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Jean-Philippe Watbled

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SOME ASPECTS OF NATURALNESS AND ABSTRACTNESS IN PHONOLOGY

Submitted by J. P. Watbled
for the degree of Ph.D.
of the University of Bath

1986

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PREFACE

PHONETIC SYMBOLS:

In this work, I have adopted the symbols of the International Phonetic Association, with a few modifications.

Vowels:

[ɑ] is a low back unrounded vowel. [ä] is a mid-low central unrounded vowel.

Diphthongs:

In the transcription of diphthongs, the weaker element is represented by a small letter: [aⁱ] ([a] is the stronger element, and [i] is the weaker element).

Stress:

The usual sign denoting stress is ' (which precedes the prominent syllable). I do not resort to this sign in the transcription of French. In French words, it is normally final syllables which are prominent, except when the final vowel is schwa (spelt *ə*); in this language, final unstressed schwa will be

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represented as follows: *petite* [pɛtʰit^h]. We can thus distinguish *heureux* [œrø], with a final stressed syllable, as is frequent in French, from *heure* [œR^h], with a final unstressed syllable.

Consonants:

The symbol [r] is used for any variety of r-sound in English. In the transcription of French, [R] denotes the uvular approximant (in the I.P.A. system, it denotes a vibrant). The transcription of retroflex consonants, of secondary articulations, and of aspiration also differs from that of the I.P.A. system (see below). Affricates are represented as complex segments: [t^h], [d^z] etc...

Diacritical marks for consonants:

Retroflexion: a dot under the symbol.

Palatalization: a small ^j after the symbol: [t^j], [d^j] etc...

Labialization: a small ^w after the symbol: [k^w], [g^w] etc...

Velarization, pharyngealization: a small ^ˀ after the symbol: [l^ˀ], [t^ˀ], [s^ˀ] etc...

Aspiration: a small ^h after the symbol: [t^h], [p^h] etc... Note that all these sounds are distinct from sequences: [tj], [dj], [kw], [gw] etc...

In the transcription of French, connective consonants are preceded and followed by a space: [gRø z avjõ] (this phenomenon is known as *liaison*).

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OTHER SYMBOLS:

word boundary

+ morpheme boundary

\$ syllable boundary

% phrase boundary

§ pause

* before a form means (i) that it is unacceptable or (ii) that it is a historical reconstruction.

> denotes a historical change.

S = 'strong' in syllabic phonology

W = 'weak' " " "

U = 'utterance'

IP = 'intonational phrase'

PP = 'phonological phrase'

M = 'word'

£ = 'hypersyllable' (that is, a unit which is superior to the syllable, but inferior to the word)

σ = 'syllable'

C = 'consonant', or 'syllable margin' ('onset', or 'coda').

V = 'vowel', or 'syllabic peak/nucleus'.

N = 'nasal consonant'

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ABBREVIATIONS:

Approx. = approximant
Conson. = consonantal
Ex. = example
FCD = final-consonant deletion
Femin. = feminine
Fricat. = fricative
Indic. = indicative
Masc. = masculine
Perf. = perfect
Pers. = person
Plur. = plural
Pres. = present
Semivow. = semivowel
Sing. = singular
S-structure = syllable structure
SPE = *Sound Pattern of English* (see Chomsky & Halle (1968))
Vocal. = vocalic

NOTATIONAL CONVENTIONS:

Square brackets [] will enclose phonetic representations; slash marks / / will enclose phonemic (phonological) or underlying representations. Square brackets also enclose distinctive-feature specifications: [+nasal] for a nasal sound, for example, and [-nasal] for a non-nasal sound. 0 denotes unspecified values: [0 nasal]; The double sign expresses underlying, phonemic contrasts: [±nasal] means that a language has [+nasal] sounds contrasting with [-nasal] sounds.

Rules are expressed in the following manner:

A → B/C_D

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In this abstract example, CAD is the 'structural description' of the rule. A is the 'input', and B is the 'output'. C_D is the 'environment' or 'context'. A → B is the 'structural change'. In the context, C and D constitute the 'determinant'. The underscore _ indicates where the sounds undergoing the change are located with respect to the determinant. A rule with the following form will mean that consonants undergo a voicing process when they are intervocalic:

$$[+consonantal] \rightarrow [+voiced] / [+vocalic] _ [+vocalic]$$

The same rule can be expressed with the usual abbreviations:

$$C \rightarrow [+voiced] / V _ V$$

When a rule necessitates several simultaneous feature specifications for the same segment, I have adopted the sign '&' for typographical reasons:

$$[+consonantal \ \& \ +velar \ \& \ +palatal]$$

The output of deletion rules is the null sign (\emptyset), which is distinct from the symbol denoting the front mid-high rounded vowel ($\text{[}\emptyset\text{]}$):

$$C \rightarrow \emptyset / _ \#$$

The null sign is also the input to insertion rules:

$$\emptyset \rightarrow d / n _ r$$

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Greek letters denote variables: α , β , γ etc... Variables stand for all values of a feature:

$$[+\text{consonantal}] \rightarrow [\alpha \text{ voiced}] / _ [+ \text{consonantal} \ \& \ \alpha \text{ voiced}]$$

This rule means that two adjacent consonants are both [+voiced] or [-voiced].

Parentheses allow us to combine several rules; in the example below, the rules

(i) and (ii) can be combined:

(i) $A \rightarrow B / _ CD$

(ii) $A \rightarrow B / _ D$

(iii) $A \rightarrow B / _ (C) D$

A subscript indicates the minimum number of segments which are involved by a rule, whereas a superscript indicates the maximum number of segments involved:

$C^2 = C \text{ or } CC \text{ or } \emptyset$

$C_n = \text{from zero to } n \text{ consonants.}$

Braces are read 'either ... or': {a, o} means [a] or [o].

The symbol (R) followed by a number denotes a phonological rule:

(R.1) $X \rightarrow Z / _ W$

I

INTRODUCTION

The object of investigation in this dissertation is essentially French phonology, and in particular the proper description and treatment of some well-known alternations which have often attracted the attention of linguists:

- Alternations between 'zero' and a consonant, including liaison.

- Alternations between a nasal vowel and a sequence of oral vowel plus nasal consonant.

- Alternations between 'zero' and schwa

These phenomena are related to some basic issues:

- The exact nature of *H aspiré*.
- The role of schwa in French phonology and morphology.
- The status of nasal vowels.
- The form of underlying representations, and also their degree of abstractness (see Chapters VI & VII). Underlying representations are the mental phonological structures of lexical items, which are assumed to be stored in speakers' minds.
- The question of the existence of a nasalization rule and of consonant-truncation rules.

In this research, I have adopted the framework and formal apparatus of generative phonology (see Smith & Wilson (1979) for an introduction to generative linguistics). However, the case study of French phonology leads me to reject some basic assumptions of this theory; none the less, the revised organization of the model which I put forward does not entail a return to a pre-generative era: criticism remains purely internal.

I shall attempt to demonstrate that the most abstract variants of generative phonology suffer from some fundamental inadequacies; the role of alternations is often overestimated, the distinctions between rule classes are generally obliterated, and, in spite of undeniable theoretical achievements, the psycholinguistic validity of the standard model has never been confirmed by substantive evidence (examples of substantive -- or

external -- evidence are: speech errors, such as slips of the tongue; language change; puns; spoonerisms; linguistic games; foreign-language learning; loan-word adaptation; overgeneralizations etc...).

The central topic is naturalness (this notion will be examined in Chapter II). Concerning the above-mentioned issues, two attitudes are possible:

-- In one, underlying representations are regarded as abstract, (that is, very remote from phonetic representations), and natural rules relate the two structural levels. The treatment of alternations is as simple and elegant as possible, and, generally, unified purely phonological solutions are preferred to grammaticalization (a phonological rule is grammaticalized when the environment which conditions its application ceases to be phonetic, and becomes morphological or syntactic); rules are as general as permitted by the theory (their applicability is optimal).

-- On the contrary, one can assume historical processes of *denaturalization* of rules: on the notion of *denaturalization*, see Hyman (1975: 173-178); grammaticalization is an instance of denaturalization.

Denaturalized rules cease to be phonetically conditioned, and this generally leads to the restructuring of underlying representations; at the same time, rules become more complex. The treatment of alternations is no longer unified, but processing is much simpler: the mapping of underlying representations on to phonetic representations (i.e., the 'derivation') is

much more direct. It must be clear that simpler processing and shorter derivations are not equivalent to the pre-transformational conception of the direct conversion of phonemic representations into phonetic representations in one step. The hypothesis of denaturalization remains compatible with rules relating the underlying representations of items to their concrete phonetic manifestations, or relating items to one another in an explicit way.

I shall present evidence for denaturalization. My basic claims are that the 'process model' (i.e., the standard theory of generative phonology: see Stampe (1979: 81, n.7)), which regards alternations as governed by natural rules whenever it is formally possible to do so, is inadequate, and that phonetic plausibility is not a sufficient criterion; the evaluation metric (see Chomsky & Halle (1968: 330-340)), which selects the most simple analysis, has never prevented the proliferation of competing solutions (this proliferation is particularly striking in the field of English phonology, and more precisely in the study of English vowel alternations). So the evaluation metric must be replaced by a set of integrated constraints, which will reduce indeterminacy to a large extent; these constraints will be shown to be incompatible with a monolithic conception of the phonological component, which, in my view, should be split into two different parts: *word formation* and *phonology* proper (see Chapter VI). This division into two components corresponds to two classes of rules:

- (1) *Lexical* rules, which include allomorphy rules, as well as phonotactic rules; they apply when *morphemes* are chained together.

(ii) *Post-lexical* rules, which apply in connected speech, when *words* are chained together. (lexical rules are necessarily phenomena of internal sandhi; however, post-lexical rules, as we shall see, are not exclusively processes of (external) sandhi). All these notions will be studied in detail in Chapter VI.

I shall claim that natural rules can be lexical or post-lexical, but that many processes which are assumed to be natural in the tradition of *The Sound Pattern of English* (Chomsky & Halle (1968); henceforth *SPE*) are in fact synchronic residues which are no longer productive, or which have been grammaticalized (see above): in both cases, they are no longer natural.

For linguists working within the theoretical framework of the standard model of generative phonology, the phoneme (see Trubetzkoy (1976: 36ff) for this notion) is not a valid unit (see the underlying representations of French morphemes in Schane (1968), for example; see also my discussion in SVI.2). However, the organization of phonology that I shall advocate (see chapters VI & VII) is not compatible with the rejection of the phoneme. In my view, this rejection was a fundamental error, and underlying representations are not 'deeper' than the classical phonemic level (which means that they are not more abstract than the usual phonemic representations in structuralist works: see Dubois (1965; 1967), for instance). They are also phonemic representations of *words*, rather than of *morphemes*, and are fully syllabified (see chapter VIII): in this sense, they are more natural than abstract representations in the model of *SPE* phonology, because proper constraints on rules and representations reduce the excessive power of the theory.

The present dissertation is organized in the following manner. In Chapter II, I deal with the notion of naturalness. In Chapter III, I propose an original feature system, and describe the main phonetic characteristics of French. In Chapter IV, the most interesting alternations in French phonology are examined. In Chapter V, I discuss some representative theoretical accounts of these data. In Chapters VI and VII, a new generative model is put forward, which is much more constrained than the standard theory, or other abstract versions of modern phonology. (Although the main topic of this dissertation is the French language, I have attempted in these two chapters to reinforce the validity of the model I propose by giving examples of its applicability to the description of various other languages.) In Chapter VIII, I give a new account of the French data within the revised theoretical framework. The main hypothesis which I attempt to confirm is that most alternations in French are no longer governed by natural, phonetically conditioned rules, in a synchronic analysis of the modern language.

I I

NATURALNESS

Before proceeding further, it is necessary to define naturalness: a good approach to this notion can be found in Hyman (1975: 98), for whom 'Rule plausibility usually refers to phonetic naturalness', and 'the most phonetically natural rule is not necessarily the most simple rule'. For Hyman (1975: 138), a natural rule, or representation, is 'plausible in a phonetic sense'. Conversely, some linguists, like Hooper (1976: 131), claim that all phonetically conditioned processes are natural; these processes are sometimes assumed to be universal and exceptionless: 'It is well known that many of the same processes apply in language after language', and 'a general phonetic explanation can be associated with each rule' (Hooper 1976: 133).

For Wolfram & Johnson (1982: 158), what is 'natural' is what is 'more sensible or more expectable from the perspective of how people talk', but 'some models for description may be so "powerful" they might account for almost anything'. In my view, a good example of a powerful model which 'might account for almost anything' is the *SPE* model (= Chomsky & Halle 1968), because if the underlying representation of the English noun *boy* is /boe:/, for instance (Chomsky & Halle 1968: 215), anything is possible.

In my view, a natural process is conditioned by the vocal nature of speech; speech sounds interact on the paradigmatic axis and on the syntagmatic axis (paradigmatic oppositions characterize 'des unités qui peuvent figurer dans un même contexte' (Martinet 1970: 27), such as [ɛ:] and [a:] in the French words *mer* [mɛ:R] ('sea') and *mare* [ma:R] ('pond'), while syntagmatic contrasts characterize the relationship between the segments [m], [ɛ:] and [R], for instance, in the first item). Systemic pressure may cause restructuring (the paradigmatic changes which are described by Martinet (1955)) and the transformation of phonemic systems, but, more often, coarticulation in speech causes phonetic modifications. The natural inertia of vocal organs triggers phonetic processes, such as assimilation, strengthening, weakening, deletion etc... These processes are numerous in English, and Gimson (1970: 294ff) provides several examples: *good boy* is often pronounced [gʊb bɔ¹] in fast speech (assimilation), the sequence *next day* may undergo the elision of its [t]: [nɛks de¹] (deletion). An example of strengthening is the aspiration of oral stops in stressed syllables: *pat* [p^hæt], and an example of weakening is the reduction of unstressed vowels in *I was here*: [a¹ wəz hɪ²] (p→ə). The physiological basis of speech is responsible for the permanent instability of phonological structures, but, fortunately, the tendency to make articulations easier is often inhibited by the necessity of communicative efficiency (see Martinet (1975: 52)). In short, a process is natural when it is phonetically conditioned, but, in this dissertation, I shall attempt to demonstrate that this criterion is not sufficient.

Naturalness is relevant in the field of:

- (i) rules
- (ii) representations
- (iii) phonemic systems
- (iv) rule interaction

Rule interaction (or rule ordering) plays a crucial role in generative phonology because in a derivation, rules apply in a sequential way; statements specify their *order* of application (see Chomsky & Halle (1968: 340-350)).

Naturalness is closely related to the basic issue of abstractness. A phonemic or underlying representation is *abstract* when it is very remote from its actual phonetic manifestation. The underlying representation /boe:/ for *boy* -- see above -- is therefore abstract, since the phonetic representation of this word is [bɔ¹]. If we took phonetic data at face value, the underlying representation of this non-alternating item would be /bɔ¹/, and would thus be identical to the phonetic manifestation. Phonemic representations are related to phonetic representations through a series of presumably natural rules. In this sense, naturalness and abstractness are not separate issues, because, when natural processes are postulated, whereas, in fact, alternations are governed by non-productive rules, the degree of abstractness of underlying representations increases. Hoard (1972: 124-125), for instance, assumes that *point* and *punctual* are phonologically related. This leads him to postulate a very abstract underlying stem with the vowel /ʌ:/, whose phonetic realizations are [ɔ¹] in *point* and [ʌ] in

punctual. Other linguists (such as Sommerstein (1977: 215-216, n.19)) do not take such marginal alternations into account, and the hypothesis of denaturalization, when it is justified and motivated, decreases the degree of abstractness of phonemic strings. Kenstowicz & Kisseberth (1977: 1-62) discuss this issue, and reject various constraints which would have been liable to limit the degree of abstractness of underlying representations, but they admit that their own approach 'leaves unanswered the fundamental question of whether or not the native speaker actually constructs the internalized grammar along such abstract lines' (Kenstowicz & Kisseberth 1977: 62). In Chomsky & Halle (1968: 12, 55), 'the lexical representation is abstract in a very clear sense; it relates to the signal only indirectly through the medium of rules' and 'the necessity of postulating lexical representations of a quite abstract sort' is emphasized. Unfortunately, in the *SPE* tradition, much more emphasis is placed on the naturalness of rules or phonemic systems than on the naturalness of underlying representations or of rule ordering, and stepwise processing may be quite complex and yield very unnatural results, even if each step of a derivation is a plausible natural process. A striking illustration is the derivation of the word *courage* in Chomsky & Halle (1968: 235), whose underlying representation is assumed to be /koræge/; /o/ is delabialized, /æ/ is reduced because it is unstressed, /g/ is palatalized before a front vowel, and this vowel is deleted in word-final position; these processes yield the proper output, that is, the phonetic representation ['kʌrɪdʒ]. It should be added that each rule in the derivation is a perfectly plausible process, but the whole derivation is highly implausible, because the underlying representation is too abstract.

I think that such considerations as the naturalness of a process, its recurrence 'in language after language', and its phonetic plausibility do not

guarantee its application in a particular language, or do not guarantee actual phonetic causality and productivity. Motivated constraints should prevent the possibility of deriving absolutely anything from absolutely anything, and, by restricting the set of natural rules in languages, should limit abstractness to a plausible degree. They should also account for the learnability of structures and rules. This means that psycholinguistic evidence must support the validity of constraints, which will not be regarded as mere methodological devices or procedures. In *SPE*, 'revised underlying representations [...] make rules work where they otherwise would fail' (Lass 1976: 215); as rule ordering is also unconstrained, it is possible to posit extremely marked interactions: rule order becomes a 'blocking device' (see also SVII.3). These undesirable formal manipulations will be disallowed by the set of constraints that I shall put forward in Chapter VII.

As I claimed in Chapter I, many processes in French phonology have been *denaturalized*; among the mechanisms which may be responsible for denaturalization, are *telescoping*, *morphologization*, and *rule inversion*. For Hyman (1975: 173), 'telescoping [...] can be defined as the loss of an intermediate stage in a phonological derivation'. The rules $A \rightarrow B$ and $B \rightarrow C$, for instance, merge into a single rule: $A \rightarrow C$. Hyman (1975: 175) gives an example of morphologization in German. Historically, the plural of *Gast* ('guest') underwent two processes: $gasti > gesti > g\text{est}\text{ə}$ (*Gäste*); the vowel [a] was fronted under the influence of the final [ɪ], before the latter changed to [ə]. In Modern German, the environment of 'Umlaut' is morphological, and the process is clearly conditioned by the feature [+plural]. In Chapter V, I shall attempt to show that, in French, final-consonant deletion was subject to rule inversion: this means that connective consonants in liaison were part of

the word in Old French, and were deleted before a word-initial consonant, as in *grand tourment* ('great torment'): gRant → gRän; in a subsequent stage, these consonants were no longer underlying, and were inserted in the complementary contexts, that is, before vowels, as in *grand ami* ('good friend'): gRä → gRä#t. The initial rule was also morphologized to a large extent, and split into several different processes. A unified treatment of alternations is therefore no longer possible in a synchronic description; external evidence (speech errors and child language, for instance) points towards the validity of this interpretation (see Frei (1929: 103-104), Klausenburger (1974: 172-174), and Smith & Wilson (1979: 223-229)). I claim that in Modern French, underlying representations are very similar to phonetic representations, with the result that processing is simpler (derivations are less complex). Simplicity of processing should be taken into account in the evaluation of the complexity of a grammar; it compensates for the increased complexity of rules, which may also be lexically restricted, while they were once general. In fact, standard (abstract) generative descriptions would have been more descriptively adequate a few centuries ago, especially with respect to the validity of underlying representations. This is due to the static conception of diachrony which still reigns in generative phonology: change is often attributed to the rule component, while it is in fact underlying representations which are restructured.

My reanalysis of French data is doubly motivated:

- (i) By the search for observational adequacy. I shall show that some modern, standard treatments of French data are quite simply factually incorrect, because they are unable to account for too many 'residual problems' (see Chapter V).

