Title

White, P.R.R., 1998. "Extended reality: protonouns and the vernacular", in Martin, J.R. and Veel, R. eds., *Reading science: Critical and functional perspectives on discourses of science*, Routledge, London and New York, pp.266-96.

10 Extended reality, proto-nouns and the vernacular

Distinguishing the technological from the scientific

P.R.R. White

INTRODUCTION

It is a commonplace within the academic literature and more generally in the wider community for the discourses of western experimental science and modern industrial technology to be represented as occupying the same socio-semiotic space, as constituting the same functional variety of language. The linkage of the two is such that they frequently share the same nominal group, being referenced together as 'the language of science and technology'. Thus we find that a recent study of the literacy needs of science-based industries in Australia makes no distinction between the scientific and the technological and refers simply to 'the language features of scientific/technological writing' (Rose *et al.* 1992) Similarly, the generalist science magazine, *Australasian Science*, carries the subtitle 'Exploring Science and Technology in Everyday Life'.

From a commonsense perspective, there are, of course, differences in the social context in which the two discourses operate. Science is typically understood to constitute the practices by which systematic theories are formulated about the constitution of the natural world, by means of repeatable observation and experiment. Technology, in contrast, is constituted of the practices by which tools are developed with which humans interact with each other and with their physical environment. This contrast is reflected in the distinction made, by way of example, between the 'technologists' and the 'scientists' within the research laboratories of Australia's primary telecommunications provider, Telstra. Research by the author in 1994 revealed that staff at the laboratories operated with this broad conceptual division, designating as 'scientists' those workers involved with 'pure', 'theoretical' research and as 'technologists' those involved with developing new devices or new modes of operation for telecommunications equipment.

The two domains are, nevertheless, intimately interconnected as social institutions. Science relies on technology to provide the devices by which it conducts its experimentation just as technology relies upon science to provide the theoretical basis for its development of new or more efficient

devices. The two enterprises are therefore mutually implicated, the one serving both as the other's servant and as the other's beneficiary.

Should we assume, however, that the texts which enact these two domains necessarily share the same key linguistic features? Should we assume that the semantic, lexico-grammatical and text-organisational features which distinguish scientific texts also characterise technological discourse?

This chapter will argue that it is possible to identify systematic patterns of difference in the lexico-grammatical preferences of the two discourses and that these can be explained by reference to a fundamental difference in the communicative purposes of their respective specialist lexis. (In this, I am picking up on the distinction made by Halliday between 'concrete technological' terms and 'abstract scientific' terms in his discussion of Chaucer's *Treatise on the Astrolabe*, a text which is both technological and proto-scientific, Halliday and Martin 1993.) While the two discourses rely on the same range of lexical resources when developing new specialist terminology, they differ, however, in their preferences for particular resources, in the degree that they mobilise particular resources when construing the phenomenon of their respective 'non-commonsensical' ideational domains. English-language science, for example, favours morphologically non-native forms derived from Greek and Latin, while modern technology favours elaborately premodified nominal groups built from items drawn from the vernacular lexicon and the acronyms derived from these complex groupings. They differ also with respect to certain grammatical phenomena, the most significant of which are the structures associated with specialist category definition. Science favours modes of definition which clearly articulate a taxonomic space, foregrounding and systematising both cohyponym-to-cohyponym and hyponym-to-superordinate relationships. The definitional structures of technology, in contrast, are much less directly focused on such a mapping of taxonomic spaces. They typically act to identify the functionality of items rather than to locate them in a systematised set of taxonomic relationships.

The chapter will argue that these differences can be explained by reference to the semantics of what I will term 'lexicon revaleurisation' and 'lexicon extension'. Martin (Halliday and Martin 1993) has demonstrated how much of the specialist lexico-grammar of scientific texts acts to establish experiential categories which reconstrue and hence revaleurise commonsense experiences of reality, a syndrome which he has termed 'technicality'. The chapter will argue that there is a second communicative purpose operational in the specialist lexis of scientific and technological texts by which the lexico-grammar acts not to challenge or displace the vernacular system of valeur but to extend it. I will term this 'lexicon extension', a process by which the language develops new categories and new names for these categories as the potential range

of vernacular experience is expanded over time. It will be shown that while at least a key sub-component of scientific discourse is characterised by its strong association with lexicon revaleurisation, the specialist lexis characteristic of technological discourse is that of lexicon extension.

The chapter will give special attention to the technological acronym since it is such a salient feature of technological discourse. It will be shown that many technological acronyms are no longer simply abbreviations of longer forms but have taken on at least some of the qualities of established lexical items. They have become what I will term 'proto nouns' and have features which specifically equip them for lexicon extension in the domain of modern technology where the new, extended reality to be mapped is one of constant innovation, instability and provisionality.

THE SPECIALIST LEXICONS OF SCIENCE AND TECHNOLOGY

Terminology – modes of naming

Science and technology draw on the following resources for naming their specialist, non-vernacular categories (although both vocabularies are non-vernacular, they are non-vernacular for different reasons, a point which will be demonstrated below):

- the reuse of established, vernacular lexical items: (science) *desert, fruit*; (technology) *memory, scanner, Web, bug, mouse, to mirror, firewall, to flame, Trojan Horse, worm*;
- the use of established, vernacular lexical items in nominal groups where specific reference is established through premodification: (science) *saturated fat, dark matter*; (technology) *floppy disk, random access memory, disk operating system, central processing unit, beginning of message segment*;
- neologisation in which clearly non-vernacular terms are derived, typically through Greek and Latin borrowings: (science) *cytoplasm, halophile, isotope, neutrino, to plasmolyse*; (technology) *telephone, television*;
- nominal groups where the Head is of vernacular origin but where premodification includes some clearly non-vernacular element: (science) *deoxyribonucleic acid, catabolic pathway*; (technology) *digital fibre-optic data links, cathode ray tube, pseudorandom binary sequence generators*;
- nominal groups where both the head and some element of the premodification are clearly of non-vernacular origin: (science) *low density lipoprotein cholesterol, colloidal gold-low-density lipoprotein conjugates*; (technology) no examples as yet identified;
- acronymisation where the abbreviated, word-like form replaces the longer, full form as the primary mode of reference: (science) *AIDS, DNA*; (technology) *laser, scuba, CD-Rom, DOS, RAM, modem.*

For the sake of simplicity of presentation, the above examples all involved concrete, inter-stratally congruent categories. However, much specialist, non-vernacular terminology relies on what Halliday has termed 'virtual entities', the inter-statally incongruent entities derived when semantic categories such as process, quality and relator are mapped on to the lexico-grammatical category of nominal group. (See Halliday, Chapter 8, this volume.) As Halliday demonstrates, these virtual entities are central to scientific discourse. Examples include *apoptosis, osmolarity*, etc.

Specialist lexis in science and technology: textual exemplification

While the discourses of science and technology access the same set of lexical resources for their specialist terminology, they display different preferences in their use of these resources. Key elements of these differences will be illustrated by means of a detailed comparison between a text extract which exemplifies many of the features of scientific discourse and a representative technological text. The scientific text, from the field of microbiology, was identified by Halliday (Chapter 8, this volume) as typical of scientific discourse and analysed by him in some detail. The analysis here will be supported by reference to additional texts ranging from expert to more generalist or popular texts. These popular texts (for example, mass-circulation computer magazines) are relevant because they enable us to explore the interface between the specialist and the vernacular – the lexico-grammatical reflexes which occur when a non-vernacular discourse comes up against vernacular construals of reality and acts either to infiltrate some of its specialist categories into the vernacular domain or to draw the non-specialist reader into its own uncommonsense reality. It is in the computer magazines, for example, that the general public is introduced to the new devices and processes brought into being by a key area of technological innovation and acquires a particular set of lexico-grammatical resources to talk about these devices. It is in such a context that we can expect to see the underlying semantic functionality of the various specialist vocabularies revealed as they come up against and interact with the vernacular.

