those of research articles.

The issues raised in this section are general but also relate the idea back to Hasan's proposal of GSP because she consistently relates analysis to the three stratal interrelationship, that is, how does the context relate to the semantics and to the grammar and from the grammar back to the context (via the semantics). In this thesis, the level that will receive the greatest attention, because it carries the most responsibility for characterising the genre, will be the generic level and its particular relationship to the semantics. Therefore, we must think of syntagm first of all in terms of the discourse or genre level.

In the following section, I will focus on the differences between research articles and popular scientific articles in terms of their generic structure. The generic structure of a text refers to "the global structure of the message form" (Hasan 1985:53) and the

Generic Structure Potential (GSP) of a particular genre is "a statement of the structural resources available within a given genre" (Hasan 1984:79). It has been proposed (Gosden 1992) that there is a standard generic structure or, to use Hasan's term, Generic Structure Potential (GSP), for scientific research articles. That is, such articles may be characterised as having the following discourse elements: Abstract ^ Introduction ^ Methods ^ Results ^ Discussion ^ Conclusion. Some researchers have postulated that an Abstract is a genre of its own (Swales 1990). In those studies, Title does not receive particular attention.

The present study shows that popular science articles exhibit a specific GSP. It is, however, too early to characterise the GSP for popular science articles because the realisation at the semantic and lexicogrammatical levels needs to be examined in great detail. This is the major aim of my study. Superficial positional parallels between the two genres in the outer structure of the article such as the Title, Abstract, and Conclusion may have led people into thinking that they are similar, possibly because they are under the umbrella term "science". A brief review of a subset of specialist and popular science articles indicates just how different the two genres are. This difference is reflected in semantic values and is even more evident when we move into the inner core of the information being disseminated and the typical rhetorical strategies employed by popular science writers. It has to be stressed here that the superficial similarities of purpose, that is, disseminating scientific information, can be just as misleading as they are helpful, while the differences in the readerships (contextual participants) have systematic consequences for the form of the genre.

To illustrate my point, Title, clearly has been in the same position in both forms of writing. This can also apply to the Abstract. There appears to be at least locational parallel between the two generic elements of the two genres that we might call 'Title' and 'Abstract'. When we look at both opening elements, we find that the 'Title' and the 'Abstract' in fact differ markedly between the two genres. The 'Title' in the specialist articles usually contains a technical term of great lexical density with very

low scale of elements of dramatisation. As Ziman (1984: 59) points out in *An Introduction to Science Studies: the Philosophical and Social Aspects of Science and Technology,* "the Title of a long paper tells one very little about its contents, which are therefore usually summarised in a brief 'Abstract' published with the main text". A closer look at 'Title' in research articles, such as, THE ROLE OF THE TROPICAL SUPER GREENHOUSE EFFECT IN HEATING THE OCEAN SURFACE (Lubin 1994), and INDIRECT INFLUENCE OF OZONE DEPLETION ON CLIMATE FORCING BY CLOUDS (Toumi 1994) suggests that the semantics of the 'Title' foregrounds the technicality. By comparison, the 'Title' in the popular science articles is comparatively more dramatised and sensational, trying to create fear or other emotions by using a few words; for example, *THE HEAT IS ON* (Lemonick 1987), *DRYING OUT THE TROPICS* (Rind 1995), *THE OZONE VANISHES* (Lemonick 1992), *PLAYING WITH FIRE* (Linden 1989), *THE MAKING OF AN ECO-DISASTER* (Nash 1994) and *HUNGER VERSUS THE ENVIRONMENT: A RECIPE FOR GLOBAL SUICIDE* (Megalli 1992). The semantics of the 'Title' of the popular science article is more like a semantics of dramatisation and linguistic naturalisation, often with the common journalistic strategy of punning on words and idioms.

It is appropriate at this point to consider the 'Abstract' in the specialist articles and GLIMPSE (a term I propose) in popular articles. The two elements are similar to each other in terms of their textual perspective; they appear in similar positions that is second in order. They differ from each other in terms of their ideational and their interpersonal perspective. Ideationally, the 'Abstract' summarises the article. It is long (approximately 200 words), informative, includes something from all parts of the article, and enumerates the main findings and conclusions. The GLIMPSE varies a great deal in length, but is usually short (approximately 10 - 50 words). It rarely deals with findings and conclusions, but rather anticipates disturbing or sensationalising information for the reader's reaction. It may include the latest findings. And if there are latest findings, they are usually without specific data but rather some alarming or worrying consequences. Interpersonally, the 'Abstract' is neutral in tone while the

GLIMPSE contains the interpersonal charge or attitude by highlighting sensational findings.

As we look further into the opening section or the introduction of each of the two kinds of writing, we find that popular science writing signals just how different it is as a genre. In particular, its use of predominant personalisation, direct quotations from the wording of a participant scientist, vignettes from the actual social circumstances of the scientist, and episodes on location with the scientist, or a report of a trip to a rainforest, all tend to reflect the manner in which popular science dramatises scientific material at the outset. It seems hard to relate these characteristics to specialist journal articles.

In the main text around which the argument is centred, the distinction between research articles and popular science articles becomes increasingly evident. It would appear that a scientific paper is a straightforward completed report of an investigation intended to answer a specific scientific question. In fact, it is more than a mere report. It must have persuasive power to convince other scientists that its claims are valid or at least very plausible and thus have a place in the archives as a potential contribution to the future scientific consensus (Ziman 1984: 62-63). As a result, the main text is devoted to detailed methods of an experiment conducted by one scientist or a team of scientists, followed by the results and discussion sections. The purpose of providing detailed methods is that the work can be replicated in the future. Given that readers of research articles are specialised in a certain scientific discipline, the writer can assume that the readers are familiar with the subject matter and thus s/he does not need to constantly naturalise the ideational material.

Like research articles, popular science articles can be categorised as 'persuasive' writing because the writer wants to present his/her viewpoint. However, popular science writers have a different motivation to persuade. They do not have to convince other scientists about the validity of their own experiment. Instead, they have to

convince not only lay readers about what they present, but also scientists who may read the article. Moreover, the lay readers are not going to replicate the experiments as it is not part of their social activities. To transfer scientific knowledge to the general public, the writer must ensure that s/he provides them with adequate information, entertains them and takes the responsibility of evaluating the issue being discussed. Krieghbaum (1967: 21) wrote in *Science and the Mass Media* that "Science, like all the other information sources, has been mined to provide human interest materials, vicarious thrills, and amusing anecdotes". We would expect, therefore, that the rhetorical strategies in popular science writing are different.

What we find in a popular science article is that the main text contains several sources to support the writer's viewpoint. The sources can come from sources such as newspaper cuttings, CD-ROM databases, books, published research articles, conferences attended by the writer, face-to face interviews, telephone conversations etc. (Hennessy 1997: 14-42). The information gathered from those sources is often rewritten and rearranged chronologically. So, we find that the main text of popular science articles may range from presenting a number of results of experiments and evaluating the whole issue to presenting a number of results of experiments in a conversational form or presenting a scientist's profile which also includes his/her experiments or discoveries. In an attempt to make popular readers understand their argument, popular science writers may employ various strategies of analogy. These strategies differ from those used in research articles. Even though both kinds of writing are mainly explanatory, they have different explaining strategies. I will go on to argue that the semantics in the main text of research articles is that of 'doing' and 'quantity' whereas that in popular science is of 'happening' and 'comparing'. In other words, specialist discourse is a discourse of *x equals y* or *x means y*, while popular discourse is a discourse of *x has y* or *x is like y*. These differences in semantics reflect different choices in lexicogrammar.