- (ii) By a desire for descriptive and explanatory adequacy. I shall propose a set of constraints which will considerably reduce the power of phonological theory (see Chapters VI & VII). In the absence of such conditions, the discussion 'suffers from a fundamental theoretical inadequacy' (Chomsky & Halle 1968: 400), and 'there are many rules that can be formulated that are incorrect' (Chomsky & Halle 1968: 330). So many alternative grammars are possible, but I do not think that procedures of evaluation are sufficient in the selection of the correct analysis.

III

THE SOUND SYSTEM

III.1. A set of features

III.1.1. Major classes

Before describing the sound system of French, I shall present the phonetic framework that I shall use in this work. This framework differs significantly from the standard one found in Chomsky & Halle (1968: chapter VII). However, feature values will be binary, just as in the *SPE* system. A feature will thus be positively or negatively specified, and there is no other alternative at the underlying level; English /p/, for instance, is clearly [-nasal], whereas /m/ is [+nasal]: there are no intermediate categories in English, and phonemes are not 'more' or 'less' nasal.

For major classes, I adopt the following three features:

- (1) [vocalic]
- [consonantal]
- [sonorant]

The definition of *vocalic* does not correspond to the Jakobsonian feature (see Jakobson & Waugh (1979: 84-86), for whom liquids ([l], [r]) are [+vocalic]): only true vowels will be [+vocalic] (for Catford (1977: 166), true vowels constitute 'a class of maintainable sounds with non-fricative central, oral, dorso-domal, or linguo-pharyngeal articulation'). Note that this feature does not refer to syllable structure; it is true that [+vocalic] segments are universally syllabic nuclei (and can be defined as such), but if a consonant constitutes a syllabic nucleus (i.e., the sonority peak of the syllable, as syllabic [n] in *cotton* [kɒtn]), it will keep its [+consonantal] and [-vocalic] values.

Semivowels constitute an intermediate class which is [-consonantal] and [-vocalic]: they are approximants (that is, frictionless continuants); like true consonants, they are [-vocalic]. This yields the following tripartite division:

(2)	<i>vowels</i>	<i>semivowels</i>	<i>consonants</i>
[vocalic]	+	-	-
[conson.]	-	-	+

Examples of semivowels are [j] [w] in *yard* [jɑ:d], *when* [wen].

Segments with complete closure, and which are [-nasal] (i.e., oral stops, such as [p], [t], [k]), or fricatives (such as [f], [s]), are [-sonorant].

III.1.2. Manner of articulation

For manner of articulation and the oro-nasal process, I adopt the following features:

- (3) [nasal]
 [stop]
 [laterall]
 [vibrant]
 [roll]

Laterals ([l] for example) are [-stop], because only segments with complete occlusion are [+stop] ([p], [t], [k] etc...). Trills and flaps (i.e., r-sounds) are [+vibrant], and the feature [roll] can differentiate them. In Spanish, there is a contrast between a trill and a flap: *perro* ('dog') has a trill, while *pero* ('but') has a flap. In (4), values are assigned to sound classes:

(4)	<i>oral</i>	<i>nasal</i>	<i>fricatives</i>	<i>vibrants</i>	<i>lateral</i>	<i>lateral</i>	<i>central</i>
	<i>stop</i>	<i>stop</i>			<i>fricat.</i>	<i>approx.</i>	<i>approx.</i>
							<i>semivow.</i>
[sonorant]	-	+	-	+	-	+	+
[nasal]	-	+	-	-	-	-	-
[stop]	+	+	-	-	-	-	-
[laterall]	-	-	-	-	+	+	-
[vibrant]	-	-	-	+	-	-	-

The values [+vibrant] and [-sonorant] can also be combined, as in the Czech fricative trill [ʀ].

I shall not deal with the complex questions of airstream mechanisms and phonation (on these questions, see Catford (1977: 63-116)). In my study of French, the following features are quite sufficient:

(5) [voiced]

[fortis]

III.1.3. Place of articulation

Regarding locational features, my position is very similar to that of Ladefoged (1971: 37, 91), who postulates a set of non-binary features for what he regards as equipollent oppositions (points of articulation). This approach is reminiscent of traditional articulatory descriptions (see Gimson (1970: 149) and O'Connor (1973: 61)). However, such features as *bilabial*, *labio-dental*, etc... being *singulary*, are not ideal from a methodological point of view. Singular features were commonly used by linguists working in a structuralist framework (Martinet (1970), for instance), and are distinct from binary features, since they are never preceded by a + or a - . This entails several undesirable consequences. First, they fail to express the relationship between all consonants involving a lip gesture; the two singular features *bilabial* and *labio-dental* cannot express the fact that the two series form a functional class, unless one distinguishes a phonological feature *labial* from phonetic features, which should certainly be avoided, because there would thus be two sets of features corresponding to two different structural levels; it would then become very difficult to relate them in a non-arbitrary way. Moreover,

phonological features would be mere conventional labels, which would not conform to the principles of generative phonology (see Sommerstein (1977: 108-109)). One could also claim that adjacent places of articulation form natural classes: however, this is far from ideal, because there is a disjunction, in French, as in many other languages, between labio-dentals and apicals (Sommerstein 1977: 101). Martinet's (1970: 73) description of French consonants, with its 'ordres', is subject to the same kind of criticism. Martinet's subsystem of French obstruents is as follows:

p f t s ʃ k
b v d z ʒ g

In this pattern, it is assumed that the place of articulation conditions the manner of articulation: bilabials are stops, labio-dentals are fricatives, etc... but the lateral /l/ falls outside locational classes, because its place of articulation is redundant; this time, manner conditions place. It is clear that Martinet's description suffers from internal contradictions. In spite of this, the number of disciples who accepted his account of French consonants remains considerable (e.g., François (1968), Carton (1974), Walter (1977)). A second drawback of non-binary features is that rules can refer to sounds which share a property, but not to a class of sounds which are characterized by the absence of this property. In addition, Ladefoged's (1971) features, which are identical to the traditional places of articulation, do not distinguish passive from active articulators.

For all these reasons, I shall regard all features as binary, but they will be accompanied by a set of constraints ruling out simultaneous *plus*

values for some of them. The place of articulation of a consonant will also be treated as a complex label, more precisely as the association of a passive and an active articulator (in some cases, only active articulators are involved). The active articulators are:

- (i) the lips
- (ii) the apex or the blade of the tongue
- (iii) the dorsum
- (iv) the pharynx
- (v) the glottis

Several features will correspond to these articulators; let us note that in many phonological systems, whether a consonant is articulated with the apex or with the blade of the tongue is immaterial at the underlying level. The features are:

- (6) [labial]
- [coronal]
- [apical] (the apex is active or not)
- [retroflex]
- [dorsal]
- [pharyngeal]
- [glottal]

[+coronal] sounds are either apical or laminal (that is, articulated with the apex, or with the blade, respectively):

(7)	<i>apical</i>	<i>laminal</i>	<i>retroflex</i>
[coronal]	+	+	+
[apical]	+	-	+
[retroflex]	-	-	+

Sounds with a simple articulation are either [+labial], or [+coronal], or [+dorsal], or [+pharyngeal], or [+glottal]; a *plus* value for more than one of these features is impossible, in this case. However, some consonants are complex: labial-velar and labial-palatal sounds, with two strictures of equal status, are [+labial] and [+dorsal]. Pharyngealized consonants may be [+labial], or [+coronal], or [+dorsal] (pharyngealized consonants occur in Arabic and in Berber languages: see Ladefoged (1971: 63-64)). Any of these values will be associated with the value [+pharyngeal]: in such cases, this value signals a secondary articulation. One of the advantages of this system is that we do not need extra 'places', such as labial-velar etc... for complex articulations. These extra 'places' are necessary in frameworks with singular features (see Ladefoged (1971: 92)); moreover, the similarities between labial-velar and labial or velar consonants, from the point of view of speech production, become fortuitous, since they cannot be expressed (Ladefoged's (1971: 44) feature *grave* refers to acoustics, not to production). Note also that, following Catford (1977: 253, n.1), I reserve such compounds as *apico-dental* etc... for combinations of an active and a passive articulator; in this sense, the sound [kp], for instance, is labial-velar, and not labio-velar. With the present system, we can also use the same features for primary and secondary articulations. The features [+coronal] and [+dorsal] are necessarily associated with positive values for

passive articulators, but bilabial consonants, involving only the lips, are simply [+labial].

I prefer the terms *active* and *passive* for articulators, in spite of Catford's (1977: 252, n.2) criticism. Catford resorts to the terms *upper articulator* and *lower articulator*. Note that if we followed him, we would need two different features for lip gestures: one for the upper lip, and one for the lower lip. In my system, bilabials can simply be defined as [+labial], and the values of other locational features will be negative. Whether the uvula is active or passive is immaterial: as it stands in a series of passive articulators, I shall regard it as passive. In any case, my point of view is linguistic, and not phonetic *stricto sensu*. The passive articulators are:

- (i) the teeth
- (ii) the alveolar region
- (iii) the hard palate
- (iv) the soft palate (velum)
- (v) the uvula

The features for passive articulators are as follows:

- (8) [dental]
 - [alveolar]
 - [palatal]
 - [velar]
 - [uvular]

For simple sounds, the following associations are possible:

(9) bilabial:	[+labial], [-dental]
labio-dental:	[+labial], [+dental]
dental:	[+coronal], [+dental]
alveolar:	[+coronal], [+alveolar]
palato-alveolar:	[+coronal], [+alveolar], [+palatal]
retroflex:	[+coronal], [+palatal], [+retroflex]
palatal:	[+dorsal], [+palatal]
velar:	[+dorsal], [+velar]
uvular:	[+dorsal], [+uvular]

The value [+dental] defines labio-dental, interdental, and post-dental consonants; the value [+alveolar] defines alveolar or post-alveolar consonants. Normally, no more than one *plus* value may be associated with the features in (8), except in two cases: (i) Long, extended strictures, such as denti-alveolar or palato-alveolar sounds (ii) More generally, the association of a primary and a secondary articulation. Dentals and alveolars can be palatalized, for example, or velarized:

- (10) [+dental] and [+palatal]
 [+alveolar] and [+palatal]
 [+dental] and [+velar]
 [+alveolar] and [+velar]

These types of consonants occur in Russian (Garde 1980: 53-57). It is easy to decide whether the features [palatal] and [velar] refer to primary or

secondary articulations: if they are associated with the value [+dorsal], they refer to a primary articulation; in other cases, they refer to a secondary articulation (when they are associated with the values [+labial], or [+coronal], or [-dorsal]). Sounds which are simultaneously [+apical], as well as [-dorsal], and [+palatal] are necessarily [+retroflex], if they are also [-dental] and [-alveolar] (this is due to a physiological constraint: the apex is automatically retracted when it is in contact with the hard palate).

Palatals *stricto sensu* (that is, dorso-palatals) or palatalized sounds are [+palatal] and [-retroflex], since they are 'convex' articulations, while retroflex consonants are not 'convex', although they are articulated in the palatal area in most cases.

Two other features are necessary:

(11) [sibilant]

[hissing]

There are in fact two kinds of fricatives, and the features in (11) refer to the aerodynamic point of view and to the shape of strictures: [f] and [θ], for instance, are 'flat' or 'slit-like', or 'wide', that is, [-sibilant]; [s] [ʃ] [ʒ] are 'grooved' or 'narrow', that is, [+sibilant]. In addition, sibilants fall into two sub-classes: the 'hissing' and the 'hushing' type ([s] and [ʃ] [ʒ] respectively). Hushing sibilants are generally more retracted, and their channel is less narrow (Catford (1977: 154-155) and Malmberg (1979: 56)).

Table (12) provides the feature specifications of a few frequent types of fricative consonants:

(12)	[f]	[θ]	[s]	[ʃ]	[ʂ]	[ç]
[dental]	+	+	-	-	-	-
[coronal]	-	+	+	+	+	-
[sibilant]	-	-	+	+	+	-
[hissing]	-	-	+	-	-	-
[retroflex]	-	-	-	-	+	-
[dorsal]	-	-	-	-	-	+

[s] and [ʃ] may both be regarded as [+alveolar], in spite of a slight difference: [ʃ] is also palatalized (Malmberg 1971b: 73), and therefore [+palatal] (however, the contrast between [s] and [ʃ] is not solely a matter of secondary articulation: [s] can be palatalized (= [sʲ]), too, and remain distinct from [ʃ]). This possible contrast invalidates Lass's (1976: 188-89) proposal; for Lass, palato-alveolars are simply palatalized alveolars. In fact, palatalized alveolars and palato-alveolars constitute two different types, even though they may be acoustically very similar. In addition, hushing sibilants can be velarized, as in Russian: [ʃʷum] ('noise'). For such contrasts as those between [θ] and [s], the feature [sibilant] is certainly more important than the exact place of articulation (dental or alveolar; see Ladefoged (1975: 146-147)).

It should be added that in many phonemic systems, a subset of locational features is able to account for all underlying contrasts:

(1) Bilabials and labio-dentals are simply [+labial] in many (but not all) languages, because they are generally stops and continuants respectively: in the same way, the value of [dentall] is often conditioned by manner of articulation (in French, the stop [t] is [+dentall], but the continuant [s] is [+alveolar]).

(11) Very often, apicals and laminals do not contrast (see above); dentals and alveolars generally belong to the same class: see Malmberg (1971b: 75); other features condition details of articulation.

Of course, these phenomena are by no means universal: in Australian languages (Dixon 1980: 132-159), there is a contrast between apicals and laminals. In several Dravidian languages, there is a contrast between apico-dentals and apico-alveolars (Ladefoged 1971: 40), which invalidates the *SPE* feature *distributed* (Chomsky & Halle 1968: 312-314), since this feature, which refers to the length of the stricture, presupposes that dentals never contrast with alveolars, and that the relevant parameter is always the active articulator (that is, the apex or the blade, for instance). In Ewe, bilabial ([p] [β]) and labio-dental continuants ([f] [v]) contrast (Ladefoged 1971: 38).

As far as lip gestures are concerned, we must distinguish two different features:

(13) [labial]
[rounded]

The feature [labial] was mentioned in (6); it signals lip *compression*, while [rounded] refers to lip *protrusion*. In Swedish, some vowels are [+rounded] and [-labial] (/y:/), while others are [+rounded] and [+labial] (/ü:/; see Ladefoged (1971: 77, 78), Malmberg (1971a: 164-167; 1971b: 249-263), and Fant (1973: 185-198)).

III.1.4. Vowels

For vowels, we must add two parameters:

(i) tongue position

(ii) tongue height

Such features as [front], [central], [back] for the horizontal axis, and [high], [mid], [low] for the vertical axis, are quite straightforward (for four-way contrasts, we can resort to the features [high], [mid-high], [mid-low], and [low]). Note that these oppositions are scalar. When there are only two possible degrees at the underlying level for position or height, it is certainly permissible to define vowels with a single feature: [back], or [high]. So this system permits the description of two binary contrasts (in Turkish, for instance: see Deny (1955)), as well as of scalar contrasts, with the same features; but for three or more degrees, there will be one feature per degree, and of course only one *plus* value for both parameters will define phonemes in such cases (contrasts among vowels are thus 'privative' or 'gradual': these terms are borrowed from Trubetzkoy (1976: 76-77)). It is apparently more economical to define mid vowels, for example,

as [-high] and [-low], as in *SPE*, and to dispense with the feature [mid], but this would not conform to linguistic reality: scalar oppositions should not be treated as if they were privative. Besides, the *SPE* system rests on the very dubious idea of neutral positions of the tongue (Chomsky & Halle 1968: 304) and cannot account for systems with four or five degrees of vowel height, which are not rare (French is a case in point). Wang (1968) introduced two features, [high] and [mid], which are supposed to account for systems with four degrees of vowel height, but are not practical for the descriptions of three-way contrasts, and cannot account for five-way contrasts (for criticism of this proposal, see Sommerstein (1977: 102)). As to the feature *tense*, which is often used in descriptions of French and many other languages (see, for instance, Jakobson & Waugh (1979: 135-136, 152-153)), I have not adopted it, because it does not seem to correspond to any clear articulatory correlate: tenseness can often be recoded as a difference in height or length etc..(see Lass (1976: 39-50), and Catford (1977: 208) who writes: 'For vowels, the existence of such a parameter is dubious, and the use of tense/lax terminology in the phonetic description of vowels is seldom if ever necessary, and should be avoided'). As for 'tense' consonants, they are [+fortis] in my framework.

Let us note that affricates and diphthongs, for instance, can be treated as complex segments, that is, monophonemic sequences: affricates will thus be [+stop], with a double specification (see Sommerstein (1977: 104)). This solution is certainly superior to those which retain the feature *delayed release* or *gradual release* (Chomsky & Halle 1968: 318-322); specifying fricatives as [+delayed release] is phonetically meaningless.

We must also posit the following equivalences:

- (14) [+front & +high] = [+palatal & -retroflex]
 [+back & +high] = [+velar]
 [+velar] or [+uvular] or [+pharyngeal] = [+back]

But [-high] vowels are neither 'palatal' nor 'velar'. The equivalences allow us to capture some generalizations between vowels, semivowels, and consonants. These equivalences are necessary, insofar as I assume, as in traditional phonetics (see Fant (1973: 210-213)), that consonants and vowels are perceived through different channels. The features [palatal], [velar] etc... refer to a constriction, while the features [high] [back] etc... refer to formant structure. The terms *palatal* and *velar* should be applied only to the highest vowels [i] [u], but not to [e] [ɛ] [o] etc... as is argued by Ladefoged (1971: 79-80).

It can therefore be seen that the feature system which I adopt is very different from the phonetic framework of *SPF* (see Chomsky & Halle (1968: chapter 7)), particularly as regards locational features of consonants and vowels: for criticism of the *SPF* system, see Ladefoged (1971: chapter 10), Hagege (1976: 163-169), and Sommerstein (1977: 100-105). I have attempted to build a more realistic system, which is closer to phonetic facts; as for binarity, I regard it as 'ontological' for most parameters, but as purely methodological for locational features, because there are strong arguments for the approach which treats locational oppositions as scalar or equipollent (see Hyman (1975: 52-58), and Smith & Wilson (1979: 131-132)). In particular, it seems impossible to resort only to the *SPF* features [high], [low] and [tense] to account for vocalic systems such as that of Alsatian (Keller 1979: 123):

i: i y: y
 ɪ: ɪ ω: ω
 e: e ø: ø o: o
 ɛ: oe: oe
 a: a ɔ: ɔ

because the features [high] and [low] can yield only three degrees of vowel height, whilst the feature [tense] can theoretically account for differences in height or length, but not for both at the same time.

III.2. The consonant system of French

In French, we find the following locational classes:

- (15) (i) [+labial & -dental]: [p] [b] and [m]
 (ii) [+labial & +dental]: [f] [v]
 (iii) [+apical & +dental]: [t] [d] [n]
 (iv) [+apical & +alveolar]: [l]
 (v) [+coronal, -apical, +alveolar, & -palatal]: [s] [z],
 which are also [+sibilant & +hissing].
 (vi) [+coronal, -apical, +alveolar, & +palatal]: [ʃ] [ʒ],
 which are also [+sibilant & -hissing].
 (vii) [+dorsal & +palatal]: [j], which is often replaced by a
 sequence [n]+[j] (see Malmberg (1971b: 316-317)).
 (viii) [+dorsal & +velar]: [k] [g]
 (ix) [+dorsal & +uvular]: [R]

There are thus nine distinct points of articulation, but their number can probably be reduced in the underlying system if we eliminate redundancies (see SVIII.2.1). All consonants are [-vocalic] and [+consonantal]; note that these sounds have only one *plus* value for [labial], [coronal], and [dorsal], and only one *plus* value for the passive articulators, if we except [ʃ] [ʒ] which are [+alveolar] and [+palatal] (palato-alveolar). In Standard French, /R/ is [-vibrant] and [+sonorant], but there are other possible realizations of the French rhotic phoneme: [+vibrant & +apical] or [+uvular & +vibrant] or [+uvular & -sonorant] (for the standard realization, I shall use the symbol [R]). In the table below, other binary values are assigned to French consonants, or, more exactly, to their basic allophones (that is, their context-free variants):

(16)	p	b	m	f	v	t	d	n	l	s	z	ʃ	ʒ	p	k	g	R
[nasal]	-	-	+	-	-	-	-	+	-	-	-	-	-	+	-	-	-
[stop]	+	+	+	-	-	+	+	+	-	-	-	-	-	+	+	+	-
[sonorant]	-	-	+	-	-	-	-	+	+	-	-	-	-	+	-	-	+
[lateral]	-	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-
[voiced]	-	+	+	-	+	-	+	+	+	-	+	-	+	+	-	+	+
[fortis]	+	-	-	+	-	+	-	-	-	+	-	+	-	-	+	-	-

III.3. The vowels and semivowels of French

In French, there are three tongue positions: [front], [central] and [back], and four degrees of vowel height: [high], [mid-high], [mid-low], and [low]; of course, each vowel has only one *plus* value for tongue position or for tongue height.