The analysis of the texts' specialist terminologies, set out in Tables 10.1 and 10.2, notes the following features:

- whether the term is 'basic' (single-word form) or 'non-basic' (expanded group, typically a nominal with sub-classificatory premodification);
- whether the term involves word forms derived from the vernacular lexis or whether it involves new word forms derived via borrowings from non-native sources (typically Greek and Latin);
- whether the term includes acronymisation;

Table 10.1 Text analysis, scientific text, 'Effects of Solutes on Growth and Metabolism' (Stanier 1937)

Borrowed versus independent acronym	*Basic: vernacular*	*Basic: non-vernacular*	*Non-basic: vernacular head and premodification*	*Non-basic: vernacular head; non-vernacular premodification*	*Non-basic: non-vernacular head; vernacular or non vernacular premodification*	*Virtual (Y/N)*
			transport mechanisms			Y
Borrowed				cellular function		Y
Borrowed				intracellular concentrations		Y
Borrowed		metabolites				N
Borrowed				catabolic pathways		N
Borrowed				biosynthetic pathways		N
Borrowed				nutrient concentrations		Y
Borrowed				microbial populations		N
Borrowed		nutrient				N
Borrowed		medium				N
Borrowed				limiting nutrient concentrations		Y
Borrowed		osmoregulation				Y
Borrowed		solutes				N
Borrowed		molecules				N
Borrowed		ions				N
Borrowed				metabolic activity		Y
Borrowed		osmolarity				Y
Borrowed		bacteria				N
Borrowed					internal osmolarity	Y
			cell wall			N

Table 10.1 (continued)

Borrowed versus independent acronym	*Basic: vernacular*	*Basic: non-vernacular*	*Non-basic: vernacular head and premodification*	*Non-basic: vernacular head; non-vernacular premodification*	*Non-basic: non-vernacular head; vernacular or non-vernacular premodification*	*Virtual (Y/N)*
Borrowed				internal osmotic pressure		Y
Borrowed				external osmstic pressure		Y
Borrowed		cytoplasm				N
Borrowed					gram-positive bacteria	N
Borrowed					cell membrane	N
Borrowed		plasmoyzed				N
Borrowed					gram-negative bacteria	N
Borrowed				osmotic requirements		Y
Borrowed					sodium chloride	N
Borrowed		micro-organisms				N
Borrowed		osmophiles				N
Borrowed		halophiles				N
			salt tolerance			Y
Borrowed		nonhalophiles				N
Borrowed			marine organisms			N
Borrowed					moderate halophiles	N
Borrowed					extreme halophiles	N
Borrowed					Pedicoccus halophilus	N
Borrowed					growth medium	N
Acro		*NaCl*				N
Borrowed					high osmolarity	Y
Borrowed				biochemical basis		Y

Table 10.2 Text analysis, technological extract, 'B-ISDN interworking' (Sutherland and Burgin 1993)

Borrowed versus independent acronym	*Basic: vernacular*	*Basic: non-vernacular*	*Non-basic: vernacular head and premodification*	*Non-basic: vernacular head; non-vernacular premodification*	*Non-basic: non-vernacular head; vernacular or non-vernacular premodification*	*Virtual (Y/N)*
	networks					N
			packet switched public data network (PSPDN)			N
			packet switched public telephone network (PSTN)			N
Acro					*64kb/s ISDN*	N
			frame mode bearer service (FMBS)			N
			metropolitan area network (MAN)			N
Acro					*B-ISDN*	
	interworking (? possibly non-vernacular)					Y
			local area network (LAN)			N
Acro, borrowed					*Ethernet LAN*	N
			end-to-end communications			Y
Acro					*IEEE 802.6 MAN*	N
Acro		*ISDN*				N
	traffic					N
Acro				Australian *FASTPAC* network		N
			high speed transmission facilities			Y

Table 10.2 (continued)

Borrowed versus independent acronym	*Basic: vernacular*	*Basic: non-vernacular*	*Non-basic: vernacular head and premodification*	*Non-basic: vernacular head; non-vernacular premodification*	*Non-basic: non-vernacular head; vernacular or non-vernacular premodification*	*Virtual (Y/N)*
Acro				national *LAN* interconnect service		N
Borrowed				switched multimegabit data service (SMDS)		N
Acro					*B-ISDN/MAN interworking*	N
			connectionless server function			N
			protocol translation			Y
	bridge					N
Borrowed		interface (possibly now entered vernacular usage)				N
			cell header			N
Acro				*IEEE* 802.6 segments		N
Acro		*ATM*		*ATM* cells		N
Acro				*ATM* virtual path (VP)		N
			virtual channel (VC)			N
			beginning of message segments (BOM)			N
Acro				*E.164* addresses		N
	packet					N
			message identification field (MID)			N
			connectionless server			N

- whether the terms are what Halliday labels virtual entities (nominal groups with nominalised Heads) or inter-stratally congruent terms (concrete nominals, verbals, etc).

Individual terms are placed in a column according to which combination of these features they represent. Thus column 2 of Tables 10.1 and 10.2 contains all specialist terms which are both 'basic' and derived from the vernacular lexicon. Whether the term includes acronymisation and/or borrowing from non-native sources is indicated by an entry in column 1. ('Borrowed' = Greek/Latin borrowing; 'Acro' = acronym. 'Borrowed' forms are also marked in **bold** type face while acronym forms are marked with *italics*.) For reasons which will be set out below, our primary concern here is not with standard abbreviatory acronyms (where a full form is first presented and then the single-word form as an abbreviation). We are more interested in those which display some lexical independence from the underlying full form. Accordingly, only 'independent' acronyms (those without a full-form explication anywhere in the text or which enter productively into processes such as nominal group expansion) will be treated as individual lexical items. Thus a term such as *frame mode bearer service (FMBS)* will not receive an entry in column 1 as an independent acronym.

Text 1 – science

Readers are directed to the Appendix of Halliday's chapter (Chapter 8, this volume) for the text of 'Effects of Solutes on Growth and Metabolism', a text drawn from the domain of microbiology. The analysis of its specialist terminology is presented below in Table 10.1.

Text 2 – technology

The technological example is extracted from an article published in the specialist telecommunications journal, *IEEE Communications Magazine*. It was authored by senior researchers from Australia's primary telecommunications provider, Telstra (then known as Telecom Australia). (See the Appendix for the full text.) The following paragraph is provided by way of a taste of typical technological style. Analysis follows in Table 10.2.

> The Australian FASTPAC network is a hierarchy of MANs interconnected by high speed transmission facilities to provide a national LAN interconnect service. The B-ISDN will need to interwork with networks based on IEEE 802.6 MAN technology and networks offering switched multimegabit data service (SMDS) [3]. A suitable reference configuration for B-ISDN/MAN interworking has been identified in CCITT Recommendation 1.327 [4].

LEXICAL EXTENSION VERSUS RE-VALEURISATION

Overview of lexical differences

The two texts reveal clear differences in the lexical preferences of the two specialist lexicons. We notice marked differences in the 'basic' terms (simple nominal forms without pre-modificatory classification) – a point of obvious interest since such items represent an ideational domain's more stable, salient and more widely referenced categories. In the scientific extract, basic terms are almost exclusively non-vernacular, Latin/Greek borrowings: for example, *metabolites osmoregulation, solutes*. In contrast, the basic terms of the technological text are primarily vernacularly derived terms as well as acronyms – thus *traffic, bridge, packet and B-ISDN, ATM*. The same preferences are reflected in the expanded nominal forms. The science text prefers forms where either the Head or some element of the pre-modification is of non-vernacular origin – *moderate* ***halophile, catabolic*** *pathway*. In contrast, the technological text prefers elaborated nominals where all elements are of vernacular derivation (packet switched public telephone network) or where either the Head or some element of the premodification is an acronym (***ATM*** *cells, Broadband* ***ISDN***).