Issues that are emerging from this kind of study include the fact that we can examine popular scientific writing from a number of strata, namely, those of the context of

culture, the GSP, the semantic characteristics that create the GSP elements, and the lexicogrammatical realisations. Each of these perspectives needs to be explored on different levels. For example, in one stratum, we may observe that there is a mixture of lexicogrammatical choices used in research articles. Certain elements may have a strong procedural orientation which is reflected by the frequent use of material processes. The pressure on the writer to emphasise quantity in the thematisation often produces a tendency towards identifying and relational clauses. On the other hand, in popular articles, attribution and the process of happening may be more common. The contextual logic to these perspectives is that when dealing with technical articles, the writer should define precisely the terms and the quantities that produce replication. But in popular articles, the writer must explain scientific concepts by using analogies so that it is easier for the popular readers to connect concepts to day by day experience.

The endings of both research and popular scientific articles are usually labelled 'Conclusions'. In this study, I propose CLOSING for popular science writing since the final sections of both types of writing are different from each other in their semantic motivations. 'Conclusion' in research papers summarises the main point of the article and sometimes recommends further studies. Interestingly enough, CLOSING in popular science articles exhibits more variety. It may provide readers with a summary as well as extend the issue a little further. It tends also to move further from the main issue, which is contrary to the pattern in research papers where the 'Conclusion' moves backward to the text again. One of the most recurrent features is a stress on what should be 'done' in the future. These are reflected by the semantic elements RECOMMENDATION, CALL FOR COLLABORATION, and SPECULATION. Most important of all, however, CLOSING is more sensational; it leaves the readers with a feeling of uncertainty, fear and anxiety, a characteristic that is not enhanced in research articles.

If these are important elements of scientific discourse, we can expect them to appear in the actual generic outline that the writer has adopted. As the discussion is related to GSP, our examination of generic structure we are forced to consider obligatory and

optional elements and their sequences. Hence, the outline is going to be determined by the order in which the writer chooses to release information. So the abstract, complex concepts typically presented in a specialist journal can also be presented in a popular article even though the latter employs a different sequencing of similar components in order to do so. In fact, the strategies used by a writer within a popular article may allow scientific information to be more easily comprehended by the reader whereas such concessions may not be made by the author of a specialist journal article. It is not necessarily the case that the concepts presented in a specialist article are any more difficult than those in a popular article and the explanatory terms and concepts may even be the same. However, the selection of elements and their characteristics and sequencing are the issues of greater importance to this study. The starting point is the generic shape since this is the linguistic feature that we need to identify and its shape will be revealed to be influenced to a significant degree by cultural assumptions and bias, which often amount to misinterpretation.

1.8 PURPOSE OF THE STUDY

As the linguistic properties of popularised scientific texts have not been extensively researched, there is a need for such a study, the immediate concern being both theoretical and empirical. Few studies in this area have attempted a detailed investigation of popularised scientific texts in terms of their patterns of discourse organisation, especially the differences and similarities of discourse patterns. To a large extent, the linguistic aim of this study is to provide an account of some crucial, representative data of popular science writing with the focus on the characteristics of the texts. Further, a study which endeavours to characterise textual structure and linguistic properties of scientific papers will, no doubt, be of interest to scientists (professionals and learners) as well as to science journalists who are continually engaged in either writing or reading these articles. It will also be of specific interest to linguists who are involved in teaching English to science and technology students.

Chapter Two

Theoretical Background

2.1 INTRODUCTION

The present study draws on two complementary components of Systemic Functional Linguistics: one in the area of discourse, the other in Functional Grammar. The discourse model that I adopt will not be argued at great length in terms of the motivation for all of its components, however its introduction in this chapter will enable it to be placed in relation to other proposals that writers in the field of discourse analysis use. The Functional Grammar, on the other hand, has been selected not only because it is congruent with functional discourse studies, but also because the very nature of the grammar is driven by the description of texts. Therefore, it has a strong textual function, or component with three metafunctions that allows us to discriminate between issues of representation, interpersonal argument and textual metafunction. The specific component of discourse that I will outline in this chapter is Hasan's proposal on Generic Structure Potential. I will give a very brief outline of its origin with Malinowski and Firth and then examine how it provides the opportunity to explore the systematic relationship between text structure, consistency of meaning, and most probable choices in the lexicogrammar. Three environmental sub-issues will be analysed in this study by drawing on Halliday's (1991) and Matthiessen's (1993) notion of 'cline of instantiation' which deals with register variation.

2.2 GENERIC STRUCTURE POTENTIAL (GSP)

Based on Systemic Functional theory, Hasan (1984, 1985) proposed a theory of Generic Structure Potential. An overview of Systemic Functional theory is therefore needed in order to comprehend Hasan's theory of GSP.

Malinowski (1923 cited in Halliday & Hasan 1985: 5-8) introduced the concept of "context of situation", meaning the environment of the text, in an attempt to present the texts from the Trobriand Islands to English readers. Convinced of the inadequacy of a direct translation, Malinowski developed the concept because he realised that any example of language behaviour must be understood as a product of the immediate situation and the wider context of culture in which it takes place. However, Malinowski developed the concept of "context of situation" in relation to the study of a "primitive" language. His theory was further developed by Firth in 1950 (cited in Halliday & Hasan 1985: 8), who posited that meaning can be thought of as complexes of statements produced both at the contextual and linguistic levels. Firth's "context of situation" (Halliday & Hasan 1985:8, Martin 1992) includes;

1. the participants, including their statuses and roles,
2. the participants' verbal and non-verbal activities
3. the surrounding objects and events,
4. the effects of the verbal action.

Halliday (1985) further developed the notion of "context of situation" by suggesting that the systematic relation between a text and its context of situation be viewed in the light of three main categories of discourse, namely;

* ***Field*** of discourse: the social activities taking place in the text, including the subject matter,
* ***Tenor*** of discourse: the participants, their social statuses and roles,
* ***Mode*** of discourse: the role that the language plays in the text, including channel (graphic or phonic), medium (written or spoken) and rhetorical mode.

Halliday (1994: 33-36) explains that a feature of the English language is that it simultaneously expresses meanings corresponding to each of the three contextual

variables above. He identifies (ibid) three functional components of language, which he calls metafunctions; ideational (most directly involved in the realisation of *field*), interpersonal (most directly involved in the realisation of *tenor*), and textual (most directly involved in the realisation of *mode*).

The ideational metafunction itself consists of two components: the experiential and the logical. The experiential aspect construes some processes in ongoing human experience while the logical aspect deals with the expression of general logical relations of the language. The interpersonal metafunction focuses on social relations between interactants, and their attitudes. The textual metafunction deals with the organisation of a text and the way in which the text creates its context.

In lexicogrammar, Halliday (1994:106) proposes that ideational meanings are expressed by the transitivity system, that is, "the processes represented in the language, with the participants and the circumstances associated with them". Interpersonal meanings are expressed through the mood and modality system; mood is the central resource that establishes and maintains an ongoing exchange between interactants by assuming and assigning speech roles; and modality deals with the negotiation of the proposition and proposal in terms of probability, usuality, obligation, and inclination (ibid). Textual meanings are expressed through Theme and Rheme; Theme functions as the point of departure of the message; while Rheme is the remainder of the message or the part which the theme develops. Halliday (1989:26) proposes the relationship between the text and its context of situation as summarised in Table 2.1.