(17) Oral vowels:

	[-back]		[+back]
[+high]	i	y	u
[+mid-high]	e	ø	o
[+mid-low]	ɛ	œ	ɔ
[+low]	a		ɑ

[-back] is strictly equivalent to [+front], or to [+central] in the case of [a], but at the underlying level, the feature [back] is sufficient. It should be added that for a large number of speakers, especially outside Paris, [ɑ] has merged with [a] (Walter 1977: 18).

(18) Nasal vowels:

	[-back]		[+back]
[+mid-low]	ɛ̃	(œ̃)	ɔ̃
[+low]			ɑ̃

In the North, [œ̃] has often merged with [ɛ̃] (Walter 1982: 106). In the South, it remains frequent (Walter 1982: 189-194), but the system is generally as follows:

(19)		[-back]	[+back]
	[+mid-high]	ɛ̃	
	[+mid-low]	œ̃	ø̃
	[+low]	ã	

For some speakers (in the South), [ã] can even be raised to [ẽ], while [ẽ] is raised to [ē] (Walter 1982: 189-194).

The semivowels [j] [w] [ɥ] are the [-vocalic] counterparts of [i] [u] and [y] respectively. They are therefore [+high]. [+high] vowels and semivowels can also be treated as [+palatal] or [+velar], according to the equivalences mentioned in (14); in addition, [ɥ] is [+labial & +palatal] while [w] is [+labial & +velar], since they are labial-palatal, and labial-velar approximants respectively.

Among vowels, there is a nasality contrast, as we have seen, but also a labialization contrast (for semivowels as well: see the tables above). As for schwa, I shall not regard it as a separate vowel from a phonetic point of view, because its realizations are never distinct from those of [ø] or [œ], at least for an increasing number of speakers (see Dell (1973a: 186-187) and Walter (1977: 51-52)); as we shall see later (Chapter IV), schwa is actually a [ø] or a [œ] which behaves in a peculiar way, but from a phonological point of view, rather than from a strictly phonetic point of

view. At this stage, it must be added that schwa is certainly not an indeterminate or reduced vowel in French, as some linguists claim (see Jakobson & Waugh (1979: 152), for instance): for Carton (1974: 63-64), 'Articulatoirement, la notation /ə/ ne convient guère, car elle désigne dans l'alphabet de l'A.p.i. la voyelle centrale et "neutre". Elle n'est nullement "indéterminée" en français'. Malmberg's (1971b: 339) view is similar: schwa 'n'est pas une voyelle réduite, de timbre et d'articulation imprécis [...], mais une voyelle pleine, tout aussi bien différenciée des autres que n'importe quelle autre voyelle, avec la seule particularité d'apparaître et de disparaître selon des règles qu'il reste encore à formuler de façon correcte'. Moreover, there is no contrast between *tense* and *lax* vowels in French: the presence of such features in some descriptions (see Jakobson & Waugh (1979: 135-136)) is perfectly *ad hoc* for phonetic reasons, as I have argued (see Catford (1977: 208)). It is clear that the contrast between /i/ and /e/ is of exactly the same nature as that between /e/ and /ɛ/, for instance: in both cases, it is a matter of tongue height.

IV

BASIC DATA

IV.1. Alternations

IV.1.1. Alternations between 'zero' and consonants

In French, a host of items present an alternation between 'zero' and a consonant; here are some typical examples:

il est petit [il ɛ pøti] ('it is small', masculine)

elle est petite [ɛl ɛ pøti] ('it is small', feminine)

un petit garçon [ø̃ pøti gaʀsø̃] ('a little boy')

une petite fille [yn pøti fi] ('a little girl')

un petit enfant [ø̃ pøti t ɑ̃fɑ̃] ('a little child', masculine)

une petite enfant [yn pøti ɑ̃fɑ̃] ('a little child', feminine)

il vend des bonbons [il vɑ̃ de bɔ̃bɔ̃] ('he sells sweets')

ils vendent des bonbons [il vɑ̃:d de bɔ̃bɔ̃] ('they sell sweets')

je vendais des bonbons [ʒø vɑ̃dɛ de bɔ̃bɔ̃] ('I sold sweets')

un marchand de vins [ø̃ maʀʃɑ̃ dø vɛ̃] ('a wine merchant', masculine)

une marchande de vins [yn maʀʃɑ̃:d dø vɛ̃] ('a wine merchant', feminine)

la marchandise [la maʀʃɑ̃di:z] ('goods')

il marchand [il maʁʃã:d] ('he bargains')

The morphemes *petit-*, *vend-*, and *marchand-* have two allomorphs:

- (i) A short allomorph: [pøti], [vã], [maʁʃã].
- (ii) A long allomorph: [pøtit-], [vãd-], [maʁʃãd-].

(We can neglect vowel length, which is purely allophonic, as well as the instability of schwa in *petit*, *petite*: [p(ø)ti], [p(ø)tit]: see §IV.2)

As regards the adjective *petit*, we observe that the feminine form is always pronounced [pøtit], whatever the phonological environment, but the masculine form is either [pøti] or [pøtit]. Its pre-pausal variant is [pøti], and the same (short) allomorph occurs before a consonant, but before a vowel, the feminine and masculine forms become homophonous: [pøtit] (= the long allomorph). The selection of the long allomorph before a vowel is known as *liaison*, but this term is reserved for a variation between 'zero' and a consonant in phonological contexts, all other things being equal (see Léon (1978: chapter 3)). *liaison* is therefore the proper term for the selection of the long allomorph in *un petit enfant*, but not for the same phenomenon in *une petite enfant*, because the pre-pausal variant of *petit* (masculine) is [pøti], while the pre-pausal variant of *petite* (feminine) is [pøtit]. If we examine surface data, *liaison* is the apparent addition of a final consonant before an initial vowel (the terms *addition* or *insertion* are here purely descriptive, and are appropriate only insofar as the pre-pausal variant is regarded as basic). For *une petite enfant*, the final consonant [t] is already present, and occurs every time the word is [+feminine]; in such

cases, French grammarians prefer the term *enchaînement* (see Fouché (1959: chapter 5), and Carton (1974: 87)), but note that *petit enfant* and *petite enfant* are perfectly homophonous, or at least that their segmental sequences are identical. Enchaînement means that the final consonant of a word forms a syllable with the initial vowel of the following word: *petite enfant* = [pø\$ti\$stã\$fã] (the symbol \$ denotes a syllable boundary). However, the syllable structure of *petit enfant* is (apparently) absolutely identical. This contradiction will be explained in Chapter VIII, when I study syllable structure; then, it will be shown that the traditional distinction between liaison and enchaînement is in fact justified. There are other examples of similar alternations in Dubois (1965: 69-72; 1967: 38-55), Martinet (1969b: chapter 6), Rigault (1971), and Pinchon & Couté (1981: 146-180).

As regards the item *vendre*, the examples show that its long allomorph appears in two different contexts (observe that verbs of the first conjugation (with the infinitive in *-er*), the only productive type, are not subject to such alternations):

(1) A morphological context: [+plural]

(1i) A phonological context: before a vowel-initial suffix.

(see Martinet (1969b: 105)).

The morpheme *marchand* in my examples above illustrates the same kind of alternation in derivational morphology: as usual, the masculine *marchand* has the short allomorph, and the feminine *marchande* has the long one, but the latter also appears before a vowel-initial suffix (*-ise*). As for the verb

marchander ('to bargain'), which is derived from the same root, it has the long allomorph [marʃäd] throughout its paradigm, whatever follows the stem (see Dubois (1967: 37-43)).

Alternations between a nasal vowel and a sequence of oral vowel plus nasal consonant are also very frequent; in similar fashion, we can talk of short and long allomorphs, which appear to have exactly the above-mentioned distributions:

un bon garçon [õe bõ gaRsõ] ('a good boy')

une bonne fille [yn bõn fij] ('a good girl')

un bon enfant [õe bõn äfä] ('a good child', masculine)

une bonne enfant [yn bõn äfä] ('a good child', feminine)

il peint [il pẽ] ('he paints')

ils peignent [il peɲ] ('they paint')

nous peignons [nu peɲõ] ('we paint')

peindre [pẽdR] ('to paint')

frein [fRẽ] ('brake')

freiner [fRene] ('to brake')

il freine [il fRen] ('he brakes')

divin [divẽ] ('divine', masculine)

divine [divin] ('divine', feminine)

divinité [divinite] ('divinity')

IV.1.2. Vowel alternations

The (apparent) addition of a consonant can cause vowel alternations:

berger [bɛRʒɛ] ('shepherd'), *bergère* [bɛRʒɛ:R] ('shepherdess'),

with an alternation [ɛ] ~ [ɛ]

sot [sɔ] ('stupid', masculine), *sotte* [sɔt] ('stupid', feminine),

with an alternation [ɔ] ~ [ɔ̃] (see Dubois (1965: 70)).

But as [ɛ] can be word-final, and as [ɔ] is allowed in checked syllables, these two vowels can be invariant (see Walter (1977: 39-45) and Léon (1978: 43-61)):

secret [sɛkRɛ] ('secret', masculine), *secrète* [sɛkRɛt] ('secret', feminine)

gros [gRɔ] ('big', masculine), *grosse* [gRɔ:s] ('big', feminine)

haut [o] ('high', masculine), *haute* [o:t] ('high', feminine)

Note that [ɛ] is disallowed in checked syllables, while [œ] and [ɔ̃] are disallowed before a word boundary. Generally, [ɔ] is lowered to [ɔ̃] before a final [t] in the feminine (*haute* is rather exceptional in this respect: see Grevisse (1980: 228)); when the masculine allomorph ends in [ɛ], it is usually [R] which is added in the feminine. As for final [ø], it is always invariant:

heureux [œRø] ('happy', masculine), *heureuse* [œRø:z] ('happy', feminine)

(for generalizations concerning consonantal and vocalic alternations, see Tranel (1981: 254-263)).

In all these examples, the addition of the final consonant is apparently conditioned by the morphological feature [+feminine] (once more, this analysis is only provisional; this hypothesis may prove incorrect, of course). It causes modifications only among mid vowels. As for the change from a nasal vowel to a sequence of oral vowel plus nasal consonant, in the same context, it causes two sorts of vocalic modification:

(i) The vowel is denasalized.

(ii) The denasalized variant is not necessarily the oral counterpart of the word-final nasal consonant of the masculine form, as appears below (see Fouché (1959: 435-436), and Rigault (1971: 86-87)):

<i>Masculine:</i>	<i>Feminine:</i>
<i>bon</i> [bõ]	<i>bonne</i> [bɔn] ('good')
<i>brun</i> [brœ̃]	<i>brune</i> [brɥn] ('brown')
<i>plein</i> [plɛ̃]	<i>pleine</i> [plɛn] ('full')
<i>fin</i> [fɛ̃]	<i>fine</i> [fin] ('thin')
<i>sultan</i> [syltã]	<i>sultane</i> [syltan] ('sultan', 'sultan's wife')

However, [œ̃] always alternates with [yn], [õ] with [ɔn], and [ã] with [an] (we know that [ã] is [+back], while [a] is [-back]), but [ɛ̃] alternates either with [ɛn] or [in]. For many speakers (see §III.3), [œ̃] has merged with [ɛ̃] (<[œ̃] > [ɛ̃]); for them, [ɛ̃] alternates with [ɛn] [in] or [yn].

The items above (*bon, brun, etc...*) as well as *berger, bergère, sot, sotté*, illustrate vowel alternations in gender inflection, that is, when the addition of a consonant corresponds to a morphological rule of feminine formation. An additional consonant is also found in liaison forms; in the next examples, the changes are absolutely identical:

bonne [bɔ̃n] ('good', feminine)

un bon ami [ɔ̃ bɔ̃n ami] ('a good friend', masculine)

divine [divin] ('divine', feminine)

le divin enfant [lə divin ɛ̃fɑ̃] ('the divine child', masculine)

(The masculine pre-pausal variants being [bɔ̃] and [divɛ̃])

secrète [sɛ̃kʁɛt] ('secret', feminine)

un secret espoir [ɔ̃ sɛ̃kʁɛ t ɛspwaʁ] ('a secret hope', masculine)

(see Rigault (1971: 87)).

However, a liaison consonant may have different effects from a consonant added to form the feminine. Consider the examples below:

commune [kɔ̃myɛn] ('common', feminine)

un commun accord [ɔ̃ kɔ̃mɔ̃n akɔ̃ʁ] ('a common agreement', masculine)

première [pʁɛmjɛʁ] ('first', feminine)

un premier enfant [ɔ̃ pʁɛmjɛ R ɛ̃fɑ̃] ('a first child', masculine)

(The masculine pre-pausal variants being [kɔ̃mɔ̃ɛ] and [pʁɛmjɛ])

In liaison, it appears that there are two sets of vowels:

(i) Vowels which are never altered when the connective consonant is added: this set comprises all oral vowels as well as [õé] and [ã].

(ii) Vowels which may be altered, but not necessarily: the nasal vowels [õ] and [ẽ] (see Fouché (1959: 435-436)).

It should be added that, more generally, nasal vowels are never affected by the addition of an *oral* consonant:

grand [gRã] ('large')

un grand espace [õé gRã t ɛspas] ('a large space')

The vowels of *commun* ('common'), *premier* ('first') (see above), *chez* (*chez moi* = 'at home'), *léger* ('light', 'slight'), *mon* ('my'), *un* ('a', 'one') in our examples are not affected by liaison:

chez [ʃe] (see above)

chez un ami [ʃe z õé n ami] ('at a friend's place')

léger [leʒe] (see above)

un léger ennui [õé leʒe R ɛnyi] ('a slight trouble')

mon [mõ] (see above)

mon avion [mõ n avjõ] ('my plane')

un [õé] (see above)

un ami [õé n ami] ('a friend')

However, the vowels of *plein*, *bon*, for instance, are:

plein [plɛ̃] ('full')

le plein emploi [lø plɛn ɛ̃plwa] ('full employment')

bon [bɔ̃] ('good')

un bon emploi [ɔ̃ bɔ̃n ɛ̃plwa] ('a good job')

For the items *commun*, *premier*, *chez*, *léger*, *mon*, *un* etc... liaison consists of the addition of an oral or a nasal consonant, without any vocalic modification; in such cases, the masculine form in liaison contexts is not homophonous with the feminine form:

<i>Masc. (pre-pausal)</i>	<i>Feminine</i>	<i>Masc. (liaison context)</i>
[kɔ̃mɔ̃]	[kɔ̃mɔ̃n]	[kɔ̃mɔ̃n-] ('common')
[pʁɔ̃mjɛ]	[pʁɔ̃mjɛR]	[pʁɔ̃mjɛR-] ('first')
[leʒɛ]	[leʒɛR]	[leʒɛR-] ('slight')
[ɔ̃]	[yn]	[ɔ̃n-] (a', 'one')

The distribution of allomorphs is different in other paradigms:

<i>Masc. (pre-pausal)</i>	<i>Femin./Masc. (liaison context)</i>
[pɔ̃ti]	[pɔ̃ti] ('small')
[bɔ̃]	[bɔ̃n] ('good')
[plɛ̃]	[plɛ̃n] ('full') etc...

Let us note that adjectives or noun modifiers whose pre-pausal masculine forms end in a nasal vowel fall into two classes:

- (i) *mon, ton, son, ancien, un, commun* etc... (respectively: 'my', 'your', 'his' or 'her', 'old', 'one', 'common') whose final vowel is not modified in liaison, although the connective consonant is [n].
- (ii) *bon, plein, moyen, divin, etc...* (respectively: 'good', 'full', 'average', 'divine') whose feminine forms and masculine forms in liaison contexts are homophonous (that is, whose vowels are denasalized both in gender inflection and in liaison).

We can observe a certain degree of fluctuation (see Fouché (1959: 435-436) and Grammont (1966: 134)): some speakers tend to denasalize the vowels of the items listed in (i) above, in liaison contexts; denasalization is very variable, from speaker to speaker, and from item to item:

mon ami [mõ n ami] ('my friend'), and more rarely: [mɔn ami] etc...

Denasalization is much more frequent in Southern French, where it can affect even items in [õê]:

commun accord [kɔmõ n akɔR] or [kɔmoen akɔR] ('common agreement')

This example provides evidence that denasalization of the items of the first class -- that is, in (i) above -- does not imply that feminine forms and masculine forms in liaison contexts are homophonous in all cases; compare *commun accord* with *commune action* [kɔmyn aksjõ] ('common action').

Invariable items normally belong to the same class as *mon*, *ton*, *son* etc... :

on arrive [ɔ̃ n aRiv] ('we come'), *bien habillé* [bjɛ̃ n abiʒe] ('well dressed').

In certain idiolects or dialects, the addition of a connective [R] can also lower [e] to [ɛ]; we find the same fluctuation in textbooks:

-- According to Fouché (1959: 435), connective consonants have no effect on the preceding oral vowel, except for items in *-er*, *-ier*:

un léger ennui [œ̃ leʒɛ R ɛ̃nyi]

-- For Léon (1978: 122), 'En général la liaison n'a pas d'effet sur la voyelle précédente':

dernier étage [dɛRnje R eta:ʒ] ('upper floor') (pre-pausal variant: [dɛRnje]).

My own observations and intuitions favour Léon's view as against Fouché's, although before [R], speakers find it difficult to perceive a difference between [e] and [ɛ]. For most speakers, [e] is not lowered, but it must be stressed that there is considerable variation in the data.

IV.1.3. Liaison, inflection, and derivation

The same items may be subject to liaison, and also to the addition of a consonant in inflection and in the formation of derived words:

<i>Masc. (pre-pausal)</i>	<i>Masc. (liaison)</i>	<i>Feminine</i>	<i>Derived words</i>
<i>petit</i> [pøti]	[pøtit-]	[pøtit]	<i>petitesse</i> [pøtites]
<i>léger</i> [leze]	[lezeR-]	[lezεR]	<i>légèreté</i> [lezεRte]
<i>trois</i> [tRwa]	[tRwaz-]		<i>troisième</i> [tRwazjem]
<i>divin</i> [divě]	[divin-]	[divin]	<i>divinité</i> [divinite]

(*trois* = 'three', and the derived items mean 'smallness', 'slightness', 'third', and 'divinity', respectively. In the examples below, *connaître*, *vendre*, *battre* mean 'to know', 'to sell', and 'to beat' respectively. The derived items mean 'knowledge', 'seller', 'beat', respectively).

<i>Present ind. sing</i>	<i>Present ind. plur.</i>	<i>Derived words</i>
(il) <i>connait</i> [kɔne]	(ils) <i>connaissent</i> [kɔnes]	<i>connaissance</i> [kɔnesã:s]
(il) <i>vend</i> [vã]	(ils) <i>vendent</i> [vã:d]	<i>vendeur</i> [vãdoe:R]
(il) <i>bat</i> [ba]	(ils) <i>battent</i> [bat]	<i>battement</i> [batmã]

It is generally the *same* consonant which is added in all contexts, as is illustrated in the examples above. However, the set of connective consonants is rather limited, and we can observe the following correspondences (consonants other than [t] [z] [n] can appear in liaison, but these correspondences suffer no exception):

<u>Inflection, derivation</u>	<u>Liaison</u>
[t], [d]	correspond to [t]
[s], [z]	correspond to [z]
[n], [ɲ]	correspond to [n]

and [ʀ] in inflection and derivation corresponds to [ʀ] in liaison:

grand (masc.): [gʀɑ̃], and in liaison: [gʀɑ̃t-] ('large')

grande (femin.): [gʀɑ̃:d] ('large')

gros (masc.): [gʀo], and in liaison: [gʀoz-] ('big')

grosse (femin.): [gʀo:s] ('big')

The only really frequent connective consonants are [t] [z] and [n]; [ʀ] is rather rare; [p] is added to only two items: *trop* ('too much') and *beaucoup* ('much, many'). Liaison in [k] has practically become obsolete in Modern French: *long ennui* [lɔ̃ k ɑ̃ni] or [lɔ̃ ɑ̃ni] ('long grief') (some speakers add a connective [g] instead of [k] in such cases). A connective [n] is allowed only after words whose pre-pausal variants end in a nasal vowel but the reverse is not true: oral consonants can be added after nasal vowels (cf. *grand*).