Redeployed vernacular lexis

Technology

The vernacular origin of terms such as *traffic* and *packet* may at first obscure their specialist nature. But the categories referenced by such terms are, of course, not the same as those referenced by the terms in vernacular contexts. In everyday language, *traffic*, for example, refers to the movement of vehicles while in the specialist domain of telecommunications it refers to the movement of signals through the telecommunications network. There is, of course, an obvious connection between the vernacular and the technological application of the term – they are related by an analogy turning on the notion of directed movement towards a fixed destination. A similar relationship exists between the vernacular *packet* and its technological counterpart – a 'unit of data'. The connection involves a shared notion of 'bundling up' or 'packing together'. The same semantics can be observed operating generally within vernacularly derived basic technological terms. For example, the technological use of the term *memory* – a component of electronic computing machines – involves a metaphor of storing and retrieving information.

In all such cases, technology redeploys a vernacular lexical item but does not replace or displace the original everyday sense of the term, acting rather to extend it. It does this by broadening the polysemous

range of the vernacular vocabulary item, essentially through lexical metaphor. This is possible because the polysemous nature of much vernacular lexis means that different phenomena may be referenced by the same lexical item when there is some salient point of similarity. (For a discussion of polysemy in general see Allan 1986. For a discussion of the role of polysemy in generating new terms in vernacular botanical taxonomies see Berlin 1995.) Thus the polysemous range of the term *mouth* extends to include the *mouth* of animals, the *mouth* of a bottle and the *mouth* of a river. The relationship between the technological *packet* and the vernacular *packet* or technological *memory* and the vernacular *memory* is therefore of the same order as that between the *mouth* of a river and the *mouth* of an animal.

Similar polysemous extension can be observed across the technological lexicon in, for example, the *read* in *read only memory* (reading extended to include the electronic accessing of information), *scanner* (to scan, extended to name a device which rapidly produces a copy of a document), the *Web* (an interconnected network of sometimes bewildering complexity), *speaker* (a device which emits noise), *to mirror* (one Web site is said to mirror another when it contains a regularly updated copy of the other site's data) and so on.

The 'non-basic' specialist terms in the technological text (those in which a Head is sub-classified through premodification) have a similar lexical constitution and are directed towards the same communicative objective. We note that they too are typically derived from items drawn from the vernacular lexicon both in their Head and in their premodification. In some instances the Head is an element which redeploys vernacular lexis in the manner outlined above, with the premodification mobilising additional vernacular elements. Consider, for example, *message identification field connectionless server.* The Head, the term *server,* involves only a trivial extension of the vernacular sense of the word – within the technological lexicon, a *server* is a device which acts to assist other devices in carrying out some function. This Head is then sub-classified (a sub-type of *server* is indicated) by means of pre-modification through categories drawn from the vernacular lexicon – *message identification field connectionless.*

A related sub-type of elaborated term uses common, vernacular terms to establish reference to the specific technological category. Thus *local area network, beginning of message segment, disk operating system,* etc. The Head of such terms often has highly generalised reference to, for example, some location (*field* as in *data count field* or *segment* as in *beginning of message segment*) or to some abstraction of functionality or means – thus *facility* (*high speed transmission facility*), *service* (*national local area network interconnect service*), *system* (*disk operating system*), etc.

Such terms take categories which are part of vernacular experience (*system, service, unit,* etc.) or which are connected to vernacular experience through polysemous extension (*server, packet,* etc.) and then enlist further vernacular terms to specify some sub-type of that category. Thus a *disk operating system* is unproblematically a mechanism or means for operating a disk. Specialised reference is thereby achieved by the combination of non-specialised categories. While the categories thereby referenced may not typically be encountered in the course of everyday experience, their lexis indicates that they are ontologically of the same order as categories of vernacular experience.

Redeployment of vernacular lexis in scientific discourse

Although there are no examples in the microbiology text cited above, a minority of specialist scientific terms do involve a redeployment of vernacular lexical forms. Although not the norm in science, such terms will be examined here because they provide general insights into the semantics of scientific terminology.

Vernacular lexis redeployed by the specialist scientific vocabulary includes, for example, the botanical term *fruit* and the geographical term *desert.* Thus under scientific terminology, *desert* refers to an ecosystem in which there is insufficient surface water to support permanent plant growth. The *Encyclopaedia Britannica*, for example, defines *desert* as an area where 'the level of aridity . . . is a mean annual precipitation value equal to 250 mm (10 inches) or less'. The online *BioTech Life Science Dictionary* (Indiana University: HTTP) defines *fruit* as 'the seed-bearing structure in angiosperms (a major division of the plant kingdom, commonly called flowering plants) formed from the ovary after flowering'.

In both instances, the redeployment does not extend the vernacular sense by metaphorical extension, as was the case with technological terms. Rather the scientific categorisation challenges the vernacular sense of the term. *Deserts* in commonsense terms are dry, hot places with scant vegetation, typically featuring sand hills and the occasional oasis. The vernacular meaning is at odds with the scientific in that it excludes the cold deserts of, for example, the Arctic which the scientific categorisation explicitly encompasses. Similarly, the scientific sense of the term excludes the notion of *desert* associated with the *desert island* so beloved by popular-cultural cartoonists – an ecosystem where the obligatory well-developed palm tree testifies to the presence of sufficient ground water to support permanent plant growth.

A similar semantics operates with the term *fruit.* Under the vernacular system of valeur, the term is defined prototypically by reference to items such as *apple* and *orange* and is loosely held to encompass edible parts of plants which are sweet to the taste and are typically not eaten with main courses in western culinary traditions, at least within the version of vernacular reality with which I operate. The vernacular *fruit* is thus clearly at odds with the scientific. It excludes items encompassed by

the scientific categorisation such as *pumpkin* and *tomato* and is unclear about *avocado* (avocados are similar in shape to stone fruit and yet are not sweet and are not eaten as dessert). As well, the vernacular *fruit* includes at least one item which is excluded by the scientific categorisation, that of *rhubarb* (an item formerly popular as dessert in Australia).

In both instances, the vernacular and the scientific categories entail a different system of valeur relationships. The vernacular *desert* enters into an immediate paradigmatic relationship with categories such as *jungle, forest* and *ocean* while the scientific desert enters into a valeur relationship with other scientifically defined ecosystems such as *tundra* and *rainforest*. Similarly, the vernacular fruit enters into a valeur relationship with *vegetable, meat, seafood*, etc. while the botanical *fruit* enters into a meronymic relationship with other systematically defined parts of plants.

Technological versus scientific redeployment of the vernacular

Two key observations follow. First, technology favours vernacularly derived lexical items, both in its 'basic' and 'non-basic' specialist technology, while science only makes minimal use of such lexis. Second, even when science does use such items, it puts them to a markedly different use. Science takes the terms but redefines them. The scientific terms challenge vernacular experience, insisting on a semantic breach with vernacular meanings. In technology, however, such lexis provides for a direct connection between the specialist ideational domain and that of vernacular experience. Such items acknowledge and encompass the meanings these terms take in the vernacular lexicon and act only to extend their scope.

Acronymisation and specialist terminology

The technological preference for the acronym

The second primary lexical resource utilised by the technological text was the acronym. The short extract analysed above contained numerous examples of what will be termed 'abbreviatory' acronyms (forms where an elaborated nominal group is presented first and the acronym immediately after as an abbreviation) as well as two examples of independent acronyms (forms where the underlying full-form nominal is not provided anywhere in the text). In contrast, the scientific extract is free of acronyms, with the exception of the acronym-like chemical term *NaCl*, not an acronym in the strict sense of the term. In this, the two texts are illustrative of a general trend found across a significant selection of scientific and technological texts – the author's initial investigations of texts from the technological domains of telecommunications, computing and electronics, and scientific texts from the domains of biology, zoology,

astronomy and geology indicate a significantly higher occurrence of acronyms in the technological domain. Acronyms, however, do occur not only in both scientific and technological texts but broadly across the language. As well, their frequency varies across individual texts within a given ideational domain as it does across the sub-domains which make up the general category of science. (Medical research texts, for example, appear to feature a higher number of acronyms than some other domains.) Thus while the tendency illustrated by the texts analysed above may be suggestive, and may point to underlying differences in communicative purpose, we cannot draw strong conclusions from a simple count of acronyms within texts, unless our sample is significantly larger than that covered in my initial investigations.