SITUATION: Feature of the context	(realised by)	TEXT: Functional component of semantic system
field of discourse (what is going on)		Experiential meanings (transitivity, naming, etc.)
tenor of discourse (who are taking part)		Interpersonal meanings (mood, modality, person, etc.)
mode of discourse (role assigned to language)		Textual meanings (theme, information, cohesive relations)

Table 2.1 Relation of the Text to the 'Context of Situation'.

The slanting arrow shows the dynamic relationship between text and context. That is, *field*, experiential meaning, and transitivity cannot be tied up in a direct, single way. So too, *tenor*, interpersonal meaning, and Mood; and *mode*, textual meaning, and Theme. As a result, the ramifications for *field* can be felt across grammatical choices and the ramifications of *tenor* may have some implications on the experiential aspect as well. In other words, any three textual variables can be realised by any of the three metafunctions. When dealing with genre and its elements, one issue involved in identifying elements is similarities of and differences between the elements. The combination of the three metafunctions can give us a discriminative power to distinguish one element from another.

Hence, applying the notion of "context of situation" to popular scientific discourse, a provisional convergence of values is as follows:

1. ***Field***: Transferring, explaining, and interpreting a particular field of scientific knowledge from scientists or journalists to non-specialist readers, and stimulating non-specialists' interests.
2. ***Tenor***: Asymmetrical relationship between writers and readers, i.e. those who know more and those who know less; writers are not familiar with readers and therefore social distance is maximal.

3. *Mode* : Language is constitutive (though there may also be diagrams, pictures, and graphs), graphic channel and written medium (quite informal), entertaining, monologue, expository and persuasive.

According to Halliday (op. cit.) and Hasan (op. cit.), the semantic level is the "key" to the whole system as the semantic system relates the high-level concepts of semiotic meanings to their linguistic realisations on the level of grammar, vocabulary and phonology. Halliday (1989:36) also maintains that there is a close relationship between context and text, that is context creates text, thus we can infer the text from its context and vice versa.

A particular contextual configuration, that is, a set of specific values for *field*, *tenor*, and *mode*, therefore acts as determinant of the texts through its specification of the register. At the same time these three components are systemically associated with the linguistic system through the functional components of the semantics (Halliday 1978:122). In other words, *field*, *tenor*, and *mode* motivate a particular contextual configuration of semantic meanings realised by linguistic units, which are, in turn realised in lexicogrammar and phonology (Hasan 1985: 56). As a result, texts made up of the same contextual configuration are thought of as belonging to the same type or register. Under the Systemic Functional theory of Halliday and Hasan, register is a semantic concept.

Hasan (1984) not only builds her GSP theory on the dialectical relationship between text and context but also develops further the specific interconnection between the two. She holds that we need to interpret the total set of features (all of the selected values of *field*, *tenor*, and *mode*) as one configuration that determines the generic structures themselves (Hasan 1984, 1989:56). When these values are common to a class of social events, the texts will resemble one another functionally and thus can be classified as belonging to the same genre (Martin 1985, 1992; Ventola 1987:43). In other words, genre represents the recognisable pattern of verbal and non-verbal

structures which constitutes a social exchange. It follows that the texts that vary in their structures can, therefore, be recognised as belonging to different genres. This postulation does not mean that texts belonging to the same genre must have exactly the same structure. Hasan argues that variations within texts belonging to the same genre are possible, but within certain limits, which results in texts having similar functional elements. According to Hasan (1984), approaches to text analysis comprise three components:

1. The level of discourse, at which functional elements and textual structures are defined, and the GSP is formulated;
2. The level of semantics, at which we are able to identify statements about "crucial semantic attributes" of the functional elements proposed at the discourse level;
3. The lexicogrammatical level, at which the description of lexicogrammatical patterns realising semantic properties of the elements in question is attempted.

In order to capture the total range of textual structures available within a genre, Hasan (1984:79, 1989:56) proposes utilising the GSP statement which is an abstraction capable of specifying the following:

1. the obligatory elements;
2. the optional elements;
3. the sequencing of elements;
4. the possibility of iteration of elements.

The obligatory elements, she argues (ibid) are specific to a particular genre and thus define the genre. This means that the text can only be perceived as a complete instance of a given genre if it contains all obligatory elements. The optional elements may affect the actual structure of a particular text but they do not affect the GSP of the text.

An analysis and identification of a GSP can, therefore, offer a powerful analytical tool at the level of system for it allows a classification of text types on the basis of the obligatory elements and can account for their generic relatedness.

The GSP approach has been successfully applied to shorter texts embedded in the context of culture such as 'service encounters' (Hasan 1978). Moreover, the individual elements in the service encounters are realised by at most three utterances. According to Hasan (1984), the essential attributes of the structurally important units of any text type have to be stated in semantic terms and further specified in terms of lexicogrammatical patterns capable of realising specific semantic properties. The GSP model is, therefore, based on three strata: the levels of discourse, semantics, and lexicogrammar. The task is to show the systematic interrelationships among these three levels.

However, a number of difficulties emerge when applying this approach to other types of texts. Hasan herself also anticipates some difficulties when analysing texts for which the environment is not pragmatic. In the case of the service encounters, both context of culture and the language are complementary to each other. Both dimensions can be used to characterise the genre and to define its elements. But for the nursery tale, which Hasan has dealt with in detail, the motivation from the context of situation/culture is not as determinant as the language itself works to construct the context. In Hasan's terms we are moving towards the constitutive end of the ancillary-constitutive cline. Another difficulty also lies in the fact that elements in other types of texts are realised by long "chunks" of text and not by particular utterances (Harris 1987/88:100). Ventola (1987) acknowledges the difficulty of analysing long "real" texts. She argues that the process of composing texts "in the real world" involves bypassing certain features, unlimited possibilities for recursions, and even importing "alien genres" within the one being composed. "Real" texts often represent an array of possible combinations of prototypical structures. Ventola's view seems to be

congruent with the notion of "textual dynamics" used by Bazerman and Paradis (1991:4) when they say that,

> *The phrase "textual dynamics" refers to the idea that written discourse is produced by a complex of social, cognitive, material and rhetorical activities; in return, written texts dialectically precipitate the various contexts and actions that constitute the professions.*

In response to the issues raised by Ventola, Bazerman and Paradis, however, one must recognise that the text that Hasan uses for the study of the nursery tale, or for 'service encounter' are in fact real texts, not diminished or ideal. Her approach constitutes the challenge that if one can show a text of that genre not conforming to the GSP statement then a better accounting of the genre needs to be enunciated. The question of the length and recursion of elements is certainly germane to this thesis. The texts I am dealing with are considerably longer than any of the texts analysed completely in the literature. In fact, many descriptions by linguists address only the 'abstracts', or one component, such as the 'introduction' of a work, whereas I have found that in the analysis of popular science texts, one must return constantly to a semantic strategy. Alternatively, the articles themselves fall back on the semantic strategy such as the explanation of background information (called BRIDGING in this thesis), or the elaboration of an issue as it bears on the future (treated in the next chapter under the labels THREAT, PROPHECY, PREDICTION, CONCERNS, SPECULATION, SOLUTION, and SUGGESTION). Nevertheless, while this has challenged the generic approach it has not undermined it. In fact, the theory of text and context, semantics, and lexicogrammar employed in this thesis has been well expounded by Halliday and Hasan, and others in relation to registerial aspects. It is helpful to elucidate some of the fundamental concepts necessary for understanding the argument concerning register variation.