Thus far, I have mentioned examples of liaison in the singular, or with invariable items:

dans un mois [dã z œ mwa] ('within a month') (pre-pausal variant: [dã])
petit ami [pøti t ami] ('boy friend') (pre-pausal variant: [pøti])

But connective consonants can also function as morphological signs; such signs are only indirect, since they appear in specific phonetic contexts; so they cannot be regarded as the regular, invariant manifestations of morpho-syntactic categories:

petits avions [pøti z avjõ] ('small planes')
premiers enfants [pRømje z äfã] ('first children')
petites élèves [pøtit z elev] ('little schoolgirls')
premières années [pRømjeR z anel] ('first years')

The only obligatory liaison which is at the same time the (indirect) implementation of a morpho-syntactic category is plural liaison in [z]. The alternation can affect masculine, but also feminine forms, as shown in the preceding examples, while in the singular, liaison affects the former, but not the latter. In the plural, the connective [z] is added to the pre-pausal form (in liaison contexts, of course) without any other modification:

bons avions [bõ z avjõ] ('good planes') (pre-pausal form: [bõ])
bonnes élèves [bõn z elev] ('good schoolchildren') (pre-pausal form:
 [bõn])
légers effets [leze z efe] ('slight effects') (pre-pausal form: [leze])

légères améliorations [lezɛR z amelʝɔRasjõ] ('slight improvements')

(pre-pausal form: [lezɛR])

(While Fouché (1959: 435) claims that a connective [R] modifies the quality of [e], he writes that 'on continue à prononcer un [e] dans *de légers ennuis*').

For many adjectives or noun modifiers, two connective consonants alternate in the singular and in the plural, provided they are not feminine:

petit ami [pɛti t ami] ('boy friend')

petits amis [pɛti z ami] ('boy friends')

Here, the connective [t] signals that the string is [-plural]. In the feminine, the plural sign [z] alternates with 'zero' in the singular:

petite amie [pɛtit ami] ('girl friend')

petites amies [pɛtit z ami] ('girl friends')

This time, [t] is not a connective consonant (cf. §IV.1.1): it is the surface implementation of the feature [+feminine]. Some items are subject to liaison, but only in the plural:

un joli enfant [õ zɔli ɛfã] ('a nice-looking child')

de jolis enfants [dø zɔli z ɛfã] ('nice-looking children')

(these words have the same allomorphs in the masculine and in the feminine).

If we regard short allomorphs as basic, it is obvious that the only really predictable consonant which is added in the formation of the long allomorphs is the plural connective sign [z]. The following examples of gender inflection illustrate the unpredictability of the consonants added in this context:

<i>Masculine</i>	<i>Feminine</i>
[pøti]	[pøtit] ('small')
[gRi]	[gRi:z] ('grey')
[zɔli]	[zɔli] ('pretty')
[bø]	[bɔn] ('good')
[søgø]	[søgø:d] ('second')
[lø]	[lø:g] ('long')

Moreover, many adjectives have homophonous masculine and feminine forms:

joli [zɔli] ('pretty'); *rapide* [Rapid] ('rapid'); *cher* [ʃe:R] ('dear')
noir [nwa:R] ('black') etc...

The examination of surface forms induces me to posit several inflectional classes, unless complementary data contradict this first conclusion. The question is: 'Are there deeper regularities which are obliterated by the effect of phonological rules? Are deep forms more regular than surface forms?' I shall attempt to answer this question in the next chapters.

IV.1.4. Liaison and surface generalizations

Liaison poses specific problems because two surface generalizations which are otherwise exceptionless are apparently violated when a connective consonant is added; these surface generalizations are:

(i) A word-final or a morpheme-final [n] is never preceded by a nasal vowel.

(ii) The vowel [e] never precedes a word-final consonant or semivowel.

The final [e] of *premier* ('first'), for instance, is lowered to [ɛ] in the feminine, when the final [R] is added: *premier* [pRømjɛ], *première* [pRømjɛR]. The nasal vowel of *plein* ('full') is denasalized when a final [n] is added in the feminine: *plein* [plɛ̃], *pleine* [plɛn]. We can therefore formulate the following surface phonetic constraints:

(R.1) [+vocalic][n]{+ or #}
 ↓
 [-nasal]

(R.2) * [+vocalic & +mid-high & -rounded][-vocalic]#

Apparently, these two constraints are not respected in the following examples:

chez eux [ʃe z ø] ('in their house'); *léger ennui* [leʒe R ɛnui] ('slight trouble'); *premier enfant* [pRømjɛ R ɛfɑ̃] ('first child'); *mon ami*

[mɔ̃ n ami] ('my friend'); *un obstacle* [œ̃ n ɔbstakl] ('an obstacle')

These violations of (R.1) and (R.2) are puzzling. On the other hand, such strings as *légers effets* [leʒe z efe] ('slight effects') can be accounted for if we assume that [z] is an inflectional affix which is preceded by an internal word boundary (#): [leʒe#z#efe]

IV.1.5. Liaison contexts

The question of the phonological environments in which the alternants are distributed must be examined in a more precise way. Connective consonants occur:

(i) After vowels.

(ii) After consonants or semivowels.

The following examples illustrate this:

il est ici [il ɛ t isi] ('he is here'); *toujours à l'heure*

[tuʒuʀ z a loe:ʀ] ('always on time'); *on arrive* [œ̃ n aʀi:v] ('we are

coming'); *ils arrivent* [il z aʀi:v] ('they are coming')

So the context preceding the connective consonant is not decisive. A connective [z] occurs frequently after another consonant. However, after invariable words, or after adjectives and noun modifiers in the masculine singular, the connective consonant usually follows a vowel.

It is certain that the environment following the consonant plays a crucial role; liaison applies before:

(i) Initial vowels.

(ii) Initial semivowels (the approximants [j] [w] [ɥ])

as appears in the following examples:

c'est un idiot [s ε t œ̃ n idjo] ('he is stupid'); *c'est un oiseau*

[s ε t œ̃ n wazo] (with a connective [n] between the determiner and the noun).

But liaison never applies before initial consonants. The problem is that words with initial semivowels fall into two categories:

(i) Some, like *oiseau* [wazo] ('bird'), admit liaison.

(ii) Others, like *whisky*, inhibit it: they are *disjunctive*.

So disjunctiveness characterizes items which prevent the application of liaison. Of course, consonant-initial items are automatically disjunctive, but as regards other items, disjunctiveness is largely an idiosyncratic property -- the only possible generalization concerns foreign words with initial semivowels, which belong automatically to the second category; but native items may also be disjunctive: *des petites hyènes* ('small hyenas'), without liaison before the noun. We can even observe variation; some words are optionally treated as disjunctive or non-disjunctive: *hyène*, *ouate* ('cotton wool'), *hiatus* ('hiatus') etc... (*hiatus* is treated as non-disjunctive

in several dictionaries, while in actual speech, I have observed that it is disjunctive for most -- if not nearly all -- speakers (the semantic content of the item may influence them).

The so-called *H-aspiré* words, whose initial segment in phonetic representations is [+vocalic], inhibit liaison; they appear to constitute exceptional environments. They are disjunctive vowel-initial words:

grands héros [gRÄ eRo] ('great heroes'), *petits hangars* [pøti äga:R]
 ('small sheds'), *grands hêtres* [gRÄ etχ] ('big beech trees') ([χ] is the unvoiced variant of the phoneme /R/ between an unvoiced obstruent and a word boundary)

We can even find minimal pairs, such as *être* ('being') and *hêtre*, which have identical surface forms: [etχ]; the former is not disjunctive, but the latter is.

Connective consonants can appear after practically all grammatical categories:

- Prepositions and conjunctions: *dans un mois* ('within a month')
- Adverbs: *très intelligent* ('very clever')
- Adjectives: *un gros avion* ('a big plane')
- Modifiers: *mes amis* ('my friends')
- Pronouns: *elles ont raison* ('they are right')
- Verbs: *l'aime-t-elle?* ('does he love her')
- Nouns: *des prix élevés* ('high prices')

But liaison is obligatory only after the first six categories listed above, as well as after verbs when these are immediately followed by a clitic (verb plus clitic sequences are limited to interrogative and imperative forms):

prend-il? ('does he take') (connective [t])

joue-t-il? ('does he play') (" " ")

donne~~s~~-en ('give some') (" " [z])

va~~s~~-y ('go on') (" " ")

Liaison is optional, and rather frequent, after some forms of *être* ('to be') and *avoir* ('to have'). It is optional and stylistically marked:

(i) After other verb forms, such as infinitives in *-er* (liaison in [R]).

(ii) After nouns, in the plural:

ils veule~~n~~t aller au bal ('they want to go to the ball')

des boi~~s~~ immenses ('immense forests')

After nouns, in the singular, liaison is ruled out; we can find minimal pairs, as is well known (see Grammont (1966: 132)):

(a) *un savant aveugle* [œ savã avoegl] ('a blind scientist')

(b) *un savant aveugle* [œ savã t avoegl] ('a learned blindman')

Liaison occurs in the adjective plus noun sequence (= (b)), but not in the noun plus adjective sequence (= (a)). It is never possible in the following examples:

il est petit, alors ('he is really small'), or: *souvent, il vient*
('he often comes')

that is, at the end of what I shall call an *intonational phrase* (see Chapter VIII, p.392). It is also disallowed after sequences of verb plus clitic:

viennent-ils aussi? ('do they also come?'); *fais-les entrer* ('show them in')

But, as we have seen, it is obligatory *within* such sequences; It should be added that in marked styles, it is allowed after *nous, vous* ('we', 'you'): see Fouché (1959: 454).

The optionality of liaison can be due to grammatical factors, as in *ils veulent aller au bal*, but it can also be lexically idiosyncratic; in the same grammatical and phonological contexts, liaison is obligatory after some invariable words: *dans* ('in'), *on* ('people'), *très* ('very') etc... but optional after others: *pas* ('not'), *fort* ('very'), *toujours* ('always'), *après* ('after'), *trop* ('too much'), *beaucoup* ('much'), *assez* ('enough') etc... and we can be sure that this is subject to strong idiolectal variation (speakers' stylistic judgments may also differ).

Thus far, we have examined the behaviour of words in liaison contexts, and it is clear that connective consonants appear neither before another consonant nor before a pause; some words, however, behave in a peculiar way: numerals, for instance. Some numerals have two allomorphs, and follow the general pattern:

trois [tRwa] ('three'), *trois garçons* [tRwa gaRsõ] ('three boys'), *trois amis* [tRwa z amil] ('three friends')

cinq ('five') and *huit* ('eight') also have two allomorphs, but their distribution is different: the long allomorph appears in liaison context, but also before a pause or when the numeral is stressed. The short allomorph appears before consonants and disjunctive items:

huit [yit] ('eight'), *huit sont venus* [yit sõ vøny] ('eight of them have come'); *huit amis* [yit amil] ('eight friends'), *huit garçons* [yi gaRsõ] ('eight boys')

It is true that more and more speakers tend to use the long allomorph of *cinq* even before a consonant or a disjunctive item; one can also observe the same tendency with *huit*, although less frequently (it is probably a case of analogical extension, and of reduction of allomorphy. There may also be a perceptual factor; the presence of the final consonant certainly increases the intelligibility of those very short items).

six ('six') and *dix* ('ten') behave in a more complex way; they have three allomorphs: the short allomorphs [sil] [dil] occur before consonants and

disjunctive items; the long allomorphs [sis] [dis] occur before a pause or when the words are stressed; the long allomorphs [siz] [diz], with a voiced final consonant, appear in liaison context:

six garçons [si gaʁsɔ̃] ('six boys')

ils sont dix [il sɔ̃ dis] ('there are ten of them')

six amis [si z ami] ('six friends')

The alternation between [s] and [z] is reminiscent of the same alternation in the paradigm of *gros, grosse* ('big', masculine and feminine) -- [z] in liaison, and [s] in the feminine form -- but the contexts are of course different for the numerals.

IV.1.6. Liaison and suppletion

The feminine forms of the following adjectives or noun modifiers are clearly suppletive: *nouveau* ('new'); *beau* ('beautiful'); *fou* ('crazy'); *mou* ('soft'); *vieux* ('old'); *ce* ('this'). Synchronically, it seems difficult to posit natural rules relating the masculine and feminine forms (rules might relate some of the following pairs, but they are certainly not phonetically conditioned):

nouveau, nouvelle; beau, belle

mou, molle; fou, folle

vieux, vieille; ce, cette

The phonetic representations of these items are respectively: [nuvɔ], [nuvɛl]; [bɔ], [bɛl]; [mu], [mɔl]; [fu], [fɔl]; [vjø], [vjɛj]; [sø], [sɛt].

What is interesting is that in liaison contexts (in the singular) masculine and feminine forms are homophonous (but not in the plural, of course):

un nouvel arrivant [œ̃ nuvɛl aRivã] ('a newcomer')

un bel enfant [œ̃ bɛl ɛ̃fã] ('a pretty child')

un vieil ami [œ̃ vjɛj ami] ('an old friend')

But:

de beaux enfants [dø bo z ɛ̃fã] ('pretty children')

Many items present an alternation between [f] and [v]: *vif*, *vive* ('quick', masculine and feminine); *neuf*, *neuve* ('new') etc... but in liaison contexts, the masculine form remains unchanged, as in *un vif étonnement* ('a big surprise'), whose phonetic representation is [œ̃ vif etɔnmã]; it seems that this alternation, without being really productive in the usual sense, falls outside the scope of suppletion, as far as all existing adjectives in [f] have their feminine form in [v]. Other alternations are more isolated: *sec*, *sèche* ('dry', masculine and feminine), for instance; the alternation between [k] and [ʃ] affects this single item.

IV.2. The problem of 'schwa'

IV.2.1. Schwa and abstractness

The importance of this problem is absolutely crucial in generative phonology, as will become obvious in the next chapter. Much depends on the proper interpretation of the data. Before proceeding further, it must be specified that considerations of style will also play a crucial role (see Domingue (1974)). Results will also be different if one adopts a pandialectal approach, that is, if one considers that underlying representations are identical in all regional varieties, and that phonetic differences are merely superficial and are governed by low-level rules; this pandialectal approach characterizes Schane's (1968) work, for instance. Various serious objections can be levelled against such an abstract approach which obliterates the importance of stylistic and regional variation. For Linell (1979: 62), 'The generative integrated pandialectal model is not psychologically valid'.

IV.2.2. Schwa in Standard French

I shall now describe the data in the variety known as Standard French (see Léon (1978)), and in careful style, which excludes variants occurring only in artificial styles, such as hypercorrect speech, or poetic diction: these variants are never elicited in normal, natural situations, such as conversations, spontaneous forms of speech, etc...

Schwa is the vowel which is usually represented in textbooks or dictionaries by the symbol [ə]. Yet, in spite of this usage, which is misleading, it is not a 'lax' vowel (see the discussion in SIII.3); its quality is not indeterminate, contrary to some frequent assertions. It is definitely a front mid rounded vowel, acoustically very similar to [ø] or [œ] (see Blichler-Labaeye (1970), for an instrumental study), when it is distinct from them; then, it is probably a little higher than [œ]. But for more and more speakers, schwa has completely merged with [ø] or [œ], and is no longer a separate vowel (see SIII.3): this is why I do not regard it as a different phoneme, but rather as a [ø] or [œ] behaving in a peculiar way, and corresponding to the grapheme *E*; besides, what often characterizes schwa is its instability (note that in some areas, speakers prefer the variant [ø] in free syllables, and in other areas, they prefer [œ] in the same context: *je* ('I') = [ʒø] or [ʒœ]).

Schwa never appears after another vowel, or in word-initial position; we can find it in the following contexts:

(i) In initial syllables of polysyllables:

petit ('small'), *secret* ('secret'), *pelouse* ('lawn')

(ii) In monosyllables:

le ('it'), *me* ('me'), *ne* (negative particle), *te* ('you')...

(iii) In internal syllables:

il restera ('he will stay'), *il parlera* ('he will speak'),

recevoir ('to receive'), *devenir* ('to become')

(iv) In final syllables:

une autre personne ('another person'), *un film[ø] slave*

('a Slavonic film') (in the last example, schwa corresponds to no grapheme at all).

There are strong restrictions on the occurrences of schwa in internal and final syllables of polysyllables. In internal syllables, it is disallowed in the following context: VC_C, except if V is itself an unstable schwa:

recevoir [R(ø)s(ø)vwa:R] ('to receive'), *devenir* [d(ø)v(ø)ni:R]

('to become')

but:

souvenir [suvni:R] ('souvenir'), *décevoir* [desvwa:R] ('to disappoint')

samedi [samdi] ('saturday'), *médecin* [medsɛ̃] ('doctor')

ennemi [ɛnmi] ('enemy'), *caneton* [kantø] ('duckling') (In the phonetic representations, the parentheses mean that schwa can be dropped).

It should be added that [ø] or [œ] are perfectly possible in the context VC_C, provided they correspond to the grapheme *EU* (≠ schwa). The following pronunciations of the same items are possible, but are clearly artificial in Standard French: [suvøni:R] [samødi] [medøɛ̃] [ɛn*mi] [kanøtø]; they characterize hypercorrect reading style, or artificially syllabated speech: so I shall regard them as linguistically marginal (such pronunciations are normal in Southern French, but we are now concerned with Standard French).

On the other hand, schwa in internal syllables is allowed in the context

CC_C:

appartement ('flat'), *débarquement* ('landing'), *justement* ('rightly'),
vertement ('sharply'), *tristement* ('sadly'), *il restera* ('he will stay'),
il parlera ('he will speak').

Schwa is obligatory (stable) in the first five items, but is unstable (and often dropped) in the two verb forms. Compare the two future verb forms above with those below:

il chantera [il ʃɑ̃tRa] ('he will sing'), *il aimera* [il emRa] ('he will like').

After only one consonant, schwa is disallowed. Note also that its occurrence is only optional after two consonants in verb forms before the affix /+R+/. We can also compare the adverbs above, in which schwa is obligatory after two consonants for most speakers (but not all), with those below, where it is disallowed:

intimement [ɛ̃timã] ('intimately'), *bêtement* [betmã] ('stupidly') (The grapheme *E* is not 'sounded').

In final syllables, or, in other terms, in word-final position, schwa is ruled out if a pause follows; however, it appears frequently in the following context: CC_#C. In such cases, it breaks a consonant cluster (although its appearance is not obligatory):

un film slave [œ̃ film^h sla:v] ('a Slavonic film')

ne reste pas [nø Rest^h pa] ('do not stay')

apporte-la [apɔRt^h la] ('bring it')

(In these phonetic representations, final [ø] is not stressed, and the penultimate syllable of the words is prominent)

Note that schwa is probably epenthetic in the context CC_#C, since its insertion is automatically conditioned by the consonantal environment and since it does not necessarily coincide with an orthographic schwa (that is, the grapheme *È*); epenthesis, however, is optional.

In the context VC_#CV, schwa is disallowed in natural speech. Schwa appears variably before *H aspiré* (that is, disjunctive vowels: see SIV.1.5) in non-initial syllables:

quelle honte [kœl^h ø:t] ('what a disgrace')

légère hausse [lezœR^h o:s] ('slight rise')

courte halte [kuRt^h alt] ('short stop')

immense hangar [imãs^h äga:R] ('huge shed')

It must be noted that the occurrence of schwa is not always phonologically predictable:

cette haine [set^h œn] ('that hatred')

sept héros [set eRo] ('seven heroes')

It is true that, in this context, schwa can be grammatically predicted at the end of [+feminine] adjectives or noun modifiers. Note also that *cette* ('this', feminine) has a final orthographic schwa, while *sept* ('seven') has not. Yet a rule of epenthesis before *H aspiré* would not be automatic, and would necessitate lexical marking (but this does not mean that this solution is not correct).