We can, however, draw stronger conclusions when we identify clear patterns of difference between scientific and technological discourse in the way acronyms occur and in the way they are used. The following discussion will outline a number of such differences and argue that these ultimately reflect an underlying distinction between the lexicon extension of technology and the lexical revaleurisation of science.

The linguistic properties of the acronym: a general overview

Acronyms are typically formed by combining the first letters of the words of a complex nominal group and using all upper case for the letters of the newly derived word-like form – thus *CD* from *compact disk*, and *RAM* from *random access memory*. Acronyms are of two types: what might be called proper noun acronyms which reference the names of single human institutions or social entities – *NATO, the CIA, the USA*, etc. – and common noun acronyms which reference general entities such as *RAM, CPU*, etc. Proper noun acronyms behave in the same manner across discourse types and will therefore be excluded from the analysis.

Common noun acronymisation is associated with two separate but related lexico-grammatical outcomes. All acronyms, whether in technological texts or otherwise, begin their lives, so to speak, as abbreviations, as a mechanism for speeding up the expression plane. As Martin states,

> It is important to note here that acronyms such as PLF are not technical terms, but abbreviations. Unlike technical terms, items such as PLF do not have the function of accumulating a number of less specialized meanings in a single lexical item (thus while they may be 'spelled out' through an elaborating structure at group or word rank, they are never defined). Rather, acronyms function as reductions on the expression plane; they make it quicker to write or say a wording – writing or saying P-L-F is faster than pronouncing or spelling the nominal group for which it stands.
>
> (Halliday and Martin 1993: 229)

This 'speeding up' of the expression plane is not, however, the only possible lexicogrammatical outcome of acronymisation. Once the complex nominal group has been reduced to a single word-like form, it is possible for that reduced form to lose its status as abbreviation and to become a word in its own right, replacing the original complex form as the name of the item in question. That is, the derived form acquires the status of a fully fledged, independent member of the lexicon and supplants the original complex form. This potential for full lexicalisation has been realised in terms such as *laser*, originally derived from ***l**ight **a**mplification by **s**timulated **e**mission of **r**adiation, and scuba* from ***s**elf-**c**ontained **u**nderwater **b**reathing **a**pparatus.* Although dictionaries may list the complex nominal term in definitions of these words, the original complex nominal is no longer a functional part of the word's everyday usage and the use of lower, rather than upper case indicates that for all practical semantic purposes, these terms are words, not abbreviations.

Only a small minority of acronyms achieve the full lexicalisation of terms such as *laser* and *scuba*. A larger proportion, however, achieve what might be termed partial lexicalisation, a state in which the acronym form is used as the preferred name without any reference to the original complex nominal. Terms such as *CD-ROM, DOS* and *BASIC* (the most widely used computer language), for example, have achieved this partial lexicalisation. Speakers unproblematically use *CD-ROM* or *DOS* without knowing or needing to know that they are derived from *compact disk read-only memory* and *disk operating system*. Such terms have a 'valeur' within the lexicon which the speaker can access without a knowledge of the original complex nominals from which they have been derived.

The tendency for at least some of the most widely used acronymic terms to move towards full lexicalisation is reflected in the following definition of *DOS* (a key software component of the many millions of personal computers in use around the world today) from *PC Home* (Australian Edition), a computing magazine designed explicitly for those without technological expertise.

> Dos was produced as a result of a business venture between IBM and Microsoft in the early 80s and, in a nutshell, is the link between you and your PC. Probably the best analogy is to describe Dos as a bilingual interpreter. In other words, it translates what you ask your PC to do, via a series of basic commands, into what the PC understands.
>
> (*PC Home*, March 1994: 23)

Even though the intention here is to provide a basic definition for computing novices, there is no spelling out of the complex nominal form, and lower rather than upper case is used, evidence that *Dos*, at least for *PC Home*'s editors, is now a lexical item rather than an abbreviation.

Instances where acronyms occur within a text independently of the full form they originally acted to abbreviate may in some cases, of course, be explained inter-textually. That is, the full form is not provided because the writer assumes the reader can supply the full form by recalling other texts where the elaborated form is provided. The nature of the definition of *Dos*, however, indicates that as lexicalisation proceeds, the connection with the full form becomes increasingly weaker. In instances of the type exemplified by *Dos*, no connection with a full form, whether intra-textually or inter-textually, is required for the term to function as referencing item.

Technology and acronym lexicalisation

There is a significantly stronger tendency for acronymisation in technological discourse to move toward lexicalisation than in the scientific texts analysed by the author. This tendency is reflected within the lexicogrammar in a number of ways.

Within technological texts, a much higher proportion of acronyms achieve independence of the full form they initially acted to abbreviate. That is, they freely occur without the full form present at any point in the text. Two such independent, lexicalised acronyms occurred within the space of the few paragraphs of the telecommunications article cited above. Such lexicalised acronyms occur with a significantly lower frequency in scientific texts. Here, acronyms are almost always presented as abbreviatory rather than as lexicalisations – the complex nominal will be presented at first mention in the text, with the reduced form supplied afterwards. The following is typical of both expert and popular scientific texts:

> There is now substantial evidence that the events occurring in the brain in response to stress, specifically at the *hypothalamic-pituitary-adrenal (HPA)* axis, are similar to those occurring in response to an activated immune system. In both instances, the *HPA* axis is stimulated by . . .
>
> (*Scientific American*: Science and Medicine, November/December 1995: 16)

Perhaps the best context for demonstrating abbreviation versus lexicalisation is provided by popular texts of the sort found in mass-circulation science and technology magazines or in the science and technology sections of mass circulation newspapers. Within highly specialist, narrowly targeted expert texts, instances of independent acronyms may be explained inter-textually – the expert reader may be assumed to have the inter-textual knowledge required to provide the full form of the term. But no such assumptions can be made of the inexpert reader of popular magazines. It is in the commercial interests of such publications to make their texts as accessible as possible to the

inexpert reader and therefore to assume as little expert knowledge as possible of their readers. It is in their interest, therefore, to avoid jargon, to keep unfamiliar specialist terminology to a minimum and to provide explication of that specialist terminology which is central to the domain and therefore cannot be avoided. Given these objectives, we would expect the preferred mode of acronym presentation in popular magazines to be that of the style described above – full form first-mention presentation of the complex nominal followed immediately by the acronym as abbreviation. Tellingly, this expectation is met by popular science magazines such as *New Scientist* and *Scientific American* but not by popular technological magazines such as *PC Magazine*, *PC World*, *Electronics Australia* and the computing and telecommunications sections of the daily newspapers. Perhaps the most notable feature of such texts is their very high number of independent, unexplicated, 'lexicalised' acronyms. The following extract from the opening of an article in the mass-circulation *Windows Sources Australia* is typical of this feature (independent common-noun acronyms italicised).

> WResMon II Stops Crashes
> It's just plain silly to have to worry about running out of a measly 64K block of *GDI* resources when you're sitting in front of a *PC* with 4M, 8M, or 16M of *RAM*. Now there's a solution – WResMon II provides you with your own private *INI* file and mastery of the Windows *API* functions.
>
> (*Windows Sources Australia*, July 1994: 89)

Such terms pose obvious problems of comprehension to inexpert readers, precisely the readers the publications must attract if they are to maintain and increase circulation. The fact that these terms remain in such high numbers, despite the problems, strongly suggests that they are in some way unavoidable, or at least that they provide communicative positives which significantly outweigh the negatives. Their presence can be explained in terms of communicative functionality. The independent acronym forms are preferred because within technological discourse it is the acronym itself, rather than the underlying complex nominal, which is the primary lexical item, the primary form operating within the lexicon to reference the category in question. The acronym has been at least partially lexicalised and thus acquired some of the qualities of fully fledged members of the lexicon. Since it represents the preferred name for the category in question, the acronym rather than the underlying elaborated form will be used within the text.