2.3 REGISTER VARIATION

Halliday and Hasan (1985) and Halliday (1991) elaborate their view of the relationship between textuality and the cultural context in which a text holds its place. Figure 2.1 shows how the different components of linguistics bring the study of context and the study of language into a coherent relationship.

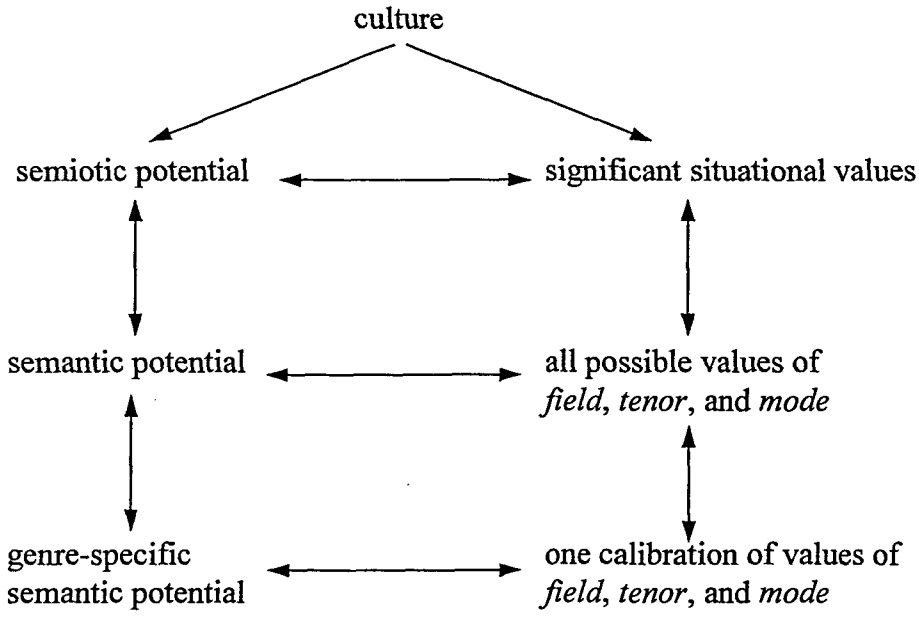

Figure 2. 1 Culture, Meaning, and Situation (Hasan 1985: 100).

The important point about the relationship between these four levels as set out by Halliday and Hasan is that I can utilise it consistently in this thesis while maintaining the idea of cultural dynamic and variation. Criticism is often made from outside, and sometimes within, linguistics about text and generic characterisation. The main points of criticism relate to how variation is managed. Given that no texts are ever going to be exactly the same, variation within one register is inevitable. Hasan (1984, 1989) maintains that it is not necessary for the texts belonging to a certain genre to have exactly the same structure. Given that over time the changes in a text pattern are motivated by changing conditions of *field*, *tenor*, and *mode*, there is an inherent tension in the need to reconcile fundamental generic commonality with the fact that there is always variation. This is so whether variation is based on the unique instance

of a text, that is, instantial variation, or whether its variation can be related to phylogenetic changes over the whole system. This variation would be based on the kind of register development that occurs naturally with the development of a new subject area.

Based on the idea that register is a social process and product that develops over time, Matthiessen (1993: 221-294) offers a strategy to handle register variation by considering three phases of potentiality; instance, instantiation, and potential. The relationship between potential and 'instance' is one of time-depth. Halliday (1991:7-87) points out that;

> *I have suggested that the context for the meaning potential - for language as a system - is the context of culture.... The context for the particular instances - for language as processes of text - is the context of situation. And just as a piece of text is an instance of language, so a situation is an instance of culture. So there is a proportion here. The context for an instance of language (text) is an instance of culture (situation). And the context for the system that lies behind each text (language) is the system which lies behind each situation - namely, the culture....*

The relationship between potential and instance also depends on the observer's viewpoint, and Halliday (ibid) compares them by drawing on the analogy of climate and weather.

> *We can perhaps use an analogy from the physical world: the difference between 'culture' and 'situation' is rather like that between the 'climate' and the 'weather'. Climate and weather are not two different things; they are the same thing, which we call weather when we are looking at it close up, and climate, when we are looking at it from a distance. The weather goes on around us all the time; it is the actual* ***instances*** *of temperature and precipitation and air movement that you can hear and feel. The climate is the* ***potential*** *that lies behind all these things; it is the weather seen from a distance, by an observer standing some way off in time. So of course there is a continuum from one to the other; there is no way of deciding when a 'long-term pattern' becomes a 'temporary condition of the climate', or when 'climatic variation' becomes merely 'changes in the weather'. And likewise with 'culture' and 'situation'. . .*

To elaborate, on any particular day, the weather can have features quite unique to the day. Suppose that the fourth of November, 1997 is unreasonably hot, not a typical day for early November. It could be considered to be more like a summer's day because it has characteristics considered to be those of a summer day within the climate system. So the weather, as an instance on the fourth of November, 1997 can be reported by the weatherman as "five degrees above average". The variation on the fourth of November, 1997 does not mean the climate of the whole region has changed, however the accumulation of several unreasonably hot days in a row bears upon our sense of what counts as typical or normal. It changes what is normal. Those daily averages combine so the averages determine an average from which we conclude what 'average' is. So the weather is modifying our notion of the climate.

By analogy, any particular text (or the instance) of a context is its own unique 'day' or own unique meaning pattern. It will have words, pattern, length, and features that construct meaning which varies from that of any other text. But it is not relevant to stress all of those features because its overall semantic pattern may fit closely with an outline, namely GSP, whose basic texture (cohesion, lexicogrammar) we recognise as falling into a typical kind of semantic process in our culture. Does this mean that the uniqueness of a particular text will be picked up and multiplied in its consistency; that is, aspects of its meaning be confirmed, repeated, and echoed through other examples? We must acknowledge an increasing tendency for shifts to occur in the meaning-making processes of society. We are using different language in particular contexts and thereby seeing the general generic/registerial tendencies of culture develop new forms.

In this, the semantics of 'climate' has shifted enormously over a few hundred years. One can detect a significant movement of instances into a climate. So Halliday's metaphor (1991) of climate provides a means of seeing that the instance and the system together, like the weather and climate, are not inseparable. This is how we want to consider a text and its contribution to the overall culture. It is not text-making

alone, it is part of the system. No matter how small, or whatever the text concerns, it makes a contribution to text semantic processes. It is the instance that constructs the meaning potential of the culture or the system. The instance and potential are part of a cline which naturally describes how the construction of text becomes the possibility of meaning in culture. This construction of meaning potential is summarised by Matthiessen in Figure 2.2 and 2.3 below.