In the same context as for liaison, the schwa of monosyllables is elided:

l'ami [l ami] ('the friend'), *l'avion* [l avjɔ̃] ('the plane').

This effacement is absolutely obligatory before non-disjunctive vowels and semivowels (see §IV.1.5). Yet a post-verbal clitic, or a stressed monosyllable, are not elided:

laisse-le entrer ('let him in')

Elision must be carefully kept distinct from the optional deletion of schwa before [-vocalic] segments; this rule affects the unstable schwa of initial syllables, internal syllables, or monosyllables:

la fenêtre [la fnetʀ] ('the window'), *le whisky* [l wiski]

recevoir [ʀɛsvwa:ʀ] or [ʀsɔvwa:ʀ] ('to receive')

Schwas which are subject to elision happen to be unstable before consonants and semivowels, but the two processes are distinct, and their stylistic

values are different (elision is obligatory, but the other process is optional). We must observe that the schwa of monosyllables cannot be dropped before *H aspiré* (that is, before disjunctive vowels):

le héros *[l eRɔ] ('the hero'), *le hasard* *[l azaR] ('chance')

In *l'oiseau* ('the bird'), schwa is deleted by the obligatory elision rule before a non-disjunctive semivowel, while in *le yod* ('the yod'), it may be deleted by the optional rule before a disjunctive semivowel:

l'oiseau [l wazo], *[lɔ wazo], *le yod* [l(ə) jɔd]

Deletion is impossible in the following contexts:

(i) [-sonorant][R or l]_[+ or #]

(ii) [-vocalic]_[R or l][j]

The following forms exemplify these rules:

nous céderions [nu sɛd^əRjɔ̃] ('we would yield')

nous appelions [nu z apɔljɔ̃] ('we called')

il montrera [il mɔ̃tR^əRa] ('he will show')

So in those contexts, schwa is necessarily stable. Some schwas are also immune from deletion before [-vocalic] segments even though their deletion is expected: *peler* [pɔ̃le] ('to peel'), *belon* [bɔ̃lɔ̃] ('belon oyster'), since such words have an orthographic schwa (the grapheme *E*). However, if schwa

and [ø] are not distinct units (see §III.3), the rule deleting [ø] cannot be general: in this sense, *peler*, *belon* etc... are exceptional only if we take orthography into account. From a strictly phonetic point of view, *peler*, *belon* behave exactly like *feuler* ('to growl'), for instance, with the grapheme *EU*, and not the grapheme *E*. No phonetic generalization can be drawn since the schwa of *pelouse* ('lawn'), for instance, is unstable in the same environment: [+labial]_[-l].

It is clear that schwas (that is, [ø] or [œ], corresponding to the grapheme *E*) fall into two arbitrary classes:

- (i) Those which can be deleted.
- (ii) Those which cannot be deleted, and are stable.

Besides, the distinction between stable schwas and [ø] or [œ] is purely orthographic, and rests on no decisive phonological basis: the former are represented by the grapheme *E*, and the latter by the grapheme *EU*.

In traditional descriptions, schwa is usually called *E muet* or *E caduc* (see Carton (1974: 63-64)); I suggest that we should keep the two terms, but they should not be regarded as equivalent: *E caduc* should mean that schwa is present in the underlying representation, but is subject to optional deletion (unstable schwa), whereas *E muet* should designate purely orthographic schwas, which are never pronounced in natural speech (mute schwa). So the following forms have *E muet*:

il jouera [il zuRa] ('he will play')

il nouera [il nuRa] ('he will tie')

Even though the grapheme *E* may correspond to a phonetic reality in the same morphological context in:

il restera [il RɛstʰRa] ('he will stay')

il montrera [il mɔ̃tʰRa] ('he will show')

Schwa is also *E muet* in *samedi*, *éperon*, *pèlerin* ('saturday', 'spur', 'pilgrim'), but it is *E caduc* in *fenêtre*, *secret*, *petit* ('window', 'secret', 'small') etc... The verb *ressemeler* ('to resole') is an interesting example, since it contains an instance of each category of schwa: it can be pronounced [Rɛsɔ̃mɛlɛ], or [Rɛsɔ̃mɛlɛ]. The first schwa is unstable (*E caduc*), the second is stable, and cannot be distinguished from any other occurrence of the phones [ø] or [œ], while the third is purely orthographic and mute (*E muet*).

IV.2.3. Schwa in artificial styles

Poetic diction is characterized by the following features:

- (i) *E caduc*, that is, unstable schwa, is never affected by optional deletion.

- (ii) *E muet*, that is, purely orthographic schwa, is pronounced before consonants and disjunctive semivowels, provided it does not follow another vowel (*belle saison* [bɛl* sɛzø] ('beautiful season')). It should be added that schwa can be *E muet* in conversational style, and be restored in poetic diction, for example; the term *E muet*, then, is relative to style.

Poetic diction is of course a very artificial, archaic style, which is largely conventional; it obeys specific grapho-phonological rules; the written text becomes the primary medium, and it is 'interpreted' by readers. Rules of poetic diction must be *learnt* by speakers, who are often tempted not to respect them. It is clear that the underlying representations of lexical items should not be set up on the basis of artificial pronunciations, but rather of normal, natural careful style, in the speech of educated speakers (we may also envisage a more complex possibility: there might be, in some cases, an underlying representation for normal speech, and an alternative underlying representation for artificial styles).

IV.3. *H aspiré*

I have already alluded to this question in §IV.1.5. *H-aspiré* words are not phonetically different from any other vowel-initial item; we can even find homophonous pairs, as we saw above (*être* ('being'), *hêtre* ('beech')). The difference between *H-aspiré* words and other vowel-initial words appears only in connected speech. *H-aspiré* words are characterized by five features:

- (i) They inhibit liaison (see §IV.1.5):

les hêtres [le etʁ] ('the beech trees')

- (ii) They inhibit elision (see §IV.2.1):

le hêtre [lə etʁ] ('the beech tree')

- (iii) They do not trigger the optional loss of *E caduc* when a monosyllabic clitic precedes them (this deletion occurs only before [-vocalic] segments): same example as in (ii).

- (iv) Between a word-final consonant and disjunctive vowels, schwa can appear, but this is quite variable (cf. §IV.2.2), and not automatic.

- (v) A glottal stop can appear between a final consonant and a disjunctive vowel. This occurrence is also quite variable:

sept héros [sɛt (?)erɔ] ('seven heroes')

légère hausse [lezɛR* ɔ:s] or [lezɛR (?)ɔ:s] ('slight rise')

(data elicited from informants)

I must admit that in my own idiolect, the presence of [ʔ] is also quite variable, and probably style-dependent. Those glottal stops are not phonemes: they are rather demarcative signs which are the mere consequence of the absence of enchaînement (cf. §IV.1.1). The glottal stop occurs when

the syllable structure is [setseRo], rather than the expected [setsteRo]. So what characterizes *H-aspiré* words in this particular case is rather the possibility of absence of enchainement. This fact agrees with the inhibition of liaison and elision, as well as with the occurrence of a final schwa in polysyllables: there is a 'conspiracy' preventing the association of a consonant with the initial vowel of disjunctive words (that is, words inhibiting liaison and elision). The notion of 'conspiracy' refers to 'a situation where several formally distinct rules or conditions on rules seem to work towards the same target structure (such as no vowel clusters, no three-consonant clusters)' (Kenstowicz & Kisseberth 1977: 144-145). However, elision and liaison are absolutely ruled out, while enchainement *may* occur, and while the occurrence of a final schwa is variable and not automatic.

It should be noted that some items are disjunctive, but that words derived from them are not (Kenstowicz & Kisseberth 1977: 57-59): *les héros* [le eRo] ('the heroes'), but: *les héroïnes* [le z eRoïn] ('the heroines'). This is not systematic: *hache* ('axe'), *hacher* ('to chop'), *hachoir* ('chopper') are all disjunctive, as well as *hasard* ('chance'), *hasardeux* ('hazardous'), *hasarder* ('to venture') etc... So disjunctiveness seems to characterize the initial segment of *words* rather than *morphemes*. Disjunctiveness can also be a variable property for certain words: *les haricots* [le aRiko] or [le z aRiko] ('beans') (children and some adults tend to prefer the second variant). *H-aspiré* words generally have an initial orthographic *H*, but this is not automatic either; numerals, for instance, behave like other disjunctive items: *le un* ('number one'), *le onze* ('number eleven') etc... Other words are disjunctive in the speech of many speakers, while they have no

initial orthographic *H*: *ivre* ('drunk'), for instance. In Southern French, examples are more numerous:

la princesse Anne [la pʁɛ̃sɛs* an*] ('Princess Ann'), *auvent* ('canopy'), *anse* ('handle') etc... (data elicited from personal informants).

IV.4. Basic issues

In this section, I shall attempt to identify the central questions that any analysis will have to answer. These questions are:

- (i) Is schwa present in underlying representations, and if so, in what contexts? May schwa be underlying in word-final position?
- (ii) In alternations between 'zero' and a consonant, which allomorph is basic? The long one or the short one? Are final consonants inserted in liaison contexts, or are they deleted in complementary contexts? (if connective consonants are underlying, and subject to deletion rules, there is no such process as liaison, and this phenomenon would become the *non*-application of a rule.) What is the exact implementation of such features as [+feminine] in underlying representations?
- (iii) What is the status of nasal vowels? Are they underlying or are they derived? Is there a nasalization rule in French?

- (iv) What is the status of *H aspiré* ? Is it a phoneme ? A ghost segment, that is, an underlying segment without any phonetic manifestation ? Or is the diacritic-feature approach more suitable ?
- (v) Is a unified treatment of all alternations between 'zero' and consonants possible ? If the answer is affirmative, what conditions rules ? Does liaison break a hiatus ? In other words, are all alternations that we have examined governed by natural rules, or should we postulate across-the-board denaturalization ?

Any adequate theory will also have to solve the following problems:

- (i) In liaison, items ending in a nasal vowel fall into two categories (see §IV.1.2, pp.40-41). What is the proper treatment of this divergent behaviour ?
- (ii) Some words have an initial disjunctive semivowel, while other words have an initial non disjunctive semivowel. Is this due to a difference in underlying structures ?
- (iii) Some consonants are voiced, and others are devoiced in liaison (the connective consonant of *gros* ('big') is [z], and the connective consonant of *grand* ('large') is [t], whilst the final consonants of the feminine form of these adjectives are [s] and [d] respectively: *grosse* [gʁo:s], *grande* [gʁɑ:d]). Is this due to a natural process ?

- (iv) How can we account for the violations of the surface phonetic constraint (R.1) ? Is (R.1) compatible with a natural nasalization rule with exactly opposite effects ?
- (v) Liaison is obligatory between adjectives and nouns, in the singular (if the adjective is subject to it) and in the plural; it is disallowed, in the singular, between a noun and an adjective (see SIV.1.5, pp.54-55); it is optional, in the plural, between the same categories. How can we explain these differences ?
- (vi) In the same contexts, liaison is obligatory with *très* ('very'), for instance, but only optional with *assez* ('enough'), *trop* ('too much'), *beaucoup* ('much'), etc...
- (vii) Numerals (*cinq*, *six*, *huit*, *dix* ('five', 'six', 'eight', 'ten')) behave in a specific way: pre-pausal and pre-consonantal environments produce different effects.
- (viii) Supposing *H aspiré* is a phoneme, what is its feature composition ? Why does it not always behave like initial consonants or semivowels ? (the schwa of monosyllables is always preserved before it, and a final schwa, at the end of polysyllables, appears before it, whereas it does not before a consonant: compare *une légère baisse* ('a slight fall') with *une légère hausse* ('a slight rise'): [yn leʒɛR bɛs], [yn leʒɛR* o:s]).

PREVIOUS ACCOUNTS

V.1. Introduction

In this chapter, I shall review the main representative analyses of the data which were described in Chapter IV; this review is not exhaustive, but deals with the various approaches which deserve attention. This chapter comprises five important sections:

- Non-generative schools
- Abstract generative accounts
- Concrete generative accounts
- Syllabic accounts, in non-linear frameworks
- Additional data

In the first three of these sections, the approaches which are examined are purely linear and segmental. I have ignored, for obvious reasons, purely descriptive studies which are based on orthography and which can hardly be termed 'theories'. In such studies, the written language is implicitly regarded as the primary code: their object is to provide the reader with a list of rules which convert the written word into its phonetic shape; the

usual question is: 'How should we pronounce this or that ?' The terms 'consonant' and 'vowel' are ambiguous, since they can refer to graphemes or phonemes. Grammont's (1966: 93) assertion illustrates this ambiguity: 'Les consonnes finales ne se prononcent pas'. We should not conclude that Grammont is postulating a rule of consonant truncation: he is simply referring to graphemes.

There are other examples of purely descriptive approaches, tacitly regarding rules as grapho-phonological, that is, converting graphemes into phonemes: 'La liaison consiste [...] à prononcer devant un mot commençant par une voyelle une consonne finale, muette en dehors de cette condition' (Fouché 1959: 434). It is clear that Fouché means *graphic* consonant and *graphic* vowel; so the initial letter of *oiseau* ('bird') is a graphic vowel, and *oiseau* [wazo] is an environment for liaison, while the initial letter of *whisky* is a graphic consonant which inhibits liaison, although the initial segment of *oiseau* and *whisky* is the semivowel [w] (therefore, initial semivowels pose a special problem: I shall return to this problem later, in Chapter VIII). Léon (1978: 118) writes: 'La consonne finale d'un mot (écrite, mais non prononcée, devant consonne ou h aspiré), se prononce devant voyelle ou h muet'. We note that Léon is silent about initial semivowels. For Carton (1974: 87), 'La liaison affecte des consonnes qu'on ne prononce pas si le mot est isolé'. It is perfectly clear that all these definitions refer typically to orthography; otherwise, it would be surprising that trained phoneticians could write: 'des consonnes qu'on ne prononce pas'. Grevisse (1980: 70) is no exception: 'Une consonne finale, muette dans un mot isolé, se prononce, dans certains cas, devant la voyelle ou l'h muet initial du mot suivant'. The terms 'consonne muette' and 'h muet initial' can only characterize the written language.

V.2. Non-generative schools

V.2.1. The structuralist tradition

Far more interesting are the accounts of phonologists working within the structuralist tradition, such as Dubois (1965; 1967), and Martinet (1969a; 1969b; 1970; 1974; 1983; 1985). Practically all these works adopt the same position concerning the alternations between 'zero' and a consonant and the problem of final *E muet* and *H aspiré*: they take phonetic representations at face value, list the allomorphs and their contexts, but do not postulate any rule. For the majority of these phonologists, word-final *E muet* is not a phoneme, except before *H aspiré*, which is not a phoneme either: although the term is not used, *H aspiré* is probably regarded as an exceptional environment requiring the presence of schwa at the end of certain items when they precede it. In contexts other than *H aspiré*, schwa is a syllabic realization of consonants which is conditioned by the context. The notion of underlying representation is unknown. Let us consider our standard examples: *petit* ('small') and *bon* ('good'). Their allomorphs are:

(i) Masculine: /pti/, /bɔ̃/, and /ptit/, /bɔ̃n/ in liaison. *H aspiré* inhibits liaison.

(ii) Feminine: /ptitʰ/, /bɔ̃nʰ/, and /ptitʰ/, /bɔ̃nʰ/ before *H aspiré*.

Since phonetic representations are taken at face value, and since these theories are not generative, there is no rule of truncation or of insertion

of final consonants. Note that schwa before *H aspiré* is not an implementation of the feature [+feminine], as the normal feminine allomorph is /ptit/ etc... (the schwa of [pøti] [pøtit] being also a syllabic realization of the initial consonant /p/): 'Il n'y a vraiment [...] qu'une position où se réalise nettement une opposition de /ə/ à son absence. Il s'agit de la réalisation de *e muet* devant l'initiale vocalique du mot suivant lorsque ce mot est dit commencer par un «H aspiré»' (Martinet 1969b: 219). This is clear: schwa is a phoneme only before *H aspiré*, and *H aspiré* is not a phoneme: *H-aspiré* words have an 'initiale vocalique'. This entails that the phonemic representations of monosyllabic clitics, such as *le, me, ne* ('it', 'me', negative particle) etc... are /l/, /m/, /n/ etc... In the sequence *le héros* [lø eRo] ('the hero'), [øeRo] is an allomorph of *héros*. Naturally, such a view creates enormous problems: we may ask why *héros* is realized [øeRo] in some cases, but [eRo] in others: *sept héros* [set (?eRo] ('seven heroes'), *triste héros* [tRist^e eRo] ('sad hero'). Even worse, the schwas in the preceding examples are interpreted differently from the same unit in *le trou* [lø tRu] ('the hole'); in *le héros, triste héros*, it is part of the realization of *héros*, but in *le trou*, it is part of the 'syllabic' variant of the clitic *le*: so for the *same* item (*le*), it is either phonemic, or epenthetic (note that the symbol /ə/ denotes schwa in most structuralist works: for criticism, see SIII.3; we know that for many speakers the realization of schwa is in fact [ø] or [øe])..

For Bazylko (1981: 100), 'puisque l'apparition de [ə] est automatique et due aux facteurs que nous venons d'énumérer, on pourrait décréter dès maintenant que ce segment n'a aucun pouvoir distinctif'. However, Bazylko treats *H aspiré* as a phoneme, and about this segment, he writes: 'Il constitue donc une classe à part' (98), which is certainly not a satisfying answer to the question of its feature

composition; this phoneme would trigger the appearance of [ə]; it seems that Martinet and his disciples are in favour of what we could call an insertion rule; strangely enough, they think that if the appearance of a sound is rule-governed, it is not phonemic: I fail to understand why external-sandhi rules (that is, rules applying at word boundaries -- see SVI.3.4) could not insert phonemes. Bazylko (1981: 100) admits the existence of a 'cas résiduel': the initial groups /pl-/ /pR-/ /bl-/ bR-/ etc... that is, initial clusters of obstruent plus liquid, contrasting with sequences of obstruent plus [ə] plus liquid (cf. *plan* ('plan'), *pelouse* ('lawn')) and he concludes that 'l'apparition de [ə] dans des contextes inhabituels peut avoir, tout au plus, une fonction paralinguistique (expressive)'. I cannot accept this view, which fails to explain why schwa occurs between the obstruent and the liquid in some words, why it is stable in some words and unstable in others (compare *pelouse* ('lawn') with *peler* ('to peel'): the former has an unstable schwa, and the latter has a stable schwa), and finally why it never occurs in the same context in other items. Once more, it should be added that, in my view, in the variety of French which I am considering, it is impossible to distinguish schwa from any occurrence of [ø] or [œ] (see SIV.2; for Grammont (1966: 50), the phone [œ] in unstressed syllables is 'l'e caduc dans les cas où il se prononce'): some occurrences are stable, and others are not, but it is *a priori* difficult to infer the non-phonemic status of a vowel from its instability. One thing is certain, in the structuralist analysis: 'en français parlé, le féminin n'est jamais marqué par la présence d'un e muet [ə] (ou d'aucune autre voyelle) à la fin des mots' (Rigault 1971: 83).

For Martinet (1969b: 88), the standard model of generative phonology is 'un prétexte pour justifier les archaïsmes des orthographe'. Although I think that

abstract generative phonologists are wrong when they regard French orthography as rational or quasi-optimal (see Dell (1973a: 193)), I cannot follow Martinet: generative phonology is not a 'pretext'. This type of criticism is certainly questionable because it is only *a posteriori* that analysts discover some regularities in the correlation between underlying representations and conventional spelling.

According to Martinet (1969b: 105), many verbs of the second and the third conjugations (that is, verbs whose infinitives do not end in *-er*) have two stem allomorphs:

- (i) 'Un thème plein en consonne': *ils écrivent* /il z ekRiv/ ('they write')
- (ii) 'Un thème écourté de la consonne finale du précédent': *j'écris* /ʒ ekRi/ ('I write')

Martinet gives the proper morpho-syntactic contexts in which these allomorphs appear. Final schwa is absent from the phonemic representation of the long allomorph (this detail is crucial because other phonologists will posit a word-final schwa in the phonemic representation of *ils écrivent*, for instance, or of all items whose final segment in phonetic representations is a consonant: see SV.2.2 and SV.3).