The lexicalised nature of technological acronyms is reflected at a number of additional points in the grammar, which once again show up most clearly in popular texts. When first mention of the acronym is accompanied by the full, expanded form of the term, the preferred mode is what I will term 'reverse acronym presentation'. The acronym is

presented first with the full form following afterwards, typically in brackets. For example,

> VRML (virtual reality modeling language) has already become the standard development environment on the Net and there are a number of VRML authoring tools and browsers for exploring these Web environments.
>
> (*Sydney Morning Herald*, Computer and Communications Section, 12 December 1995: 4)

This structure reflects the lexical primacy of the lexicalised acronym over the complex nominal term. Rather than suggesting a process of abbreviation, such 'reverse presentation' forms construct the acronym as the primary term and the expanded form as its meaning – the structure is one of term plus dictionary definition.

Additionally acronyms behave as nouns, or at least as 'proto-nouns' rather than as abbreviations when they enter into noun-like processes within the nominal group. Thus acronyms can act as Classifiers in expanded nominal groups – *ATM network*. They can act as the Heads of premodified nominal groups – *General MIDI*, and they can act as Heads of nominal groups which enter into further recursive processes of acronymisation – *B-ISDN* from *Broadband ISDN* and *GM* from *General MIDI*.

Finally there is the phenomenon of pseudo-acronyms such as *TWAIN* and indeterminate acronyms such as *DVD*. Pseudo-acronyms are new terms which mimic acronyms but which, in fact, have no actual underlying complex nominal form. A new software standard, for example, for programs which communicate between scanners and computers has been named *TWAIN*. Software will be described as *TWAIN-compliant* or as supporting *TWAIN*. Glossaries of computing terms reveal, however, that *TWAIN* stands for 'Tool Without An Interesting Name', with the entry typically adding a comment to reassure the reader that this is not a joke, that this is the 'real' meaning of *TWAIN*. (It would appear that whoever coined the term had a humorous outcome in mind. For many years scanners and computers were notoriously difficult to connect. There appears here to be a word play on the quotation 'never the twain shall meet'.) With such pseudo-forms, the new term achieves legitimacy by mimicking the canonical form for new terms in technological discourse – the independent, lexicalised acronym. The term *DVD* is indeterminate in that it is variously held to stand for *Digital Video Disk* and *Digital Versatile Disk*. The term functions unproblematically, however, because as a proto-noun it acts to reference a new large-format digital storage mechanism irrespective of the extended form which might underlie it.

Acronyms in science and technology compared

This is not to argue, of course, that acronymisation in science is exclusively associated with abbreviation and in technology with lexicalisation. The abbreviatory acronym and its associated set of lexico-grammatical phenomena are found in virtually all social contexts – certainly within scientific, social scientific, bureaucratic and journalistic discourses – as well as within technology. Additionally, some acronyms within scientific discourse display features associated with lexicalisation. The terms *DNA* and *AIDS* for example occur typically as independent, lexicalised terms. The point, however, is that there are pronounced patterns of preference – the lexico-grammar of acronymisation within science (or at least within the sub-domains of science examined for this chapter) is predominantly abbreviatory while within technology it is overwhelmingly lexicalising. (The acronyms of certain domains within medicine appear to be more lexicalising than abbreviatory. A reason for this will be proposed in a later section.) Thus within both expert and popular scientific texts, independent first-mention acronyms occur only rarely and almost all acronym presentation adopts the full-form plus acronym structure. In contrast, independent first-mention acronyms are common in both expert and popular technological texts and the reverse dictionary definition structure is the preferred mode of full-form explication within popular texts. There was, for example, only one instance of an abbreviatory acronym structure in the twenty-six articles which made up the computer section of the *Sydney Morning Herald* of 18 November 1995. Tellingly, this instance involved a device which was very new at the time and over which there was still uncertainty as to name – the previously mentioned *DVD* device, then also referred to as the *Super Density Disk (SD)*.

The technological acronym explained

The association, therefore, between the lexicalising acronym and technological language is a close and highly salient one and provides one compelling criterion for distinguishing the technological from the scientific. The reason why modern technology favours neologisation by acronymisation may be linked to the nature of the reality that these terms are called upon to map. That nature has two aspects. First, it is constantly expanding as technological innovation comes up with ever more devices, processes and modes of interaction. Second, it is inherently unstable as new devices and processes are trialled, some successfully, others not so, as some devices, processes and relationships become obsolete or go out of fashion, or alternatively, achieve widespread use and acceptance and become part of vernacular experience.

The creator of new technological terms can choose, of course, from an

array of lexical resources – they can redeploy vernacular lexis, borrow forms from Latin and Greek (and any other language for that matter), invent entirely new word forms or use acronymisation. In the past, Greek/Latin coinings were popular (thus *telephone, television*, etc.). But the acronym seems particularly well suited today to reflect the twin features of contemporary technological reality identified above.

Acronymisation well serves technology's innovativeness because it is a highly efficient and relatively unproblematic source of a virtually limitless supply of new terms. The would-be neologiser need simply formulate a descriptive nominal group of the type described in the previous section – *read only memory, disk operating system* for example – and then mechanically apply the rules of abbreviation. Such a process is obviously less demanding than one in which entirely new word-forms must be invented or where foreign vocabularies must be accessed. (The fact that classical scholarship is no longer so widespread may offer a part explanation as to why Greek/Latin coinings have declined. They remain the norm, however, in science for reasons which will be explained below, despite the decline in classical scholarship, suggesting that this does not provide a complete explanation for the emergence of the acronym in technology.) Acronymisation is thus eminently well equipped to meet the constant need for new lexis to map the ever-unfolding reality of technological development.

Of equal importance is the unstable, provisional nature of technological reality. Here we need to consider the semantics of basic terms – names constituted of single-word forms without pre- or post-modification – and what is entailed when acronymisation provides a term with at least some of the qualities of the basic term. The existence of a lexically minimal term – a single-word form – to reference a given category is generally seen as evidence that the category is stable and salient within its ideational domain. (See for example Bulmer 1970 and Berlin *et al.* 1993.) That is, the more permanent and salient the entity as an item of valeur, then the greater the likelihood that it will be denoted by a single word rather than by a descriptive nominal group with pre- or post-modification.

The shift, therefore, under lexicalising acronymisation from an extended nominal group to a single word can be expected to have semogenetic consequences. The single-word form will more strongly suggest ideational stability and salience than the complex, expanded nominal from which it is derived. This process has its parallel in the derivation of vernacular terms such as *blackbird* and *gum-tree*. As both items became established, salient items of valeur they acquired their own single-word names which were derived, in this case, simply by fusing what were originally independent elements of a complex nominal group. Thus the term *blackbird* no longer refers to any bird which is black but directly to a particular species of bird. Similarly, we no longer think of a

gum-tree as a tree with gum. The single-word form now refers directly to a stable item of valeur with the presence of gum now entirely coincidental.

Thus by using the single-word acronym form, we are indicating that the category has at least some of the stability and functional saliency of entities which have their own unique, permanent name – their own dictionary entry. At least at the graphological level, and sometimes phonologically as well, we are dealing with what amounts to a new morpheme or at least a construct which shares some of the properties of a morpheme. As a consequence, the meaning of even the newest, most abbreviatory acronym goes beyond that of the longer form it abbreviates to include some suggestion of stability and salience. That stability may be limited to the text in which the acronym occurs, but it is nevertheless a genuine, if circumscribed, semantic outcome. When the acronym operates inter-textually and begins to achieve lexical independence, then the sense of stability and saliency attached to the item it references is enhanced.

We must note, however, by way of counter tendency, that there is always some restriction on lexicalisation, some falling short by the acronym of fully fledged membership in the lexicon, except for those rare cases where full lexicalisation is achieved. The acronym, in fact, explicitly signals its non-standard status, its non-membership in the lexicon through its all upper-case orthography, a graphological symbolism which also acts to signal a connection with the original process of abbreviation. From this perspective, then, the acronym must be seen as a provisional or proto-noun, a linguistic entity which, while more than just an abbreviation of the expression plane, is always less than a fully formed item of the lexicon.