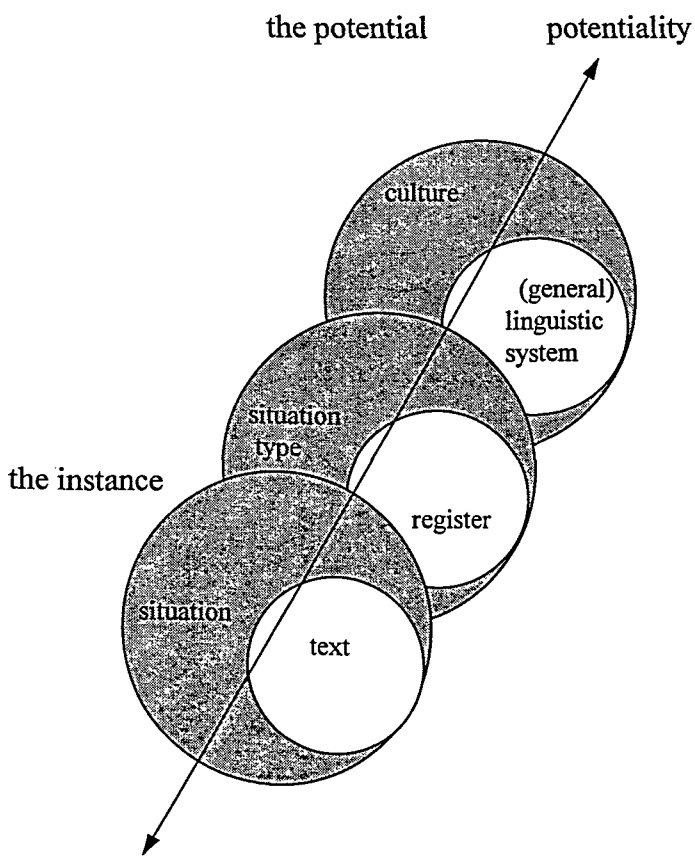

Figure 2. 2 Context of Culture and Context of Situation along the Dimension of Long-term Potentiality (Matthiessen 1993:272).

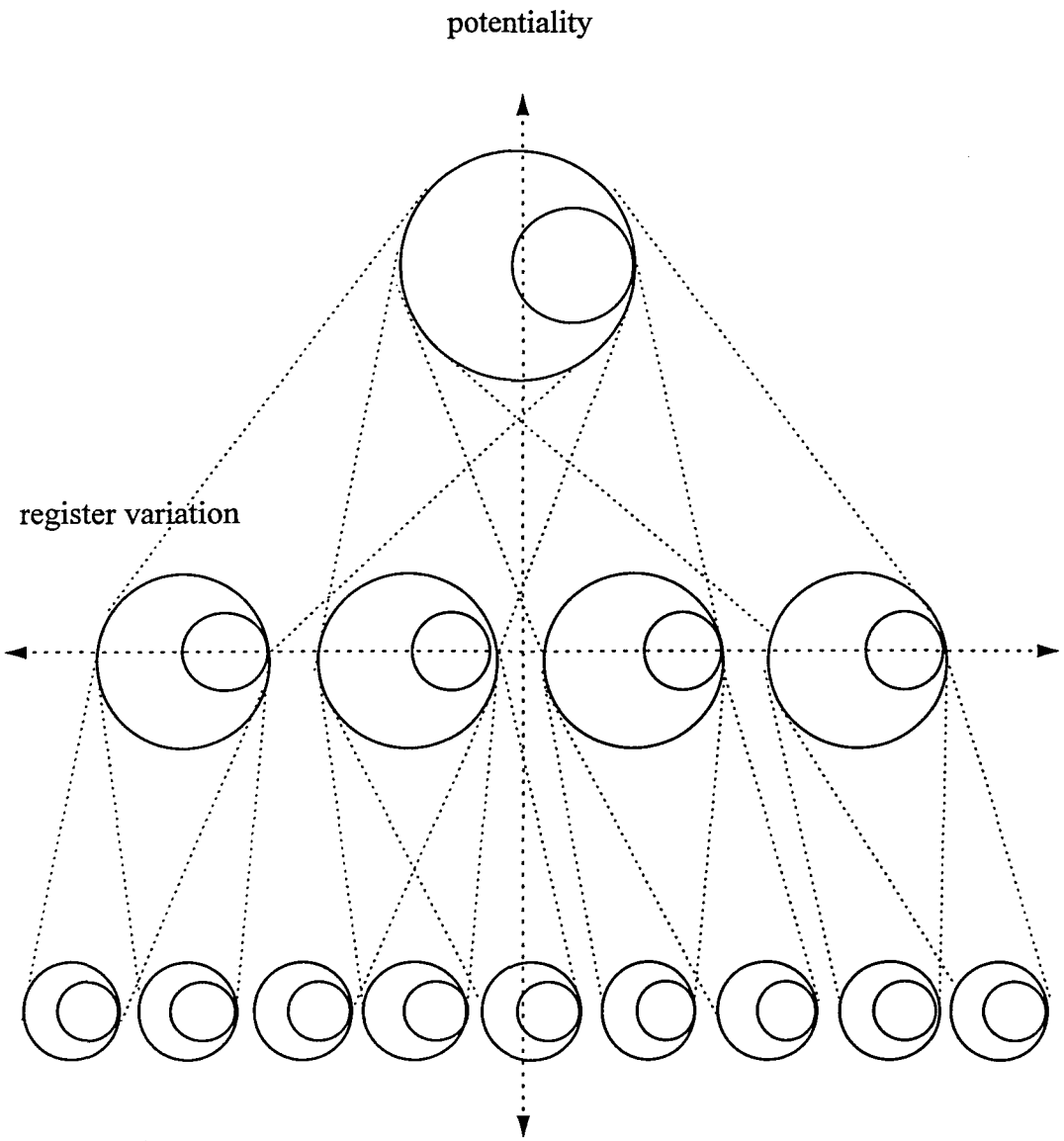

Figure 2. 3 The Intersection of Potentiality and Register Variation (Matthiessen 1993: 273).

Halliday's discussion (1993: 54-68) of the development of scientific English over six hundred years shows that the register has shifted over time in the history of science to create unique kinds of periodised textuality. It demonstrates that we can have variation based on the instances. Things change over time and register is the best way of seeing those kinds of changes. This demonstrates my argument that an overall tension exists between being able to identify what is the norm and what provides the basis for

calling a semantic variety a register or a genre, and getting into view the importance of actual variation.

In this thesis, a central theoretical problem is the reconciliation of generic homogeneity with actual variation in the text. I will demonstrate that variability is not a threat to generic studies, but that variation is in fact part of generic structure. We will find that generic variation across three sub-issues in the environmental sciences, namely, climate change, population growth, and deforestation, takes a logical form and illustrates a very important issue raised by Halliday, Hasan, and Matthiessen. That is, how the system-based view of register/genre, or the language of a particular context, has to be balanced against the cline of instantiation where we see the meaning-making processes addressing differences in the *field*, *tenor*, and *mode* in quite subtle, but logical ways.

2.3.1 Alternative approaches

Various models for looking at the relationship between context and text have been offered, one of which is Martin's (1985). Martin's approach differs from that of Halliday & Hasan's in that Halliday & Hasan consider the notion of register/genre to be a linguistic abstraction on the context level (Figure 2.4); a configuration of values of meaning which constitutes a typical formation, a type of meaning-making activity. Martin uses the Hjelmslevian notion of connotative semiotics in order to see genre as a system on a semiotic communication plane which has no expression and phonology in its own right. He stacks up genre and register above language. In other words, genre and register are considered strata above the semantics (Figure 2.5).