In most cases, in fact, phonemic representations (in structuralist works) are similar to phonetic representations, but without redundant features, such as vowel length. In French, nasal vowels, for instance, are phonemic and contrast with sequences of oral vowel plus nasal consonant, or with oral vowels: *bon* /bõ/ ('good', masculine), *beau* /bo/ ('beautiful'), *bonne* /bõn/ ('good', feminine). In Malmberg (1971b: 312), we read: 'Je continue donc à

compter les voyelles nasales parmi les phonèmes vocaliques'. For Jakobson & Waugh (1979: 135), 'attempts to interpret the French nasal vowels as a mere implementation of a sequence -- oral vowels + nasal consonant -- meet with a number of obstacles'. Among these 'obstacles', Jakobson & Waugh mention the nasality contrast in liaison:

bon ami /bɔ̃n ami/ ('good friend'), *mon ami* /mɔ̃ n ami/ ('my friend').

V.2.2. Glossematics

The biphonemic interpretation of nasal vowels would entail that the phonetic sequences of oral vowel plus nasal consonant (e.g., *bonne* ('good', feminine)) are followed by a schwa: as Malmberg (1971b: 312) notes, this step was taken by the Danish glossematic school, led by Hjelmslev. This constitutes a remarkable exception; glossematicians (see Togeby (1951)) interpret *bon* [bɔ̃] ('good', masculine) as /bɔ̃n/, and *bonne* [bɔ̃n] ('good', feminine) as /bɔ̃nə/. In the same way, final consonants are truncated: *grand* [gRã] ('large', masculine) = /gRand/, and *grande* [gRã:d] ('large', feminine) = /gRandə/, where the final schwa 'protects' /d/ from truncation, and is itself truncated.

However, more 'orthodox' structuralists have frequently objected to this interpretation of French data: 'Un inconvénient qui est évident et qui consiste en une discordance énorme entre la substance et la forme, entre le modèle et sa manifestation physique' (Malmberg 1971b: 312), or: 'Le principal inconvénient de ce type d'interprétation est qu'il offre une image complètement déformée du comportement des français d'aujourd'hui' (Martinet 1969a: 27). It is also true that although the system is simplified, by

dispensing with four nasal phonemes, phonemic strings are made more complex: *caneton* ('duckling') will be phonemicized as /kanə̃tɔ̃n/ instead of /kantō/, but as Martinet adds, 'il semble que la simplicité formaliste s'applique exclusivement au nombre d'unités dans le système, et non au nombre d'unités dans la chaîne'. As we shall see in SV.3, this type of criticism applies equally to the most classical versions of generative phonology.

V.2.3. Jakobson

As we have already seen (SV.2.2), Jakobson's interpretation of nasal vowels is at variance with that of the glossematians. The latter represent the 'abstract' version of structuralist phonology.

Jakobson's solution for final schwa and *H aspiré* is original: for Jakobson & Waugh (1979: 151-152), they constitute 'two peculiar entities' and 'The final vowel or the final consonant of the preceding constituent [...] is treated by the *h aspiré* in a similar way as it would be by a consonant'. In the preceding chapter (SIV.2; SIV.3), I showed that this was not quite true. For Jakobson & Waugh, *E muet* is 'an optionally pronounced syllabic': this definition is unexceptionable. *H aspiré* and *E muet* are 'sound units in latency' which are in complementary distribution: they are 'contextual variants' of a 'latent glide'; *H aspiré* is optionally realized as a glottal catch after a consonant: *il hait* [il ʔɛ] or [il ɛ] ('he hates'), and when *H aspiré* follows *E muet*, only the latter is 'materialized'.

The appeal to complementary distribution is far-fetched: word-final schwa, when realized, is a 'full' vowel, and phonetically different from the

English reduced unstressed vowel [ə] (cf. the first and last segments of *America*); it is not a 'glide': Jakobson's solution is therefore unacceptable. In any case, he is not explicit about the possible morphological role of final schwa: as this vowel is realized only before *H aspiré*, we can conclude that it is certainly not regarded as the morphological mark of the feature [+feminine].

V.2.4. Bloomfield

Bloomfield's (1933: 217) point of view deserves to be mentioned because it departs from Martinet's and the glossematians'. For Bloomfield, word-final schwa is not a phoneme, and therefore phonetic representations are also taken at face value. However, he observes that this has undesirable consequences: the feminine allomorphs are not predictable from the masculine ones:

<i>second</i>	[səgø]	<i>seconde</i>	[səgø:d]	('second',	masculine and	feminine)
<i>bon</i>	[bø]	<i>bonne</i>	[bøn]	('good',	"	" " ")
<i>joli</i>	[zøli]	<i>jolie</i>	[zøli]	('pretty',	"	" " ")
<i>petit</i>	[pøti]	<i>petite</i>	[pøti]	('small',	"	" " ")

In order to avoid this, he decides to regard the feminine allomorphs as basic, and derives the masculine forms via a rule of truncation; in the derivation of *grand* ('large', masculine), we delete the final /d/ of *grande* ('large', feminine): /gRäd/ → /gRÄ/

We can call this rule *morphological truncation*, since it is conditioned by the feature [-feminine]. This position is not immune from criticism: it is well known that the positive value of the feature [feminine] is marked (that is, more complex: see Jakobson (1940: chapters 2 & 3)), and therefore that, syntactically, the feminine forms cannot be regarded as basic (Matthews (1974: 42) writes that 'semantically, there are grounds for saying that the Masculine Gender is the neutral or 'unmarked' member'. The masculine can be characterized as 'non-feminine'). The rule of morphological truncation has another shortcoming: it amounts to a *subtractive morpheme*. We know that for some structuralists a 'zero' morpheme may have a semantic value: see Martinet (1970: 101-102); a subtractive morpheme is in fact a morphological operation deleting a segment; it is 'less' than a 'zero' morpheme: see Matthews (1974: 134). The final consonant in the feminine has no morphological function, while a 'zero' alternant in the masculine is the implementation of the unmarked value [-feminine]; this violates natural principles of morphological analysis (see Hooper (1979: 113ff)):

grand /gRã/: masculine, unmarked gender: [*U* feminine]

grande /gRãd/: feminine, marked gender: [*M* feminine]

The consonantal alternant is also marked, while 'zero' is unmarked; the consonantal alternant should therefore be associated with the marked gender, that is [+feminine] ([+segment] = [*M* segment], while [-segment], or 'zero' = [*U* segment]).

This process of morphological truncation may be valid in some cases, when its output is more complex than its input, that is, when it is marked: in French, the plural of *œuf* [œf] ('egg') is *œufs* [ø]; *a priori*, we can admit that the final consonant is truncated, when the value of the feature [plural] is positive, or marked. In such cases, natural principles of morphological analysis are respected.

What is essential and common to Martinet and Bloomfield is the fact that the alternations between 'zero' and a consonant, or between a nasal vowel and a sequence of oral vowel plus nasal consonant are a matter of morphology, and not of phonology; for Martinet (1974: 101), 'En français d'aujourd'hui, l'alternance *-in/-ine* ([-ʒ/-in]) est morphologique (masculin/féminin)'. Whether alternants are derived by rules (Bloomfield) or listed (Martinet) constitutes a minor difference: in both cases, the contexts are purely morphological. Processes which were initially phonetic, in Old and Middle French (see Pope (1934: chapters 11, 18)), were later morphologized (see Chapter II on naturalness and denaturalization).

V.2.5. Liaison

Connective consonants are interpreted in various ways by structuralists. The 'abstract' schools (Togoby (1951), for instance) considered them as latent phonemes, which were preserved in liaison contexts, and truncated in other contexts.

The 'concrete' schools offered several solutions: for some, it is a matter of allomorphy, and there is no real difference between their theory and my purely descriptive account in Chapter IV; for Rigault (1971: 87), for instance, 'il y a neutralisation de la distinction entre formes masculines et formes féminines' (in liaison contexts). Note that this assertion is not always accurate; compare *un doux ami* [œ̃ du z ami] ('a tender friend', masculine), with *une douce amie* [yn dus ami] ('a tender friend', feminine)). However, plural [z] is generally interpreted as an affix. Martinet (1974: 57) observes that the virtual pauses are different in *petite orange* [pɛ̃tit/ɔ̃ʀɑ̃ːz] and *petit orage* [pɛ̃ti/tɔ̃ʀɑːz] (the / signals the virtual pause). In the first example, there is enchaînement, but in the second example, there is liaison (see SIV.1.1). In Dubois's (1965: 32, 45) representations, connective consonants are also treated as transitional sounds ('son de transition'); [œ̃ leze-R-œ̃kœ̃vɛ̃njɑ̃] for *un léger inconvénient* ('a slight drawback'), and [dɛ vwa-z-agʀeabl] for *des voix agréables* ('pleasant voices'), for instance. For Dubois, connective consonants increase syntagmatic cohesion, but plural [z] is also a morphological mark. In his representations, he treats any connective consonant in exactly the same way as plural [z]: these segments always perform a 'linking' function, whether they are morphological marks or not.

The problem of liaison can be solved only if we are able to answer the following question (among others): 'Are connective consonants inserted or underlying ?' In this respect, non-generative theories will often be unsatisfactory, insofar as they are essentially 'taxonomic'. Structuralist theories are generally lacking in explicit formalization.

V.2.6. Underlying representations

This term is naturally absent from structuralists' descriptions; structuralist linguists prefer the expression 'phonemic representation', but this terminological issue is not crucial. If we except the representatives of glossematics, the consequences of the structuralist analysis of French data are very straightforward, as regards the nature of underlying representations. Many consonants which are word-final in phonetic representations are in fact followed by the grapheme *E* in conventional spelling: consider, for instance, the feminine form of adjectives (*petite, bonne, chère* ('small', 'good', 'dear') etc...) and many verb forms (*ils finissent, ils mettent* ('they finish', 'they put') etc...). This orthographic schwa can be found even after final vowels (that is, after the last vocalic phoneme): *jolie* ('pretty', feminine), *il joue* ('he plays'), *ils jouent* ('they play') (in which *-ent* is not pronounced). These schwas are always 'silent' after a vowel, and also, normally, after a consonant. However, there are occurrences of word-final schwas in phonetic representations of Standard French, when these schwas break a consonant cluster. This fact, as was shown in Chapter IV, does not mean that these word-final schwas correspond to the orthographic ones, since a phonetic schwa can be inserted even when it has no existence in the written word (schwa is not orthographic in: *un film[ə] slave* ('a Slavonic film')). Such final schwas are never the most prominent vowel of the word: in such cases, the pre-final syllable is prominent). In these conditions, it could reasonably be assumed that word-final orthographic schwas have no phonological existence in the underlying representations of Standard French. This assumption, if it is well founded, has very serious consequences: it means that a large number of French

words have a final consonant in their underlying representation. Consider, for instance, the adjective *petit* ('small'); it has two forms: [pøti] and [pøtit] (on their distribution, see Chapter IV). We are forced to accept the fact that the feminine form has a final consonant in its underlying representation, and that, by virtue of a principle of *morphological transparency*, this final [t] would be the phonological implementation of the feature value [+feminine] (see Hooper (1979) for the notion of 'semantic transparency', which is analogous to what I call 'morphological transparency'). This [t] would be inserted by a morphological rule; it would also be inserted in liaison contexts. The lexical representation of *petit* could be something like /pøti/, [+T], where [+T] is a morphological feature, referring to an inflectional class, and meaning that the consonant [t] must be inserted in the morphological context [+feminine], and in the morphophonological context of liaison. So while data in the written language are rather regular, we would have to posit several inflectional classes, from a phonological point of view. Note that such a position is criticized by Dell (1973a: 179-180).

Of course, what precedes is a plausible translation of structuralist descriptions into generative terminology. It is *not* the structuralist description itself. However, Dubois (1967: 37-38) is very explicit; for him, the formation of verb stems like [degut-], [mãdat-] (for *dégoûter*, *mandater* ('to disgust', 'to give a mandate')), related to the nouns *dégoût*, *mandat* [degul], [mãda] ('disgust', 'mandate') is the 'transformation par l'addition d'une consonne', and also: 'L'addition de [t] est masquée dans la langue écrite par la graphie du substantif qui porte le plus souvent un graphème -t', and 'synchroniquement il se produit une modification de la base nominale par addition d'un morphème [t]'. About inserted consonants

(we can assume the term 'addition' is equivalent to 'insertion'), Dubois (1967: 52) writes that 'dans la langue parlée leur présence à la fin du morphème lexématique a la valeur d'une marque'. That nasal vowels are phonemes is very clear in Dubois's mind (53): 'la caractéristique propre du français qui possède un jeu de voyelles nasales opposées à un système de voyelles orales, est certainement l'utilisation morphophonologique de la variation entre la voyelle nasale et la voyelle orale, [...] diachroniquement la transformation des variantes combinatoires des voyelles orales suivies de nasales en opposition phonologique n'est pas seulement un fait fondamental de la phonologie du français; c'est un phénomène déterminant en morphologie'. So Dubois admits the denaturalization and the grammaticalization of rules (see Chapter III). In Modern French, final consonants are inserted when they alternate with 'zero'; nasal vowels are underlying. Long allomorphs are regarded as marked. This summarizes what is at least the dominant view in structuralist circles.

V.3. Abstract generative theories

V.3.1. Introduction

In this section, I shall examine several theories of French phonology which postulate one or several general rules of consonant deletion. These rules are supposed to be phonologically conditioned and to be fairly general: the standard accounts are therefore variants of the 'process model' (Stampe 1979: 80-81, n.21), and the rules of consonant deletion are supposed to be *natural*, as opposed to the *morphological* interpretation of structuralism (if we except its rare 'abstract' schools).

V.3.2. Schane (1968)

The classic standard treatment is Schane (1968). In this work, Schane advocates a great degree of abstractness: for instance, final schwa is underlying in the following words, which have a final consonant in phonetic representations (in cases of alternations between 'zero' and a consonant, consonants which are final in phonetic representations (= 'surface forms') are followed by schwa in underlying representations):

petite [pətɪt] = /pətɪt+ə/ ('small', feminine)

grande [gRäd] = /gRand+ə/ ('large', feminine)

Schwa plays a 'protective' role, preventing the deletion of the consonant preceding it; rule order (see Chapter II) is assumed to be crucial in this respect: schwa is 'protective' insofar as consonant truncation is not allowed to follow the loss of schwa:

/pətɪt+ə/ → [pətɪt] → *[pɛtɪ]

In this theory, schwa is also a morphological mark, an affix implementing the feature value [+feminine]: *petite* /pətɪt+ə/, or the feature value [+subjunctive]: *qu'il parte* /paRt+ə/ ('let him go away'), for instance. When there is an alternation between 'zero' and a consonant, the consonant is underlying and a rule of nasalization, followed by the deletion of the nasal consonant, is postulated:

petit ('small', masculine): /pətɪt/ → [pətɪ]

bon ('good', masculine): /bɔ̃n/ → [bɔ̃]

grand ('large', masculine): /gRɑ̃d/ → [gRɑ̃]

The latter example shows that nasal vowels are never regarded as underlying, even when they are invariant: they are always derived from a sequence of oral vowel plus nasal consonant (this *reductio ad absurdum* is of course objectionable. Note that the principle of application of rules to a maximum number of forms is called 'free ride': see Zwicky (1970)). In liaison contexts, final consonants are not deleted: *petit ami* [pətɪ t ami] ('boy friend'). In the same context (i.e., before vowels), final schwa is deleted by the elision rule:

petite amie ('girl friend'): /pətɪt+ə#ami+ə/ → [pətɪt ami]

l'avion ('the plane'): /lə#avjɔ̃n/ → [l avjɔ̃]

However, elision must be kept distinct from another ('late') rule deleting final schwas before a pause or a consonant (a 'late' rule is a process applying at the end of a derivation):

une grande table ('a big table'): /yn+ə#gRɑ̃d+ə#tabl/

→ [yn gRɑ̃d tabl]

Schane's theory is original because he collapses the rule deleting final consonants (except liquids) before consonants, and the rule of elision; the alpha notation (see Sommerstein (1977: 118-120)) allows him to characterize consonants and vowels as a *natural class* (but the alpha notation is nothing

but a formal abbreviation: may we conclude that diametrically opposed segments, as vowels and consonants are, constitute a class?). He called the resulting unique rule *truncation*:

$$[\alpha \text{ conson.} \ \& \ -\alpha \text{ vocal.} \ \& \ -\text{stress}] \rightarrow \emptyset / _ [\# \text{ or}] [\alpha \text{ consonant}]$$

The alpha notation -- or use of variables -- means here that the values of the features [consonantal] and [vocalic] are opposite: [+consonantal] and [-vocalic], or [-consonantal] and [+vocalic]. Schane (1968) uses the Jakobsonian feature 'vocalic' (see §III.1.1): in this feature system, vowels and liquids are [+vocalic] (whereas in the system that I propounded in Chapter III, only true vowels are [+vocalic]). Truncation deletes consonantal segments (except liquids) only before consonants: another rule accounts for the deletion of pre-pausal consonants, or of consonants preceding a phrase boundary (the phrase is the constituent which is immediately superior to the word: see Radford (1981: chapter 2); Nespor & Vogel (1982: 228)); this rule is called *Final Consonant Deletion* (henceforth: FCD).

Schane's initial account of French phonology can be criticized in several respects: recourse to alpha notation is *ad hoc* in the present case; consonants and vowels do *not* form a natural class, and they constitute two distinct major classes: collapsing the deletion of consonants and schwa is therefore difficult to justify.

The feature 'stress' for consonants is meaningless: this feature is relevant for entire syllables or syllabic peaks, but not for margins alone

(that is, the segments preceding or following the vowel). This constitutes another argument against the truncation rule.

Before vowels, truncation yields the correct results in one step:

petit avion ('small plane') [pɛti t avjɔ̃] (no application; the underlying representation is /pɛtit/)

petite aventure ('little adventure') [pɛtit avɑ̃ty:R] (truncation of schwa; the underlying representation is /pɛtit+ə/)

Yet before consonants, truncation does not systematically yield the correct result in one step:

petit garçon ('little boy') [pɛti gaʀsɔ̃] (truncation of /t/, the final consonant of the underlying representation of *petit*: see above).

petite fille ('little girl') [pɛtit fij] (schwa is not truncated before a consonant, and the correct form is therefore the output of a 'late' rule deleting pre-consonantal /ə/ (= schwa)).

Whereas the applications of truncation are symmetrical, which is the intended result, its outputs are not: [pɛti t avjɔ̃], [pɛtit avɑ̃ty:R], [pɛti gaʀsɔ̃], *[pɛtit* fij] ([∅] being the actual manifestation of schwa). This last phonetic representation is not really unacceptable, but its stylistic status is certainly different; it is artificial in Standard French, while the other strings are perfectly natural and normal. It must be added that for many idiolects, advocates of the standard model are compelled to postulate 'absolute neutralization', that is, 'the context-free merger of an underlying contrast on

the phonetic surface' (Kiparsky (1982: 59), since /ə/ (= schwa) is systematically converted into the sound [ø] or [œ] (see Dell (1973a: 186-187)), but only after undergoing various rules. It thus never appears in phonetic representations. We must also remember Martinet's (1969b: 151) criticism of the traditional American vision of French phonology: 'À les croire [...] e 'post-tonique' n'aurait disparu qu'en cas d'élision devant la voyelle suivante'. Although Schane is perfectly aware that schwa is not pronounced before a consonant or a pause, he relegates the deletion of schwa in this context to the rank of a 'late' rule (see p.90).