This is not, however, to imply that the acronym is in someway semantically immature or inchoate – language does not allow for such a condition. Rather the provisionality of the acronym, its status as proto-form has direct semantic functionality. It enables the acronym to reflect the nature of the reality it has been called upon to represent. As stated above, technological reality is characterised by its instability and transience. Many of the new categories it throws up are provisional and never achieve permanence. Only a subset achieve stability and any sort of persistent salience and thereby require fully fledged nouns as names. For many of the categories it is appropriate that there should be referring terms which signal this instability and provisionality. This is exactly the semantics provided in technological discourse by the acronym as a proto-nominal form.

The upper-case form also acts to signal a connection with the complex nominal form from which the single-word form was derived. As discussed above, that complex nominal term typically involves categories drawn from the vernacular system of valeur. Technological acronyms, in this sense, are specialist terms which are self-defining – the reader simply

references the underlying full form and the term's sense and application becomes clear. The meaning of the term *Dos*, for example, may be obscure but that of *disk operating system* is much more transparent. The lexicalising acronyms of technology therefore can be said to 'have it both ways' – they provide for new, unfamiliar single-word forms with some of the qualities of basic terms and yet simultaneously provide for a connection through the underlying full form to established, familiar vernacular categories. They are thus well suited to the task of extending vernacular reality.

Specialised terminology in science: 'classical' categories

The preference of science for Greek/Latin borrowings

The previous analysis of the microbiological text revealed a preference for terms of non-vernacular origin, derived primarily through borrowings from Greek and Latin. This preference can be observed widely throughout the scientific discourse. It is compellingly demonstrated by an example from another microbiological text, an extract from an article in *Scientific American* from December 1996. Many of the categories of the life sciences have both a non-native Greek/Latin derived name and a vernacularly derived name. In this case the term *programmed cell death* and its equivalent, *apoptosis*, both refer to the process by which cells die as a natural part of an organism's life cycle. As generalist, semi-popular journal rather than strictly specialist journal, *Scientific American* makes some concessions to vernacular discourse and consequently the opening paragraphs (as the reader is introduced to a new ideational domain) use both the vernacular and non-vernacular terms to reference the category, as well as a strictly vernacular, non-specialist equivalent, *cell suicide.* However, after this initial orientation, the Greek/Latin derived term *apoptosis* takes precedence and is the only name used for the remainder of the article. Tellingly, therefore, the non-native form is preferred despite the availability of a vernacularly derived, self-explanatory equivalent. (We note as well that the acronym option, *PCD* for *programmed cell death*, was not taken up.)

The 'classical' categorisations of science

In this preference for coinings of Greek/Latin origin, scientific discourse stands apart from the technological. In order to uncover the key semantic principles which underlie this difference it is necessary to explore the function of scientific terminology and the categories it references in greater depth.

In many of its endeavours, science enters domains not usually accessed as a part of vernacular experience. It uses its specialist devices to view, for

example, distant galaxies or microscopic objects which are usually not accessible to unassisted human perception. The phenomena thereby identified will typically be non-commonsense categories and the names which label them will be specialist or non-vernacular, regardless of whether they were formed by the redeployment of vernacular lexis, by foreign borrowings or through acronymisation. But the same can be said of the lexis of other specialist domains in the sense that their categories likewise are not part of vernacular valeur systems. The vocabularies of, for example, sports or of music are full of unfamiliar, specialist terms which construe categories unique to those domains. The earlier section on the redeployment of vernacular lexis in scientific terminology has argued, following Martin, that the categorisations of science act to displace vernacular systems of valeur relationships. But the key point here is that scientific taxonomies do not simply act to replace one system of valeur relationships with another. Rather, they are different in kind from the vernacular – they are informed by principles of categorisation which render them qualitatively different from those of vernacular discourse.

In principle, science seeks to construe the world in terms of a system of valeur where category membership is determined by systematic, stable, explicit, verifiable and theoretically motivated criteria. These categories or items of valeur can be said, at least in the ideal, to be 'classical' in that they conform to Aristotle's ontological theories as set out in the *Metaphysics*, namely that reality is constructed from clearly bounded categories, the membership of which can be determined absolutely by the conjunction of necessary and sufficient features (Aristotle, trans. Tredennick, 1933). They are what Kempton has labelled 'devised classification systems' (Kempton 1981) and Taylor as 'expert categories' (Taylor 1989). Thus the revaleuristic scientific definition of *fruit* as the part of a plant formed from the ovary after flowering provides the necessary and sufficient criteria by which an absolute, clearly bounded category can be established. Thus tomatoes, pumpkins, capsicums, avocados and a range of inedible seed containers have an absolute membership in the category which is the equal of the membership of categories such as *banana* and *orange*. Similarly, a term from the analysed microbiology text, *extreme halophile* for example, references a category which is defined in absolute terms as 'an organism which requires for growth a medium in which there is a greater than 10 percent concentration of sodium chloride' (Indiana University: HTTP).

In contrast, vernacular language is much more catholic in its modes of categorisation, including some categories which are systematic, absolute and hence 'classical' in this sense (the vernacular term *bachelor*, for example), but more typically operating with flexible categories determined by reference to function or to social practice rather than by any set of necessary and sufficient features. As Wittgenstein, Labov and Rosch, for example, have demonstrated, vernacular categories are

frequently unsystematic, contingent and *ad hoc*, may be determined by family resemblance and prototypal exemplars and often possess fuzzy boundaries. (Wittgenstein, trans. Auscombe, 1978; Labov *et al.* 1973; Rosch 1973; Rosch 1975; Taylor 1989).

The difference between scientific and vernacular systems of valeur is reflected at a number of points in the lexico-grammar, with one notable illustration provided by structures frequently labelled 'hedges' (Taylor 1989: 75–80). In vernacular discourse, for example, the phrase '*par excellence*' can act to indicate that an item represents an archetypal or core member of one of vernacular reality's fuzzy, prototype-determined categories. Thus in everyday speech we can say, 'The Sahara is a desert, *par excellence*.' Within the valeur system of science, however, such a statement would be incongruous – it would be meaningless to say, for example, 'The apple is the part of the plant which carries the ovaries after flowering, *par excellence*.'

This commitment to establishing absolute, clearly bounded categories defined by necessary and sufficient features is reflected in scientific definitions. These are typically concerned to specify both the superordinate category to which the term in question belongs and the necessary and sufficient criteria through which it enters into taxonomic relationships with its co-hyponyms. Thus we find the following typical definition in a chemistry textbook.

> Mixtures are substances that can easily be separated without making any new chemicals.
>
> Solutions are mixtures that have the same properties throughout.
>
> Suspensions are mixtures containing fine grains of one element of the mixture which can be filtered out.
>
> Colloids are mixtures containing tiny grains that do not settle out but which do not pass through filter paper.
>
> (Heffernan and Learmonth 1981, cited in Halliday and Martin 1993)

It is also reflected in the preference of the life sciences for word forms exemplified by terms such as *gymnosperm, angiosperm*. Such terms manage to combine features of the basic term (graphologically they are single-word forms) with features of the expanded nominal group. For those with at least a basic knowledge of the Greek/Latin sources from which they are derived, they can be read as combining a Head (*sperm* = 'seed bearing plant') with sub-classificatory premodification (*angio* = 'contained', 'enclosed'; *gymno* = 'exposed, uncontained, naked' – thus 'exposed seed plant' versus 'contained seed plant'). Both elements, Head and premodification, act to make explicit the systematic criteria which organise the underlying taxonomy. Thus, *sperm* indicates that the

two terms are co-hyponyms of a superordinate category of plants which depends on the presence of seeds for category membership. The pre-modificatory elements, *angio* and *gymno*, make explicit the necessary and sufficient criteria for distinguishing absolutely between the co-hyponymic members of the superordinate category.