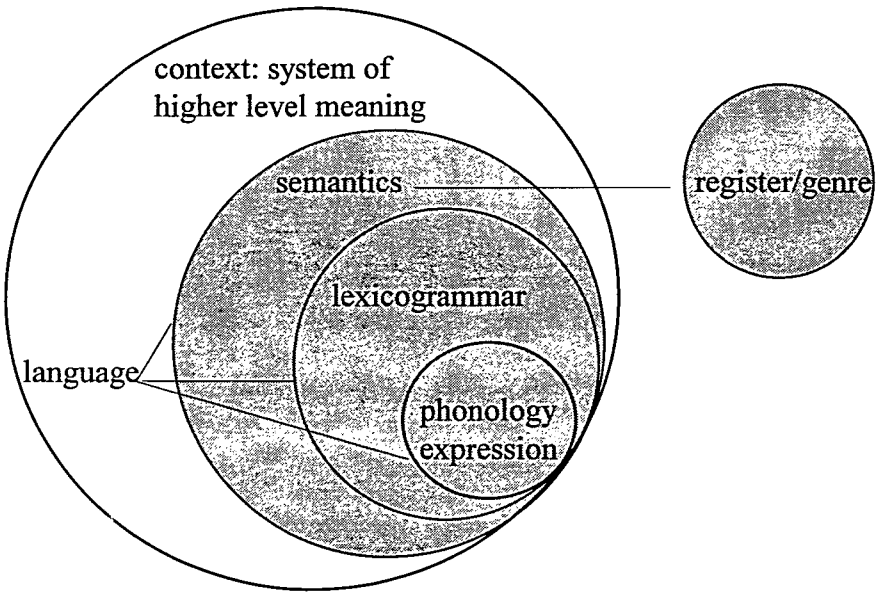

Figure 2.4 Halliday & Hasan's View of Register/Genre (adapted from Matthiessen 1993: 227)

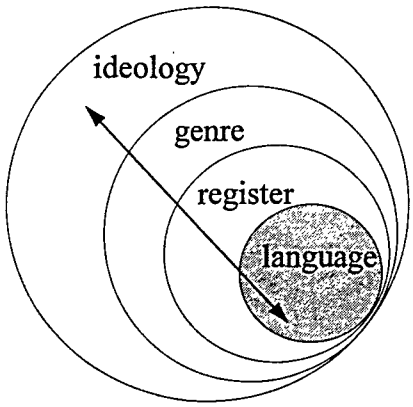

Figure 2.5 Martin's View of Register as Connotative Semiotic (adapted from Martin 1992: 496)

In this way, genre is defined as a "staged, goal-oriented, purposeful activity in which speakers engage as members of our culture" (Martin 1984) which is realised in another semiotic, language or register. For Martin then, the difference here is crucial; genre does not equal register, they exist on two different levels. For Halliday & Hasan, on the other hand, genre and register are terms which cover the same theoretical requirement in our characterisations of the functional variety of texts. Martin multiplies the strata, so that the architecture of his theory becomes more layered, by

including the stratum of ideology. This multiplication has been discussed in detail by Hasan (1995).

Martin's theory has a number of difficulties for those who adopt Hasan's approach. In a theory which has as much architecture as that of Martin's, we are moving towards a kind of Hjelmslevian multilevelled layering of a formal pattern which increases the amount of abstraction in the theory. In itself this might not be a problem, however one consequence of it is that if there are additional levels, then there are additional units which need to be discussed. One must then propose whether there is a rank scale at each level or whether there are other units at all. So too, issues arise like, what are the boundary conditions for those units?

These difficulties can be seen quite clearly with the issue of genre. Genre as a stratum distinct from register in Martin's theory, sets up a significant number of problems in relation to its boundaries. In addition, what happens when we have mixed genres, in which case variability becomes a problem for categories at the highest stratum? For example, the way genre is handled in Martin's theory is that certain texts have the same genre which are realised in the register. Because the stratum above genre is ideology, we are confronted with the issue of what kind of units exist at the ideology stratum? It is as if there is a stratum without a particular structure. The point I would stress is that Martin's notion of genre tends to reify purpose no matter how much he decries reification and how much he talks about the importance of dynamic models. As soon as one regards genres as "staged, goal-oriented, purposeful activity", purpose is abstracted out from the language event and held up as a kind of superordinate notion to which different kinds of linguistic expression can be attached as different realisations. Whatever the case, the notion of purpose becomes disembodied from the multitude of lexicogrammatical and other semantic choices, all of which create the fine embroidery of purpose.

It will be demonstrated in this thesis that purpose is as purpose does. The purpose of a text must be brought out from the competing and accumulating choices in the actual texts. This brings us back to Firth's notion of "typical actual" instance as opposed to the somewhat idealistic notion that purpose can be sought in some overarching way and then seen to be fulfilled in different ways in the lower strata.

The problems arising from Martin's theory which have been addressed so far concern the issue of theory architecture; the different strata, the multiplication of boundaries, and the fact that purpose is reified, and then taken out and treated as a separate reality. Another criticism is the overall formalisation of linguistic description which Firth compares to the diffraction of white light going through a prism. The white light which enters a glass prism is simple, however it is not simple when it passes through the prism because the new medium separates it out and on the other side we see its different levels of organisation. Different wavelengths lie separate, and that, according to Firth (1957:183), is what linguistics does. What Halliday and Hasan have done in their treatment of cline of instantiation and the role of context is to allow the separation of the white light into different patterns without creating a number of orders in a culture as Martin did. Martin develops the idea of some high order structure imposing its demands down through the different strata. Rather, every context of human participation and membership, every event of meaning, or, to use a Firthian term, every event in a 'speech fellowship', is a direct construction of culture and in that sense can be seen as instance within the totality. This approach lends itself particularly to the text analysis undertaken in my thesis.

Firstly, Hasan's analytical tool, namely GSP, provides me with the opportunity to set out in order to investigate a particular domain of the culture. Each generic form is a type of language event which can be described both from the point of view of its unfolding structure and its values as field, tenor, and mode. The *field* in each case is grouped by the culture under the heading of environmental sciences. This provisional classification allows me, however, to put a hold on what I propose as the purpose of

the texts. Given that the texts are published in such magazines as *New Scientist*, *Discover*, *Time*, *The Amicus Journal*, and *Our Planet*, they make a claim to being simple information texts which move the readers from being less informed to being more informed. This might deceive us into making the assumption that we are dealing here with a straightforward factual genre, whose main purpose (if we were to take Martin's view) is to inform the reader in a straightforward way.

My analysis of the texts moves progressively towards a particular semantic pattern, instance by instance. The particular 'logogenetic' unfolding of each text results in a cumulative analysis which gathers those logogenetic consistencies into something like a global view of this area of the culture (the characteristic of meaning-making). The actual purpose of the texts thereby emerges more plausibly from the accumulated range of choices that the analysis puts on display. The provisional values of *field*, *tenor*, and *mode* described above were revisited and modified during the study due to the fact that at the outset, I needed to adopt a provisional approach. Therefore, *field* looks like an information exchange, but as we go closer to instance, we find that there is more to the notion of purpose, and this superficial or simplistic start revealed a need to go back. Then it became possible to include different strands to do with future, action, and recommending, and consequently the whole conundrum of purpose becomes apparent as a characterisation of semiotic selections on a number of levels.