Separating truncation from FCD has an undesirable consequence: cyclic application is necessary if we want to derive certain phrases, such as *des camarades anglais* ('English comrades'). We know that 'The basic principle of the transformational cycle is that a phonological rule (usually stress placement) operates on a 'word within a word' before applying in a second cycle to the complex word as a whole' (Hyman 1975: 200). I do not claim that the 'cycle' must be dispensed with, but simply that it is more economical to postulate non-cyclic application of rules, whenever possible (for details about the cyclic application of rules, see Chomsky & Halle (1968: 59-162), and Hyman (1975: 198-203, 212)). The above-mentioned phrase is normally pronounced [de kamaRad æŋgle]; its underlying representation in the standard generative model of French phonology is /deS#kamaRadə+S##anglez+S/. In the colloquial variant without liaison, the last two segments of *camarades* must both be deleted. According to Schane, the final /S/ of *camarades* is deleted by an extension of FCD, which can affect a plural noun, but not a plural adjective or modifier. This creates an ordering paradox: FCD applies before the truncation of schwa (it 'feeds'

it, that is, it creates the proper conditions for its application: on the notions of 'feeding' and 'bleeding' order, see Kiparsky (1978: 219-222)):

/kamaRadə+S/

→ kamaRadə (by FCD)

→ kamaRad (by truncation, before a vowel)

and truncation precedes FCD:

/anglez+S/

→ angle+S (by truncation, before a consonant)

→ angle (by FCD; this form becomes [ãgle] after nasalization)

In *anglais*, if FCD applied first, it would 'bleed' truncation (that is, it would remove representations to which truncation could potentially apply), and this interaction would yield an incorrect output. In this paradox, truncation (before a vowel) deleting schwa follows FCD, while truncation of a consonant before a consonant precedes it: Schane (1968) wants to preserve the unity of his truncation rule and refuses to conclude that the truncation of schwa and the truncation of consonants are two different rules which cannot be collapsed. The ordering paradox has to be resolved in some other way: in Schane (1968), the solution to this problem is the cyclical application of truncation and FCD:

segment (see Hyman (1975: 86-87)), which is systematically deleted (and this deletion, which is context-free, is a rule of absolute neutralization (see pp.92-93) between /x/ and 'zero'). The rules deleting schwa are ordered before the deletion of /x/. Note that the feature composition of this segment, whose realization is always null, is completely *ad hoc*; but these kinds of manipulations often characterize the standard model of generative phonology.

Rule ordering plays a crucial role in abstract theories:

-- Nasalization, which does not apply when the nasal consonant is followed by a vowel, applies before truncation and before the deletion of a pre-pausal or a pre-consonantal schwa:

bonne ('good', feminine): /bɔ̃n+ə/ → [bɔ̃n].

-- FCD and truncation apply before this same rule of schwa deletion:

petite ('small', feminine): /pətɪt+ə/ → [pətɪt]

-- Truncation precedes FCD (see above the discussion about the cycle).

-- In Schane (1968), schwa is truncated before semivowels, while consonants are not:

l'oiseau ('the bird'): /lɔ̃#wazo/ → [l wazo]

le petit oiseau ('the little bird'): *[lɔ̃ pɛti wazo].

However, we need a rule truncating consonants before the initial semivowel of foreign items, and preserving schwa in the same context:

le whisky [lɛ wiskil], *les whiskies* [le wiskil] (deletion of the plural marker of the definite article *les*).

V.3.3. Rule naturalness

Truncation and FCD are perfectly natural processes (see Schane (1972: 207-208)): it is well known that the implosive position in the syllable or the final position in the word or the phonological phrase is 'weak', and is responsible for many weakening processes, and especially deletion: see for instance Straka (1979: 216-221). For Hooper (1976: 198), 'the pattern of consonantal strength and the pattern of syllable structure are related'; she further notes (201) that 'the loss of consonants in syllable-final position is extremely common'. For Haguège & Haudricourt (1978: 26), 'Les langues où l'on voit des syllabes fermées s'ouvrir au cours de leur histoire sont celles où la seconde partie de la syllabe est faible et où les implosives s'amouissent'.

The preservation of word-final consonants in liaison could logically be explained by their explosive position: it can be hypothesized that they form a syllable with the initial vowel of the following word. The nasalization of vowels preceding nasal consonants is a typical assimilatory process; it is a question of timing of articulations: 'Par assimilation à la consonne nasale voisine, le voile du palais s'abaisse pendant l'articulation de la voyelle' (Straka 1979: 525). After nasalization of the vowel, the nasal consonant can be de-

leted: for Straka, the vowel, which is low, 'affaiblit, et finalement supprime l'occlusion de la consonne finale'; the deletion of the nasal consonant is also explained by the tendency to eliminate implosive and final consonants, which are positionally weak (518). Foley (1977: 66) writes: 'Syllable-final nasals are weaker than syllable-initial nasals' (final elements being phonologically weaker than initial elements), and in Straka (1979: 504), we can read: 'Dès qu'une voyelle se nasalise, elle tend aussitôt à s'ouvrir'; this lowering accounts for the alternation between *fin* and *fine* ('thin', masculine and feminine), for instance: [fɛ̃], [fin] (historically: [fin] > [fɪn] > [fɛ̃(n)] > [fɛ̃] for *fin*; [finə] > [fɪnə] > [fin] for *fine*; see Pope (1934: 174, 236)).

The deletion of a final schwa is also a natural process, because it is a particularly weak element, being in word-final position and also post-tonic; it is therefore subject to various deletion processes, before a pause, or at the end of a phonological phrase, or before a vowel.

It is thus amply demonstrated that the rules which Schane postulates are natural; their initiation is acknowledged by all specialists in the history of French phonetics (Pope (1934) and Straka (1979), for instance). Although these rules are phonetically plausible, we cannot be certain that they are really rules of French phonology in a synchronic analysis. For Martinet (1969b: 150), 'l'élimination de tout appendice consonantique après voyelle nasale [...] a établi l'existence en français de phonèmes vocaliques nasaux'. Martinet thinks that the loss of final schwa led to the restructuring of phonemic representations. The alternatives are clear:

- The rules are still phonetically motivated, and the underlying representations have not been restructured.

- The rules are no longer *natural*: they are grammaticalized, and the underlying representations have been restructured.

In the standard model, the evaluation metric (Smith & Wilson 1979: chapter 11) allows the linguist to select the simpler analysis: in a constrained model of phonology, this criterion is unacceptable, for reasons which were set out in Chapters I and II.

V.3.4. Schane (1974)

In a subsequent article, Schane (1974: 92) wonders 'whether vowels and true consonants (excluding liquids and glides) ever function as a natural class'. The answer is negative, if we refer to the Sonority Scale, which is a well-established tradition, adopted by Saussure (1972: 70-76), for example (see also Hooper (1976: 197), and Foley (1977: 33-38, 44-48)):

- Obstruents
- Nasals
- Liquids
- Semivowels
- Vowels

This Sonority Scale is also often called the Strength Scale. Vowels, obstruents, and nasals are not adjacent on this scale: I conclude that they cannot constitute a natural class; the fact that vowels and consonants have no distinctive features in common argues for the same conclusion. Schane (1974: 93), without referring to the Sonority Scale, rightly notes that 'stress is not a feature available for marking consonants'. He follows Milner (1973: 148-152), concerning initial semivowels: this means that the elision of a pre-vocalic schwa precedes a rule converting initial vowels into semivowels; according to Milner, non-disjunctive semivowels are in fact vowels in underlying representations (the underlying representation of *oiseau* 'bird', for instance, would be /uazo/). 'As a consequence there is no longer any need for vowels to be deleted before glides and it is sufficient to state that vowels are deleted uniquely before vowels' and: 'In French Phonology and Morphology, I was forced to set up an underlying obstruent, the velar spirant /x/, as the initial segment of *H-aspiré* words' (Schane 1974: 93): if vowels are not deleted before semivowels, *H aspiré* can be represented as the 'glide' /h/ in Schane's (1974) revised theory. Unfortunately, this is sheer manipulation, because there is no empirical way of preferring one solution or the other, when the realization of this segment is normally 'zero'.

In this new article, Schane (1974: 96) combines the truncation rule and final-consonant deletion:

[+conson. & -vocalic] → Ø / _[# or +][+conson. or #]

and elision becomes a separate rule:

$[-\text{conson.} \ \& \ +\text{vocalic}] \rightarrow \emptyset / _ [\# \text{ or } +] (\#) [+\text{vocalic}]$

Elision follows consonant deletion, and the cycle can be dispensed with: in *des camarades anglais* ('English comrades'), the final /S/ of *camarades* is deleted by the consonant-deletion rule; schwa becomes final and is deleted by elision before the initial vowel of *anglais*. This analysis represents a considerable improvement:

- (i) Consonants and vowels are no longer treated as a natural class.
- (ii) The cycle is not necessary in segmental phonology.
- (iii) Stress is not relevant for consonants.
- (iv) There is one rule, instead of two, for the deletion of consonants.

In spite of these differences, the theory of Schane (1974) is still a 'process model', which means that many rules are treated as natural phonetic processes, the main consequence being an increased degree of abstractness (derivations are still 'long', and processing is still complex; underlying representations may be very different from phonetic representations). The important question remains that of rule naturalness: if a rule is *apparently* natural, may we automatically infer that it is natural? Liaison is still characterized by the non-application of rules, and, once more, there is absolutely no difference between liaison and enchainement in the formal treatment of rules.

V.3.5. Dell (1970)

Dell's (1970) account of French phonology differs from that of Schane (1968) and (1974), because in Dell's work, liaison is a rule, more precisely a rule of 'metathesis' inverting a final consonant and a word boundary (#); it is a sort of restructuring rule:

/pətit#ami/ → [pəti#tami]

In this example (*petit ami* ('boy friend')), liaison is no longer the non-application of a rule. As in Schane (1974), deletion before a consonant and deletion before a pause form a single rule. The existence of a rule of liaison represents an advantage: it permits a very simple formulation of the truncation rule:

[-sonorant]_n → Ø / _[-sonorant]_n# (the subscript indicates the minimum number of segments involved)

Liaison takes precedence over truncation (it 'bleeds' it). However, as in other standard treatments, liaison and enchaînement are not distinct phenomena.

Dell also tries to solve the difficult problem of nasal consonants in liaison (see Chapter IV). He adopts Anderson's theory of 'local ordering' (see Anderson (1974) and SVII.3.3) and explains sequences like *bon ami* ('good friend') in terms of exceptional rule ordering (see Dell (1973b)):

<i>mon ami</i> ('my friend'):	<i>bon ami</i> ('good friend'):
/mɔ̃n#ami/	/bɔ̃n#ami/
→ mɔ̃n#ami (by nasalization)	→ bɔ̃#nami (by liaison)
mɔ̃#nami (by liaison)	

In the derivation of *bon ami*, liaison applies exceptionally before nasalization and bleeds it (after the application of liaison, the structural conditions of nasalization are no longer satisfied).

Rule order can be exceptional in some derivations, but regular in others, for the same pair of rules: so exceptionality affects a specific derivation, and not a specific pair of rules in *all* derivations. This view of non-linear ordering (concerning linear or non-linear ordering, see Anderson (1974: chapter 10) and SVII.3) represents an extension, a modification of Anderson's original proposals, but this modification is perfectly *ad hoc*. In this theory of rule interaction, bleeding is marked: this is why *bon ami* is exceptional, and *mon ami* is not. This conclusion rests on the idea that maximized applicability is more natural; this is inspired by Kiparsky's (1978: 222) early works on rule order, but we are allowed to ask why the fullest utilization of rules, which increases the 'distance' between underlying and phonetic representations, should be more natural in all cases. This way of resolving the ordering paradox is certainly not orthodox. Anderson's view itself, about marked and unmarked interactions is questionable, since it is the supposedly unmarked order which makes nasalization opaque in *mon ami* (a rule is opaque when it is contradicted in phonetic representations (Kiparsky 1978: 75)), whereas opacity is usually regarded as marked, and transparency as unmarked: for

Kiparsky, 'Rules tend to be ordered so as to become maximally transparent'. Dell's rule of liaison is also very questionable, from the point of view of general phonology: restructuring at word boundaries is generally a problem of syllable structure, and not of morphological structure. It is true that, historically, word analysis is liable to change; word boundaries and morpheme boundaries can be displaced or inserted; yet a synchronic rule inverting # and a segment is a baffling phenomenon. On the other hand, resyllabification in connected speech is quite usual in various languages: in Spanish, for instance, this phenomenon is regular (Macpherson 1975: 36).

V.3.6. Dell (1973a)

In his book *Les Règles et les Sons*, Dell seems to have modified his views; his truncation rule is now formulated as follows (Dell 1973a: 182):

[-sonorant] → Ø / _[# or +][C], or: _[# #]

In short, this means that he abandons his rule of liaison (see SV.3.5), since before a vowel, the structural description of truncation is not satisfied: therefore, a rule of liaison is superfluous. Dell also adopts a transformational rule for nasalization, which he collapses with the deletion of nasal consonants (this means that he must give up the idea of exceptional ordering for *bon ami* and similar strings):

[+syllabic] [+nasal] [C or #] → [+nasal] Ø [C or #]

1 2 3 1 2 3

([+syllabic] is here equivalent to my own feature [+vocalic]: see Chapter III)

The transformational rule, which 'allows two separate structural changes to be carried out on two separate phonological elements by a single phonological rule' (Kenstowicz & Kisseberth 1977: 214), does not account for the difference between *bon ami* ('good friend') and *mon ami* ('my friend'), for instance (see SV.3.5).

Dell (1973a: 252-253, 256-257) provides a solution for the non-application of elision in *petite haie* [pøtit^h e] ('small hedge'), *le héros* [lø eRø] ('the hero'). Elision is ordered before the deletion of /ʔ/, the segment representing *H aspiré* in Dell's theory (256, n.72). So in this particular case, rule order explains why *H aspiré* does not behave exactly like other consonants in every respect. However, there are also serious problems with Dell's reanalysis. He postulates the following rules (259):

schwa → Ø / VC_o_#

schwa → Ø / VC_(#)C

Ø → schwa / CC_#C

And he states that the first two processes are *obligatory*. Then we should wonder what kind of evidence can lead Dell to regard schwas as underlying in word-final position and in internal syllables. In internal syllables, it could be the existence of alternations:

il appelle [il apɛl] ('he calls')

appeler [aple] ('to call')

nous appelions [nu z apɔljɔ̃] ('we called') (before the cluster -lj-, schwa cannot be deleted (257))

But it is difficult to support the presence of schwa in underlying representations in the next examples, because these words are invariant in non-artificial speech: *caneton* [kantɔ̃] ('duckling'), *médecin* [mɛdsɛ̃] ('doctor'), *samedi* [samdi] ('saturday') (of course, there are many other similar examples in the French lexicon). Note the consequences for a word like *caneton*: if its underlying representation is /kanətɔ̃n/, nasal vowels are not underlying, and there is a natural nasalization process:

/kanətɔ̃n/ → kanətɔ̃ → [kantɔ̃] (nasalization applies *before* the deletion of schwa)

But if there is no underlying schwa in the second syllable, the underlying representation is /kantɔ̃/, and nasal vowels are underlying, because schwa, being absent, cannot play its 'protective' role, and cannot prevent the application of nasalization: so the structural description of this process is satisfied, and in spite of that, it does not apply. The logical consequence is that it is absent from French phonology.

Concerning word-final schwas, Dell (1973a: 236) writes: 'Nous proposons donc d'effacer en un premier temps tous les schwas finaux de polysyllabes, quel que soit le nombre de consonnes qui précèdent, et de réinsérer facultativement un schwa lorsqu'un mot terminé par deux consonnes ou plus est suivi d'un autre qui commence par une consonne'. So the above-mentioned

rule (schwa → Ø/VC_o_#) will delete *all* word-final schwas, and in this position schwas in phonetic representations will necessarily be epenthetic, or in other terms, inserted by the optional epenthesis rule (Ø → schwa/CC_#C). Schwa is deleted in the context: VC_o_#; this deletion being obligatory, nothing proves the existence of *underlying* word-final schwas in polysyllables, except for their presence before *H aspiré*: *cette hausse* [set^h o:s] ('this rise'), but in fact, this phrase and similar sequences cannot be derived, because of the obligatory deletion rule (see above); the application of this process will yield the incorrect output: *[set o:s]. In *petite haie*, the final schwa of *petite* should also be deleted by the same rule. Note that whether deletion applies before or after the deletion of /ʔ/ is immaterial. Dell (1973a: 257) is perfectly aware of this problem but cannot suggest any satisfactory solution.

We must conclude that the evidence for underlying final schwa is particularly weak: it rests on the behaviour of words before *H aspiré*, which is treated as a consonant, while actually disjunctive items do *not* behave like consonant-initial items; compare:

cette bête [set bet] ('this animal'); *cette haie* [set^h e] ('this hedge')
le trait [lø tʁe] or [l tʁe] ('the line'); *le héros* [lø eʁo], *[l eʁo]
 ('the hero')

It is unfortunate that the basic issues should depend crucially on the existence of word-final schwas in polysyllables, when evidence for them is so dubious: arguments supporting the nasalization rule and the truncation rule collapse if word-final schwas are epenthetic whenever they occur in

surface forms (we should not forget that -- even before *H aspiré* -- final schwas might be inserted rather than underlying).

V.3.7. Selkirk (1972)

Selkirk's account of French phonology is very similar to that of Dell (1973a), and there is little to add. Selkirk offers an explanation for vowels which are [+nasal] even in liaison context (in such sequences as *mon ami* [mõ n ami] ('my friend')): she regards them as [+nasal] in underlying representations. The underlying representations of *on* ('people'), *mon* ('my'), etc... will be /õn/, /mõn/ etc... All other items preserving the nasality of their vowel in liaison are subject to the same analysis. In the context of truncation, her rule of consonant deletion, which is identical to that of Dell (1973a: 182), deletes final /n/ (*mon thé* ('my tea'): mõn#te → mõ#te). For nasalization, she also adopts the transformational rule (see SV.3.6, and Dell (1973a: 192)) because she claims that nasalization and the deletion of nasal consonants are not separate processes in French.

Selkirk's view is questionable: if *on*, *mon* etc... are underlyingly /õn/, /mõn/, then nasal vowels can be phonemic in at least some contexts; logically, invariant nasal vowels, in *grand*, *second*, *canton* ('large', 'second', 'district'), with the surface forms [gRã], [søgõ], [kãtõ] respectively, for instance, should be [+nasal] in underlying representations *a fortiori*, since they are no less invariant than the nasal vowels in *on*, *mon* etc... In my view, the consequence is that nasal consonants should be deleted only before a boundary, and never morpheme-internally. Moreover, as truncation

deletes the /n/ of /ɔ̃n/ (= *on*), it could also delete the /n/ of the adjective /bɔ̃n/ (= *bon*) etc... In order to derive *bon*, what we need is a separate rule of nasalization:

/bɔ̃n/

→ bɔ̃n (by nasalization)

→ bɔ̃ (by truncation)

Since the deletion of nasal consonants is integrated into the truncation rule, it follows that this deletion and nasalization should be regarded as different and separate processes. Selkirk does not take this step, and she is inconsistent: she regards the invariant nasal vowels of *on* etc... as underlying, but she derives the invariant nasal vowels of *long* ('long'), *profond* ('deep') etc... from sequences of oral vowel plus nasal consonant:

/lɔ̃ng/ (= [lɔ̃]), /pRɔ̃fɔ̃nd/ (= [pRɔ̃fɔ̃]) etc...

This amounts to considering underlying nasal vowels as exceptional; the principle of *reductio ad absurdum* is highly questionable, but an arbitrary application of this 'free-ride' principle in some forms but not in others is simply incoherent. Selkirk's account of the problem of the [+nasal] quality of the vowels of *mon*, *on* etc... in liaison is not satisfactory: nasal vowels are underlying when they are followed by /n/ (in liaison), but are nasalized by a rule when no nasal consonant follows them in surface forms. Finally, It should be added that the phonemic system is more complex in Selkirk's analysis than in Dell's or Schane's, since it is enriched with nasal vowels.

V.3.8. Abstract accounts: discussion

With this survey of standard accounts, we have reached the core of the question of naturalness. 'Orthodox' generative theories of French phonology all rest on the often tacit assumption that the various surface allomorphs of morphemes are derived via maximally general and natural rules. All other things being equal, the purely phonological analysis will be deemed superior to one involving the morphologization of rules (see Kenstowicz & Kisseberth (1979: 142)).

Rule interaction also offers 'blocking devices' (see Lass (1976: 215)) which preserve the generality of rules and allow a wide range of 'surface' exceptions: these 'surface' exceptions thus become only 'apparent' exceptions; differences in surface patterns are easily regularized (see below). At first sight, the model appears to be optimal and offers a great many advantages: I shall now review some of them.