The lexis of 'classical' classification – icons of un-commonsense

The original reasons for science's preference for Greek/Latin borrowings are, of course, historical. They relate to the social conditions which obtained at the time modern experimental science emerged, specifically the high status of Greek and Latin scholarship in western culture. Although the status of the classical languages may have declined in the twentieth century, a cultural habit, once established, may well continue to influence cultural practices, even when the social conditions which originally gave rise to that tradition no longer prevail. It is unlikely, however, that the practice would remain so dominant were it not communicatively functional. We have already noted how Greek/Latin coinings have been replaced with redeployed vernacular lexis and acronyms in technological discourse.

We need, therefore, to consider the communicative functionality of the Latin and Greek derived terms. We need to explain why, for example, the generalist *Scientific American* (with its interest in attracting non-expert readers) should prefer *apoptosis* to *programmed cell death*. The most obvious feature of these terms is their morphological and phonological 'strangeness'. Such terms typically strike the speaker as non-native and hence as in some way 'alien'. Such a feature serves an obvious purpose in the context of lexicon revaleurisation, in the context of a discourse committed not only to replacing individual vernacular categories but also to establishing a system of categorisation which challenges that of the vernacular. The strangeness is thus iconic. It serves as a signal that the version of reality which these terms construe is 'alien' to the version of reality construed by the familiar, typically native or nativised forms of vernacular discourse. The foreignness of the term's form acts to mark the discourse as construing an alternative reality where categorisations are not only different from the vernacular but organised according to different principles of category formation.

Technological modes of classification and the 'classical'

The categorisations which underlie scientific specialist terminology are therefore distinctive and clearly demarked from those of everyday, commonsense reality. Mode of categorisation provides another ground for distinguishing the technological from the scientific since the categorisations of technological discourse, as a generalised system, have more in

common with those of the vernacular than the scientific. That is to say, while some technological valeur relationships may be informed by 'classical' principles of category formation, the pursuit of absolute, clearly bounded categories is not the informing principle of technological valeur. Technological categories are not typically defined by necessary and sufficient features but focus, rather, upon functionality and social context. They may have fuzzy boundaries and be determined by prototypes or exemplars.

These features are reflected in the modes of specialist term definition found in technological discourse. Technological definition is not nearly so strongly oriented to the systematic mapping out of taxonomic space as that of science. Often the only form of definition offered is that provided by the 'reverse acronym presentation' discussed above. For example, *DOS (Disk Operating System)* and *RAM (Random Access Memory)*. Such definition assumes that all the explication needed for the unfamiliar single-word acronym form is the presentation of its underlying expanded nominal group. There is no articulating of any systematic membership in a superordinate category nor of any set of systematic co-hyponym relationships. More extended definitions – where, for example, some gloss on the meaning of the expanded nominal group is provided – have a similar orientation. They typically do not map out taxonomic relationships but are directed towards the category's functionality, its social purpose. For example:

> ADPCM Adaptive Differential Pulse Code Modulation is a popular method for encoding and compressing digital audio.
>
> Synthesiser This is a computer chip or peripheral device that produces sound from digital instructions, instead of from recorded audio or physical equipment. Most synthesisers attach to PCs using MIDI.
> (Windows Sources Australia, 1994: 71)

When technical terms are explicitly oriented towards articulating taxonomic relationships – for example, the set *LAN (Local Area Network), WAN (Wide Area Network), MAN (Metropolitan Area Network)* – that taxonomy is frequently not informed by 'classical' principles. The co-hyponym categories of *LAN* and *WAN*, for example, are prototypally determined and have fuzzy boundaries. Consider the following sets of definitions from two technological dictionaries.

> **Local Area Network**: Short-distance networks, such as Ethernet networks and Token Ring networks. LANs are data networks that are restricted in space. Typical distances are less than 500 meters. LANs are usually low-cost, high-bandwidth networks that connect many nodes in a limited geographic area such as an office or a building.
> (Gemini Consulting: HTTP)

Local Area Network: A data communications network which is geographically limited (typically to a 1 km radius) allowing easy interconnection of terminals, microprocessors and computers within adjacent buildings. Ethernet and FDDI are examples of standard LANs.

(Howe: HTTP)

Wide Area Network: Data network that is not restricted in terms of distance. Typical distances are larger than 100 kilometres. Telecommunication network that covers a large geographic area. Typically links cities, and may be owned by a private corporation or by a public telecom operator.

(Gemini Consulting: HTTP)

Wide Area Network: A network, usually constructed with serial lines, extending over distances greater than one kilometre.

(Howe: HTTP)

The definitions are clearly vernacular rather than 'classical' in their orientation to articulating valeur relationships. They provide prototypal exemplars, focus repeatedly on what is 'typical' or 'usual' and, perhaps most tellingly, provide no criteria for making an absolute distinction between the co-hyponym categories. The categorisation turns on the distinction between 'short distance' and 'extended distance', archetypally 'fuzzy' and context-dependent values. We note tellingly that *LANs* are variously specified as operating over distances less than 500 metres or less than one kilometre while *WANs* are variously specified to operate at more than 1 kilometre and more than 100 kilometres.

As a consequence, it would seem that categories such as *LAN* and *WAN* are prime candidates for the type of hedges discussed above. We might well say, 'Our department's network is a LAN *par excellence* because it's located in just the one room and only has one server.'

CONCLUSION

The lexis of the scientific and technological texts analysed in the course of this chapter reveals, therefore, a marked pattern of difference. These patterns of preferences have been shown to reflect an underlying distinction between lexicon revaleurisation and lexicon extension. The Greek/Latin-derived terms of the scientific texts stand as icons of the breach between the 'classical' scientific systems of valeur and those of commonsense reality. In contrast, the vernacularly derived terminology of the technological texts provides a bridge between the novel but potentially everyday categories thrown up by modern technological innovation and those of general vernacular experience. I propose therefore the label, 'techno-cality' for the lexicon-extending specialist terminology of technology as a counterpart to Martin's 'technicality', his label for the revaleuristic specialist terminology of science. The lexicogrammar of this 'technocality' reflects the fact that there is no difference in kind between the reality constituted by *RAM chips, CD-ROMs* and *Broadband ISDN* and that of *spades, motorbikes* and *claw hammers.*

One important qualification remains, however, to be noted. The chapter's analysis has been based on the examination of scientific texts which were all directed to the core concern of western experimental science – theorising about the fundamental relationships of cause and effect and of category formation by which the natural world is constituted. But we cannot assume that all texts which receive the label 'scientific' will necessarily be so exclusively focused. The field of medicine, for example, combines an interest in such theory with an interest in the development of devices and techniques for acting upon the human body in the course of disease prevention and cure. This second focus is instrumental, therefore, rather than 'theoretical' in the sense outlined above. It is, in fact, 'technological' in that it is concerned with the development of tools by which humans can act upon each other and the physical world. We would predict therefore that the specialist lexis of such a domain would be multi-modal – would combine revaleurising technicality with lexicon extending technocality. More generally, we would predict that the nature of the specialist lexis of any given domain would reflect the degree to which it is devoted, on the one hand, to scientific theorising and on the other to the development of instrumental technologies. Preliminary investigations into medical texts suggest that the prediction of multi-modality may be justified. The area remains in need of further investigation.

REFERENCES

Allan, K. 1986. *Linguistic Meaning*, London, Routledge and Kegan Paul.

Aristotle 1933. *Metaphysics*, translated by Tredennick, H., London, Heinemann.

Bazermann, C. 1988 *Shaping Written Knowledge: The Genre and Activity of the Experimental Article in Science*, Madison, Wisconsin, University of Wisconsin Press.

Berlin, B. 1995. 'Speculations on the Growth of Ethnobotanical Nomenclature' in *Language, Culture, and Society* Blount, B.G. (ed.), Prospect Heights, Illinois, Waveland Press.

Berlin, B., Breedlove, D.E. and Raven, P.H. 1993. 'Folk taxonomies and biological classification', *Science, 154: 273–85.*

Bulmer, R. 1970. 'Which Came First, the Chicken or the Egghead?' in *Échanges et communications. Mélanges offerts à Claude Lévi-Strauss à l'occasion de son 60ème anniversaire* Pouillon, J. and Marand, P. (eds), The Hague, Mouton and Co.