The purpose of the text is revealed by what the text does, choice by choice, and therefore rather than jumping to an overarching generic term, it is better to adopt a provisional approach, but to return to the notion of purpose as something best understood through the language. This is because it is in the language that we have the material evidence of purpose. If one steps outside language and says "the genre is this, and this is what you do in the genre", then all one is doing is creating an artificial or ideal notion which the language may or may not fit. In this vein, it is clear, for example, that my environmental sciences texts would not fit "informing" in the same way a description of the combustion engine would fit "informing", because it is not

using the same semantics. The semantics of the biosphere is established with a totally different urgency and a totally different notion of the future. One might find it extremely difficult to find the notion of the future in the combustion engine. In some sense then, the purpose comes through the language choices, not from the strata above.

2.4 THE ADVANTAGES OF USING MULTIPLE ELEMENTS IN THE TEXTUAL CHARACTERISATION

My review of Halliday and Hasan's, and Matthiessen and Martin's theoretical approaches raises a number of general relationships in the discussion of register/genre. In this study, I have drawn on the ideas or concepts set out above, but in particular I have tried to establish a relationship between context, semantics, and lexicogrammar as the three essential components in the characterisation of texts. This process has involved taking the core proposals in the Hallidayan and Firthian traditions and testing the degree to which I could account for the motivations and structure of, and the similarities and variations between, popular writings on environmental science. Therefore, my method, essentially, involves a kind of shunting between proposals on each of those three levels, whereby whatever is developed (context, semantics or lexicogrammar) allows revisions and refinements of proposals on the other strata. This allows the cultural and textual issues of the study to receive more and more attention in the theory, depending on the phenomena (such as a similarity between texts in certain dimensions or a variation between texts in certain dimensions).

A search for similarity and variation can be conducted on each of the strata. For example, at the lexicogrammatical stratum, there are a significant number of identifiable features that will be shared among texts and, at the same time, there will be a great deal of different lexicogrammatical features among the 'same' texts. To deal with a kind of aggregate count of grammatical features becomes overly complex because all of the articles which I will examine are long and the subject matter, even though restricted to environmental science, varies. In addition, the meaning of such a comparison is not likely to be clear or illuminating. It follows then, that general or global similarities and differences ought to be proposed first of all from the semantics

and context strata. These initial proposals will then facilitate my utilisation of grammar as a search tool in the process of identifying statements of meaning, which will in turn motivate elements in the discourse structure. The question of how many strata are needed between the context of culture and the context of situation, or whether the context of culture needs to be broken up into issues of ideology and genre are not issues that will arise. Alternatives for treating cultural patterns and textual patterns will be discussed as they arise.

One issue that must be raised at this stage concerns a practical implication of my proposals which becomes a theoretical issue. The practical implication is that in characterising the overall structure, or the syntagmatic character, of the text, I was forced to work with two kinds of proposals involving two degrees of generality. The question that arises is how this fits the model using the concepts outlined above in this chapter. In particular, these two degrees of generality need to be related to Hasan's notion of GSP, which subsumes the Aristotelian Beginning, Middle and End as discussed in chapter three. My analytical approach demands the use of some umbrella terms for the elements of a text that contribute to a general focus on topicality in the text. Firstly, I required a term that conveyed the idea of the development of a focus that establishes the topic, for which 'TUNING' will be used. I required a further term to cover all the elements that contributed to the extension of the author's argument - 'FOCUSSING' will be used for this purpose. The final term, selected to cover elements that contribute to the conclusions in the text, is 'CLOSING'. My next task was the grouping of the discrete elements under the umbrella terms according to their textual function. Accordingly, the identification of TUNING, FOCUSSING, and CLOSING constructed a general analytical outline which constituted a superordinate syntagmatic picture. This outline is not motivated by any social theory designed to establish mini-genre. It is a practical outcome of the fact that semantic elements needed to be characterised, yet at the same time needed to be seen in relation to one another.

Further, separate moves in the discourse syntagm also require identification and distinction by discrete terms to enable a sensitive analysis of the author's mode of construction of salient meanings. These are the meanings, I suggest, which reflect

what writing in popular science seeks to achieve. Accordingly, the labels which will be employed in this study to distinguish elements are; PROPHECY, THREAT, PREDICTION, CONCERNS, SOLUTION, SUGGESTION, CALL FOR COLLABORATION, and RECOMMENDATION. Their meanings are sometimes close (for example, PROPHECY and THREAT), but they are discernibly different elements. To compensate for such closeness of meaning I devised terms for grouping similar elements under one encompassing term; for example, PROPHECY, THREAT and PREDICTION under FORECAST. However, the gathering of elements under an encompassing element such as FORECAST, results in a loss of capacity for semantic characterisation of the texts. If we consider this in terms of the 'cline of instantiation', the instances would lose out to the larger picture of the global system, unless of course, they are identifiable from features of their specific meaning and anchored in the lexicogrammatical choices.

During refinement of the process of analysis, I recognised the importance of displaying these semantic differences in the actual outline of the texts at the context/discourse level. Consequently, I have analysed the context stratum in two layers. At the first layer, analysis is broader using the wider terms of TUNING, FOCUSSING, and CLOSING. The analytical process adopted at the second layer is the result of an attempt to discriminate it from the first layer by utilising element labels that capture the meaning differences. Once identified, such differences allowed me to find, in the grammar, a more accurate picture of selection (for example, process types related to THREAT differ from those related to PREDICTION), or modality shared throughout all of these 'irrealis' elements (see chapters three and four). While they all shared a semantic principle, they can be distinguished on the basis of that semantic principle (degree of 'irrealis'). This is a question of the instance distinguished from the potential/system, both of which should be visible at the same time.

As a result of separating the context and discourse syntagm using two analytical processes, I arrived at a global, general proposal, and a more detailed proposal. Employing two distinct proposals in this way makes it somewhat at odds with the GSP theory put forward by Hasan; however this is easily resolved. My theory of GSP

is that it can be seen as a line of semantic elements, where the combinations characterise the discourse in such a way that I can look for obligatoriness and optionality. Consequently, my dual proposals ought to provide more detail. The first is a practical device for gathering meaning elements together. It is clear that TUNING, FOCUSSING and CLOSING are not considered a GSP level because they do not involve elements that I consider to be obligatory or optional. The question of obligatoriness is not an issue because it is inherent. Every text has TUNING, FOCUSSING, and CLOSING. Similarly, there is no problematic issue in sequencing, because TUNING has to come before FOCUSSING, and FOCUSSING has to come before CLOSING. My two layered approach is a more practical, and at the same time more delicate analytical tool in working towards the GSP in relation to the long texts which I analysed.

Having characterised the selected texts according to numerous semantic elements, I then had to acknowledge that the length and variation of sequence combination in the syntagm creates difficulties in settling questions of obligatoriness or optionality. In addition, it may be suggested that my proposal for handling these different elements constitutes a semantic study of moves which is too delicate and may need a contextual generality of a slightly higher order in order to be able to establish obligatoriness, optionality, and sequencing across this genre. It would be premature to deal with this theoretical issue at this stage. I will return to this question in the final chapter when I will have fully demonstrated how my approach is applied and, I suggest, will have established the clarification that my analytical approach brings to this popular science genre.