Gemini Consulting Inc. *C4 Lab online glossary of technological terms*, available HTTP: http://www.digital.gemconsult.com/glossary/index.html

Halliday, M.A.K. 1967. *Grammar, Society and the Noun*, London, H.K. Lewis for University College London.

Halliday, M.A.K. and Martin, J.R. 1993. *Writing Science: Literacy and Discursive Power*, London, The Falmer Press.
Heffernan, D.A. and Learmonth, M.S. 1981. *The World of Science – Book 2*, Melbourne, Longman Cheshire.
Howe, D. *Online Dictionary of Computing*, London, Imperial College London, available HTTP: http://www.wombat.doc.ic.ac.uk
Indiana University, *BioTech Life Science Dictionary*, available HTTP: http://www.biotech.chem.indiana.edu/pages/dictionary.html
Kempton, W. 1981. *The Folk Classification of Ceramics: A Study of Cognitive Prototypes*, New York, Academic Press.
Labov, William, Bailey, C.-J.N. and Shuy, R.W. 1973. *The Boundaries of Words and Their Meanings*, Washington DC, Georgetown University Press.
Lemke, J.L. 1990. 'Technical Discourse and Technocratic Ideology' in *Learning, Keeping and Using Language: Selected Papers From the 8th World Congress of Applied Linguistics*, second edition Halliday, M.A.K., Gibbons, J. and Nicholas, H. (eds), Amsterdam, Benjamin: 435–60.
Martin, J.R. 1985. *Factual Writing: Exploring and Challenging Social Reality*, Geelong, Deakin University Press.
Rosch, E. 1973. 'Natural Categoriser', *Cognitive Psychology* 4: 328–50.
Rosch, E. 1975. 'Cognitive Representations of Semantic Categorisations', *Journal of Experimental Psychology: General* 104: 192–233.
Rose, D., McInnes, D. and Korner, H. 1992. *Stage1: Scientific Literacy – Literacy in Industry Research Project*, Sydney, The Write It Right Project, Metropolitan East Disadvantaged Schools' Program, NSW Department of School Education.
Stanier, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. 1937. *General Microbiology*, fifth edition, Basingstoke and London, Macmillan Education.
Sutherland, S.L. and Burgin, J. 1993. 'B-ISDN Interworking', *IEEE Communications Magazine*: 60–3.
Taylor, J.R. (1989) *Linguistic Categorisation*, Oxford, Clarendon Press.
Windows Sources Australia, 1994 *Glossary of Terms*, Sydney: Windows Sources Australia.
Wittgenstein, L. 1978. *Philosophical Investigations*, translated by Anscombe, G.E.M., Oxford, Basil Blackwell.

APPENDIX

B-ISDN Interworking:

B-ISDN can be used to establish communications between networks based on different technologies (extract)

Economic considerations place finite limits on the rate at which new technology can be deployed and the rate at which existing technologies can be depreciated. This means that networks exist simultaneously, e.g., packet switched public data network (PSPDN), packet switched telephone network (PSTN), 64 kb/s ISDN, frame-mode bearer service (FMBS), metropolitan area network (MAN) and B-ISDN. In general terms, the purpose of interworking is to enable a network user to establish communication with a user of another network and vice versa, but there are other scenarios which may require interworking:

- A network may have global coverage by design (e.g. Local area network – LAN). In this case user of networks using a common technology (e.g., Ethernet LAN) may establish end-to-end communications using another network (e.g., IEEE 802.6 MAN).
- A new network (e.g., B-ISDN) may have limited service support capabilities and/or limited coverage in early stages. In this case, a B-ISDN user may establish end-to-end communication using another network (e.g., ISDN).
- A particular network (e.g., PSTN) may be better suited to supporting a type of traffic (e.g., voice) generated by a user of another network (e.g., early B-ISDN).

This article will focus on interworking existing networks with B-ISDN. Interworking is certainly not a new problem and so the status of some current International Consultative Committee for Telephone and Telegraph (CCITT) recommendations are reviewed in the next section. Then the remaining sections examine specific examples of interworking with B-ISDN (names, MAN, LAN, 64 kb/s ISDN and FMBS).

Status of Interworking Recommendations

CCITT has been actively studying interworking scenarios and a number of recommendations have been developed. CCITT Recommendation I.510 discusses definitions and general principles for ISDN interworking [1]. Many of the same principles apply when considering interworking with B-ISDN. Table 1 shows the draft CCITT Recommendations pertinent to interworking existing networks with B-ISDN.

MAN/B-ISDN interworking

The Australian FASTPAC network is a hierarchy of MANs interconnected by high-speed transmission facilities to provide a national LAN interconnect service. The B-ISDN will need to interwork with networks based on IEEE 802.6 MAN technology and networks offering switched multimegabit data service (SMDS) [3]. A suitable reference configuration for B-ISDN/MAN interworking has been identified in CCITT Recommendation 1.327 [4] (Fig. 1).

In Figure 1 interworking between the B-ISDN and IEEE 802.6 MAN takes place across the M reference point. The P reference point [5] is an internal network reference point used to access a specialized network resource such as a connectionless server function (CLSF).

A relatively simple protocol translation exists between the IEEE 802.6 segments and ATM cells.

This protocol translation would take place within the bridge at the interface between networks.

One of the key issues to resolve in determining the appropriate cell

header is the establishment and use of ATM virtual path (VP) and virtual channel (VC) connections within the B-ISDN to transfer the MAN segments [6]. Three scenarios appear worthy of further consideration:

1 Each bridge attached to the B-ISDN maintains a semi-permanent VP connection to every likely destination bridge, in this case, beginning of message (BOM) segments enter the bridge where E.164 addresses are analysed to determine the approximate VP connection to forward the segments on. Subsequent segments of the same packet are identified via the message identification (MID) field.
2 The establishment of VC connections is triggered by the arrival of BOM segments at the bridge. In this case, the bridge uses E.164 address information contained in the BOM segment to establish a connection across the B-ISDN.
3 Each bridge attached to the B-ISDN maintains a single semi-permanent connection to a connectionless server in the B-ISDN. The connectionless server analyses the E.164 address information contained in the BOM segment.

(S.L. Sutherland and J. Burgin, *IEEE Communications Magazine*, August 1993)

11 Technicality and abstraction in social science

Peter Wignell

INTRODUCTION

This chapter discusses what will be referred to as the discourse of social science both in terms of its phylogenesis and in terms of how it is currently presented to initiates through undergraduate textbooks. The discussion is based on five 'canonical' texts from the archive of social science and on one 'standard' undergraduate textbook from the discipline of sociology. The key points in the discussion are the emergence of and the nature of technicality in social science.

A sizable body of research into the construction of knowledge in specialised disciplines has been conducted within the paradigm of systemic functional linguistics. That research has been concentrated on what have been referred to as the discourses of science and humanities, either treating each separately (Wignell, Martin and Eggins 1987; Eggins, Wignell and Martin 1987; Shea 1988; Halliday 1987, 1988, 1989a; Martin 1990a, 1990b) or comparatively (Martin, Wignell, Eggins and Rothery 1988; Martin 1989, 1993; Wignell 1994).

One strand of that work, beginning with Wignell, Martin and Eggins (1987) and Eggins, Wignell and Martin (1987), has concentrated on how these two discourses present their respective construals of the 'world' to initiates in the context of secondary education. In summary, the authors argued that science and humanities each utilise different selections of resources from lexicogrammar, discourse semantics, register and genre in the creation of specialised knowledge. Science is characterised as primarily using what is referred to as technicality. That is, it reconstrues its domains of experience technically by establishing an array of technical terms which are ordered taxonomically. This technicality is then used to explain how things happen or come to be. The humanities, on the other hand, use what is referred to as abstraction. In history, for instance, shifting from a *story* to an interpretation of a number of *stories* involves a number of progressive shifts in abstraction from context dependence to context independence as history moves from events to the interpretation of events.