2.4.1 Limitations in 'Obligatoriness and Optionality'

Two further specific points concerning the application of Hasan's model should be raised at this stage. One still concerns the question of obligatoriness and optionality. The other concerns the sequencing of elements, including what seem to be cyclical patterns in particular in the central argument section, or the FOCUSSING section. Both issues may be relevant to many genres. Regarding the notion of obligatoriness and optionality, instances of text type exist in which a great variety of elements can be

present. The absence of particular components or text structures may produce a 'good' or 'bad' text, but this does not produce a failure of the text type to fit the context. What we do get is the perception that the text is diminished because a particular element is not present. For Hasan, the 'obligatory' elements must be present. The absence of an element means that the instance is not considered to be an instance of 'sale inquiries', or a nursery tale. If an element is absent, the text fails to construct the context. In my analysis of selected texts, the degree of delicacy with which I am working means that the text can hardly be excluded from being seen as falling within the genre of popular science . However, there does appear to be a genuine basis for grading each text as a success or failure. What I am dealing with is a cline rather than genuine obligatoriness or optionality as an "either ...or ..." phenomenon. It may turn out that the cline is the result of working too closely with a unit in the semantics - namely, rhetorical unit/strategy.

The second point for consideration relates to sequencing. This raises issues similar to those concerning the question of obligatoriness above, and since there are various relevant issues to explain in any article, the writer must deal with each issue separately. This means that the writer goes through cycles of clarification, particularly in dealing with the central argument of the article (FOCUSSING). If I classify this central argument under one global block (FOCUSSING), a great deal of the specific meaning that I wish to clarify is omitted or left unexplained. This requires careful consideration. Given that I have attempted to tease out the semantic elements, two things could be happening. Firstly, it could be that I am working at the semantic stratum and moving inappropriately up to the register, context, or text type. Secondly, my analysis could be moving towards a greater degree of delicacy and be at the semantic stratum and therefore not really be proposing a term of sufficient generality at the context level (This issue also will be addressed in my concluding chapter.).

At this stage it should be pointed out that working with a greater degree of delicacy, I need to develop the notion of cycles within the argument which characterises the FOCUSSING section of the text. By contrast, TUNING and CLOSING can be considered as having multivariate structures. TUNING, for example, usually subsumes the elements of TITLE, GLIMPSE, and PROBLEM. CLOSING displays no

fixed sequence although it is much less complicated than FOCUSSING which displays a series of cycles. So the whole question of sequencing of elements becomes an interesting theoretical issue that we need to consider later in the thesis. This theme will be developed in detail in chapter three.

The difference between TUNING, FOCUSSING and CLOSING can be seen in the tables that emerged from the analysis presented in chapter three (which is the analysis of the texts on climate change). However, in chapter three, I shall also give a brief introduction to this difference which exists between the three global stages. Within each of the three tables below, one can see a fixed order or a sequence of the proposed semantic elements[1]. There is also a strong sense of obligatoriness and optionality that can be developed from TUNING and from CLOSING. The middle order, or the explanation (FOCUSSING), is most complex.

TEXT		TUNING			
COLD	TTL	GLM	PRB		
PARASOL	TTL	GLM	SET [PRB]		
OZONE HOLE	TTL	GLM	PRO	PRB	
METHANE	TTL	GLM	SET	PRB [TLI]	
ICY	TTL	GLM	PRB	TLI	
ALGAE	TTL	GLM	SET	PRB	
DRYING	TTL	GLM	PRB		
HEAT	TTL	GLM	SET	PRB	
OZONE VANISHES	TTL	GLM	THR	PRB	THR
OZONE THINS	TTL	--	SET	PRB	

Table 2.3 Semantic Elements within TUNING in the Climate Change Texts.

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[1] Key to abbreviations of the elements.

TTL - TITLE	GLM - GLIMPSE	PRB - PROBLEM	SET - SETTING	PRO - PROPHECY
THR - THREAT	TLI - TECHNICAL LEAD-IN	SPC - SPECIFIC CLAIM	GCL - GENERAL CLAIM	BRG - BRIDGING
EVN - EVALUATION	ONP - ONGOING PROJECT	PRE - PREDICTION	CNS - CONCERNS	SLN - SOLUTION
SGN - SUGGESTION	SUM - SUMMARY	CON - CONCLUSION	ANX - ANXIETY	SPN - SPECULATION
COL - CALL FOR COLLABORATION		REC - RECOMMENDATION		

TEXT	FOCUSSING																					
COLD	GCL	SPC1 [BRG]	SPC2	SPC3	SPC4	EVN	PRE	BRG	SPC5	EVN												
PARASOL	SPC1 [EVN] [BRG]	EVN [BRG]	EVN	SPC2 [BRG]	EVN [CNS]	ONP																
OZONE HOLE	BRG	SPC1	BRG	GCL [PRE]																		
METHANE	GCL [EVN]	BRG	GCL	SPC1	GCL	BRG [EVN]	ONP	SPC2	SPC3	BRG [EVN]	BRG [GCL] [CNS]	SPC4	PRE	SPC5	GCL	SPC6	SPC7	GCL	SPC8	BRG	GCL	SPC9
ICY	SPC1 [BRG]	SPC2 [BRG]	BRG	EVN	SPC3	EVN																
ALGAE	BRG	SPC1 [EVN] [BRG]	SPC2 [EVN] [BRG]	SPC3	ONP	BRG	SPC4 [BRG]	EVN	SPC5 [EVN]]	SPC6 [EVN]	ONP											
DRYING	PRE	SPC1	GCL [EVN]	SPC2 [EVN]	BRG	EVN	SPC3 [EVN]	GCL	SPC4	SPC5	SPC6	SPC7	SPC8	SPC9	SPC10	EVN [CNS]	PRE					
HEAT	GCL	EVN	BRG	PRE	GCL	PRE	BRG [EVN]	SPC1 [BRG] [EVN]	EVN	BRG	EVN	BRG	GCL	BRG	SPC2 [EVN] [PRE]	CNS [EVN]	BRG [EVN] [CNS]	SPC3 [PRE]	SLN	EVN		
OZONE VANISHES	SPC1	PRE	BRG	SLN [EVN]	BRG	PRE	SLN	BRG	SPC2 [EVN]]	BRG	EVN	SLN	BRG	EVN	PRE	BRG [BRG]	EVN	BRG	EVN	BRG	EVN	PRE	EVN	ONP	EVN
OZONE THINS	GCL	SPC1	BRG	SLN [EVN]	PRE	EVN	SLN	BRG	SPC2	BRG	EVN	SLN	BRG	EVN	PRE	BRG [EVN]	EVN	BRG	EVN	BRG	EVN	PRE	EVN	ONP	EVN

Table 2.4 Semantic Elements within FOCUSSING in the Climate Change Texts.

TEXT	CLOSING		
COLD	SPN	ANX	
PARASOL	ANX		
OZONE HOLE	SPN		
METHANE	--		
ICY	SPN		
ALGAE	CON		
DRYING	COL	ANX	
HEAT	SUM	ANX	
OZONE	CON	REC	ANX
VANISHES			
OZONE THINS	ANX [SPN][CON]		

Table 2.5 Semantic Elements within CLOSING in the Climate Change Texts.