Surface patterns exhibit a whole variety of alternations in the field of liaison and inflectional and derivational morphology (see Chapter IV). For instance, if we remain at the level of phonetic description, there are several inflectional classes of adjectives. The standard analysis reduces all these phonetic classes to a single phonological class, using only a handful of rules to achieve this task:

	<i>masculine</i>	<i>feminine</i>
<i>joli</i> ('pretty')	/ʒɔli/	/ʒɔli+ə/
<i>rapide</i> ('quick')	/Rapidə/	/Rapidə/ or /Rapidə+ə/
<i>cher</i> ('dear')	/ʃɛR/	/ʃɛR+ə/
<i>chaud</i> ('hot')	/ʃod/	/ʃod+ə/
<i>bon</i> ('good')	/bɔn/	/bɔn+ə/
<i>fin</i> ('thin')	/fin/	/fin+ə/
<i>plein</i> ('full')	/plen/	/plen+ə/
<i>malin</i> ('clever')	/malip/	/malip+ə/
etc...		

Phonetically, these adjectives belong to at least seven different classes; in 'orthodox' generative phonology, the feminine is formed very simply by adjoining the affix /+ə/ to the stem. Consider now the following words: *grand*, *grande*, *grandir* ('large' or 'big', masculine and feminine, 'to grow bigger'), with the allomorphs [gRÄ] and [gRät] in liaison for *grand*, [gRÄ(:)d] for *grande*, and [gRÄdi(:)R] for *grandir*. Without the general rules of consonant deletion, it would be apparently difficult to capture the following significant generalization: the *same* consonant, or its unvoiced counterpart, alternates with 'zero' in liaison, gender inflection, and derivational morphology. In 'orthodox' generative phonology, this is expressed in an elegant way: the stem is /gRand-/. Note that the abstract schwa (</+ə/>) plays a crucial role: without it, the phonetic realization of the masculine form ([gRÄ]) would have to be considered as basic, and various rules would insert the consonant in liaison, in the morphological context [+feminine] etc... But, naturally, the whole edifice of the abstract generative analysis rests on the existence of the morpheme /+ə/.

The notion of simplicity is central in 'orthodox' generative phonology, and the evaluation metric is often referred to. It is obvious that, in a sense, the standard analysis, by claiming that diversity of patterns in alternations is only superficial, but that, at the underlying level, facts are much more regular, and symmetrical, emphasizes the necessity of several structural layers, and increases the degree of simplicity. Data are not so simple, but the analysis and the interpretation of data are. If we remember that linguists' analyses are supposed to be simulations of speakers' internalized grammars, the consequences are important for psycholinguistics. What allows a simple account of complex data is the phonology of rules: this cannot be achieved by a taxonomic phonology of lists and static statements. Correlatively, lexical representations are simple because they are not suppletive: general principles of generative phonology impose -- as often as possible -- the selection of a unique underlying representation for a given stem, and rules will deal with allomorphy. For Kenstowicz & Kisseberth (1979: 140), 'Each morpheme is assumed to have a unique UR unless there is evidence to the contrary' (UR = 'underlying representation'). This is possible because it is supposed that various allomorphs are predictable to a great extent, once we know the underlying representation of a morpheme. . Abstract underlying representations ensure optimal predictability:

From /fin/, we derive [fɛ̃] (*fin* ('thin'))
 " /plɛn/, " " [plɛ̃] (*plein* ('full'))
 " /gRɔs/, " " [gRɔ] (*gras* ('big'))
 " /sɔt/, " " [sɔ] (*sot* ('stupid')) etc...

Compare now: [fɛ̃], [plɛ̃] (*fin, pleine*: see above))

[ʒɔli], [pɛti], [gRi] (*joli, petit, gris* ('pretty',
'small', 'grey'))

[blø], [œRø] (*bleu, heureux* ('blue', 'happy'))

[gRo], [so], [o] (*gros, sot, haut* ('big', 'stupid',
'high'))

If the underlying representations of these masculine forms were identical to their phonetic representations, in a sort of 'null' hypothesis (whereby the pre-pausal surface allomorph of basic forms would be the input to all rules), feminine forms would not be predictable; [-ɛ̃] alternates with [-in] (*fine* ('thin', feminine)), [-en] (*pleine* ('full', feminine)), or even [-ip] (*maligne* ('clever', feminine)), and also [-yn] (*brune* ('brown', feminine)), in areas where [ôé] has merged with [ɛ̃] (see §III.3); 'zero' is invariant (*jolie* ('pretty', feminine)), or alternates with [-t] (*petite* ('small', feminine)), with [-z] (*grise*, ('grey', feminine)) etc... The only solutions would be lexical marking (see Chapter IV), or suppletive representations: the grammar would be undeniably more complex. The process model, which presupposes that natural rules are preferred to morphologization by speakers, yields simpler analyses (see Kenstowicz & Kisseberth (1979: 142)).

The underlying system of phonemes (or 'segments' in the 'orthodox' generative terminology: see Chomsky (1964: 82ff)) is also simpler, as its inventory is reduced: the rules of nasalization and of nasal-consonant deletion allow us to remove nasal vowels from the phonemic pattern, which saves us four segments (except in Selkirk's account). Nasal vowels are marked (i.e., more complex): 'Les voyelles nasales ne sont des voyelles primitives dans

aucune des langues existant actuellement' (Straka 1979: 508). Although this assertion is perhaps too strong, since we do not know the history of all languages, it is probably true for the most well-known European languages. That nasal vowels should be mere allophones of oral phonemes is therefore not surprising.

Unfortunately, the criterion of simplicity is not always successful. Hale (1973), in his discussion of Maori morphology (see SVI.5.1), shows that evaluation can fail to select the right analysis, and external and structural evidence proves that speakers can internalize the more complex and most awkward solution, from a formal point of view. In 'orthodox' generative phonology, the criterion of simplicity does not take the disparities between underlying and phonetic representations into account: a simple word like *marchand* ('merchant'), for instance, has only one pronunciation: [maRʃã]; it is supposed to be stored as /maRʃand/, because nasal vowels are not underlying even when invariant, and because the item is related to *marchande* [maRʃã:d], its feminine counterpart. As even lexically restricted alternations are rule-governed, and do not always entail suppletion in the standard model (they entail suppletion only when no natural rules can relate forms), it is difficult to define the limit between rule-governed alternations and strong suppletion: the decision is often quite arbitrary; consider, for instance *écrire* ('to write') and *scriptural* ('scriptural'). In abstract phonology, no constraint prevents us from positing a single underlying form for the learned stem of *scriptural* and the non-learned stem of *écrire*, because the two items are morphologically and semantically related (see Lightner (1971: 543-546)) for examples of *reductio ad absurdum*). In the *SPF* model, when there are learned

and non-learned items in a derivational series, the common underlying source of the two variants of the stem is generally based on the phonetic structure of the learned item. The paradox is that some speakers are unaware of the meaning -- or the very existence -- of such learned words. There are, however, a few exceptions among generative phonologists: for McCawley (1979: 239), whether you relate some forms or not 'will have no particular bearing on your ability to speak and understand English. There is in fact considerable individual variation with regard to what morpheme identifications different speakers make'. The standard model does not seem to allow for such idiolectal variations, because it is probably too rigid. What we need is a more 'flexible' theory.

The standard model of the acquisition of phonology (based on Chomsky & Halle (1968: 331-332)) will also yield strange results: when the child meets the learned forms, he is supposed to restructure his lexical representations of non-learned forms, which is hardly plausible. Linell (1979: 240) writes that 'generative phonology does in fact claim that radical changes occur when the speakers learn new words and regularities, even if these words and regularities have little or no significance for speech performance'. [...] All these consequences of the generative theory are clearly absurd'. The idea of drastic restructuring due to the acquisition of learned forms is difficult to support: the standard views on these matters are questionable, because speakers are supposed to convert highly abstract underlying representations to their phonetic manifestations 'in every single act of speech production or speech recognition'. To write a grammar which presupposes instantaneous acquisition (Chomsky & Halle 1968: 332) does not solve the problem: acquisition is *not* instantaneous. For McCawley (1979: 240), 'It is not clear that a model with this idealization could have any relationship to real language acquisition'.

The disparities between underlying and phonetic representations introduce complexity into the grammar, a fact which is ignored by 'orthodox' generative phonology: counting rules and features is not sufficient, and we must also evaluate the complexity of 'processing', the length of derivations (the number of lines), as well as the complexity of phonological strings: 'il semble que la simplicité formaliste s'applique exclusivement au nombre d'unités dans la chaîne' (Martinet 1969a: 27). In my example, an underlying representation such as /maRʃand/ (for *marchand* ('merchant')) is simpler than a (phonemic) underlying representation /maRʃǎ/, because it presupposes that the system has no nasal vowels, and because a single representation underlies the stem in *marchand*, *marchande* ('merchant', masculine and feminine), *marchander* ('to bargain'), and *marchandise* ('goods'); but it is also more complex because the underlying string is composed of seven segments as against five, and because /maRʃand/ undergoes three rules:

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/məRʃand/
→ məRʃǎnd
→ məRʃǎd
→ məRʃǎ

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While /maRʃǎ/ undergoes none. Direct mapping also represents an advantage over complex processing, especially if we assume that the complexity of processing plays a role in performance.

It seems that a greater simplicity in some aspects of the object of study is correlative with a greater complexity in other aspects, and that the overall complexity of each solution is difficult (if not impossible) to

evaluate: this is why I do not really believe in evaluation. What we need is a sure criterion allowing us to adopt one solution and reject the other one. It must be added that each linguistic circle has its own view of simplicity and evaluation.

The disparities between underlying representations and phonetic representations render the question of phonotactics (i.e., the rules governing the possible combinations of phonemes) more difficult and complex: final consonants, for instance, are very frequent in underlying and phonetic representations, but many consonants which are final in underlying representations are deleted, and many consonants which are final in phonetic representations are not final in underlying representations. So while the same conditions on representations hold at both levels, the mapping of underlying representations on to phonetic ones is very indirect; this is particularly unfortunate, because Hale (1973) shows, in his study of Maori, that generalizations concerning surface phonotactics tend to be extended to underlying representations (see my discussion in SVI.5.1). It would thus appear that surface forms, which are more or less analogous to the 'classical phonemic' representations, are much more important than is usually thought in 'orthodox' generative phonology.

As we know, it is assumed in the standard framework (see Schane (1968)) that nasal vowels are mere allophones or oral vowels. This hypothesis increases the simplicity of the grammar. Yet it suffered a blow when Schane (1971) 'revisited' the phoneme, and emphasized the role of surface contrasts. In surface forms, nasal vowels contrast with oral vowels in the same contexts:

bon [bõ] ('good') ~ *beau* [bo] ('beautiful')

grande [gRã:d] ('large') ~ *grade* [gRad] ('rank')

feinte [fê:t] ('dummy move') ~ *fête* [fet] ('feast') etc...

Minimal pairs, or quasi-minimal pairs, are rather easy to find. Structuralists used to attribute the merger /õé/ ~ /ẽ/ to the low functional load of the contrast (see below). In 'orthodox' generative phonology, the underlying representation of *brun* [bRõé] ('brown') is /bRyn/, even if the nasal vowel in the surface form is [õé]. For varieties in which [bRõé] changed to [bRẽ], a rule unrounding [õé] is added (concerning the notion of rule addition in diachrony, see Sommerstein (1977: 238-239)):

/bRyn/ → bRÿn → bRỹ → bRõé → [bRẽ]

Yet the device of rule addition does not constitute an explanation, the real question being: 'What motivates this new rule?' There are probably two compatible reasons:

(i) [õé] is highly complex: it is marked for labialization and nasality; if this is correct, we must admit that markedness plays a role, not only at the underlying level, but also at the level of surface forms, since the nasal vowels [õé] and [ẽ] are not underlying in 'orthodox' generative phonology.

(ii) The functional load of the surface contrast is very low (see Martinet (1955: 54-59)).

In order to explain rule addition, we have to examine surface contrasts, but these surface contrasts, in the examples which Schane draws from French, correspond to the 'classical phoneme': nasal vowels are therefore incontrovertibly more than mere allophones of oral vowels, and there is no denying that their phonological status is different from that of, say, lengthened vowels (which are purely allophonic segments even in pre-generative theories and never contrast with short vowels in the same environments: the realization of *grande* /gRãd/ ('large', feminine), for instance, is [gRã:d], when the word is stressed).

Schane (1971: 504) admits that it is only because of alternations that 'there is no need to recognize underlying nasal vowels'. After this assertion, and even if we suppose that alternations between nasal vowels and sequences of oral vowel plus nasal consonant constitute a sufficient reason, it seems pointless to go on deriving *invariant* nasal vowels from the same abstract source, and the simplification of the phonemic system appears to be arbitrary in 'orthodox' generative phonology (I find the arguments for this *reductio ad absurdum* rather weak). Of course, to regard the nasal vowels as underlying because they are invariant makes sense only if they contrast with oral vowels on the surface, and in identical environments : invariance as such is not a valid argument.

The standard analyses can be criticized for another reason: the divergent behaviour of *bon* ('good') etc... on the one hand (see Chapter IV), and of *mon, on* ('my', 'people') etc... on the other hand, has not found any satisfactory solution in the abstract theories. Dell's recourse to exceptional rule order (see SV.3.5) is *ad hoc*, and has no explanatory value

(a formal device is not an explanation, as some advocates of abstract phonology seem to think: for a critical survey of the standard model, regarding the role of formalization, see Foley (1977: chapter 1)).

Selkirk's proposal (see SV.3.7) is inconsistent and weakens the case for the nasalization rule, insofar as some nasal vowels, followed by a nasal consonant which is supposed to condition nasalization, are not derived, but are lexical.

Schane (1973b) regards the nasal vowels of *mon*, *bien*, *on* ('my', 'well', 'people') etc... which are invariant, as nasalized by a rule rather than underlying; however, these forms are exceptional in liaison (in Dell (1970) -- see SV.3.5 -- it is the forms with non-nasalized vowels in liaison which are deemed exceptional). In this view, while nasalization applies before a nasal consonant, provided the latter is not followed by a vowel, this rule 'overapplies' in *mon*, *bien*, *on* etc... when a vowel follows the word-final /n/ (on the notion of *overapplication* of a rule, see Zonneveld (1978: 166); a process 'overapplies' if it takes place while its structural description is not *fully* satisfied).

It is clear that the 'exceptionality' of forms is contingent on theoretical principles, and unfortunately not on linguistic facts, as it should.

The surface contrasts between oral and nasal vowels which Schane (1971: 504-505) mentions are perhaps no evidence that nasal vowels are underlying in French, but the overapplication of nasalization is certainly

more problematic; it yields the same surface contrasts before nasal consonants, which are precisely supposed to condition nasalization:

plein emploi [plɛ̃ n ɑ̃plwa] ('full employment')

bien employé [bjɛ̃ n ɑ̃plwaʒe] ('properly used')

A more serious objection can be raised: the forms in which nasalization is regarded as a case of exceptional overapplication are practically the only examples in which the rule is transparent (that is, when it is not contradicted on the surface; this matter will be discussed thoroughly in Chapter VII).

In Schane's (1973b) theory of exceptions, nasalization and nasal-consonant deletion are separate processes, since the former, but not the latter, affects the string *on arrive* [ɔ̃ n aRi:v] ('we are coming'), for instance. A nasalization process can be transparent only if the nasalized vowel is followed by the nasal consonant which conditions the rule. As the 'normal', non-exceptional application of nasalisation in Schane's analysis of French is followed by the destruction of this conditioning environment, the 'normal' application of nasalization is always opaque, as is exemplified by the derivation of *plein* ('full'): plɛn → plɛ̃n → plɛ̃. Opacity is here due to 'counterbleeding' (on this notion, see Sommerstein (1977: 243-244)). In counterbleeding order, a rule applies in environments that a subsequent rule destroys. Hooper (1976: 64, n.3) notes that this interaction implies that 'the conditioned variant produced by a rule shows up in surface forms where the conditioning context is not present'. In fact, this is what happens in most abstract analyses of French.

Other rules are opaque:

-- The rules deleting final consonants are opaque, since after the deletion of final schwas, many words are consonant-final on the surface: *grasse* [gRɑ:s], the feminine form of *gras* ('fat'), is assumed to have the underlying representation /gRɑs+ə /, with a final schwa. After the deletion of this vowel, the item is consonant-final, but does not undergo FCD (or truncation), whereas the structural description of the process is satisfied.

-- Elision is opaque when it is ordered before the deletion of the underlying segment representing *H aspiré* (/h/ or /ʔ/: see SV.3.2, SV.3.4, SV.3.6): in the derivation of *le héros* ('the hero'), elision does not apply after the deletion of the initial /h/ of /heRo/. Besides, the rule deleting /h/ or /ʔ/ is a rule of absolute neutralization, that is, 'the context-free merger of an underlying contrast' between a phoneme and 'zero' (Kiparsky 1982: 59).

Opacity contributes to the complexity of the grammar. We may assume, following Kiparsky (1978: 229), that rule order is marked when it results in opacity; so rule order is very complex in 'orthodox' generative phonology (however, this does not mean that marked orders are *unacceptable*: see SVII.3 for a detailed discussion).

Another problem with abstract analyses is the systematic presence of the affix /+z/ (or any other segment representing the plural morpheme) in underlying representations, whenever a noun or an adjective is [+plural]

(just as schwa is underlying whenever an adjective is [+feminine]). This affix is then subject to truncation, in the proper context:

mes enfants ('my children'): me+z#enfant+z → me+z#äfä

The plural morpheme thus appears only in a subset of [+plural] surface forms. In normal speech, there are surface occurrences of plural /z/ after adjectives and modifiers in liaison (in the above example, the plural affix /z/ is not deleted after *mes*, in liaison context), but the same segment after nouns, in liaison, is stylistically marked: the sequence *des camarades anglais* ('English comrades') is normally pronounced [dɛ kamaRad äglɛ] more often than [dɛ kamaRad z äglɛ] (see §V.3.2). In spite of this, underlying representations, in the standard model, are based on the stylistically marked variants, with optional liaison. This method produces a stylistic paradox, because if we confined our investigation to normal colloquial usage, we would conclude that the feature value [+plural] of nouns has no phonological implementation in regular cases (*chevaux* [ʃøvo], *oeufs* [ø], the plural forms of *cheval* ('horse'), *oeuf* ('egg'), must be regarded as exceptions).

V.3.9. Conclusion

The standard accounts of French phonology are interesting insofar as just a handful of rules govern a whole set of complex alternations. The model is therefore elegant and economical. However, there is no denying the existence of several factual and formal problems, such as the issue of

nasal vowels with respect to liaison. The theory also suffers from the lack of proper constraints on the form of rules and representations. The main consequence is the excessive degree of abstractness of standard analyses.

V.4. Concrete generative accounts

V.4.1. Introduction

In concrete phonology, underlying representations are very similar to phonetic representations. Concrete phonologists assume that the basic theoretical principles of the standard model are erroneous. In their view, lexical representations of morphemes should be much less abstract than is usually supposed.

In some versions of concrete phonology (Vennemann's (1974b) 'natural generative phonology', for instance), rules are simply static conditions, and all redundant features are present in lexical representations. However, Fromkin (1975: 52-53) shows that external evidence does not argue in favour of such extreme views. There are concrete phonologists who derive phonetic representations from underlying representations by means of rules, just as in abstract phonology, but in a much more direct way. I shall now review the most representative advocates of this approach.

V.4.2. Klausenburger

In Klausenburger (1974), liaison is viewed as a case of rule inversion (see Vennemann (1972) and Chapter II for this notion). Historically, final consonants were underlying, and deleted by natural rules, but in Modern French, these sounds have become connective consonants, which are inserted by a rule of 'epenthesis' (this use of the traditional phonetic terminology is certainly unorthodox).

Klausenburger's main arguments for the insertion of word-final and connective consonants are the relative simplicity of the concrete approach, the existence of surface exceptions to the (standard) deletion rules, and external evidence (false liaisons) against abstract analyses of French phonology.

Klausenburger (1974) claims that the processes of epenthesis and elision are transparent, and form a conspiracy (see Kenstowicz & Kisseberth (1977: 143-145) and Chapter IV, p.70), which means that they are functionally related (since they both suppress sequences of vowels), while deletion in the standard theory is opaque. His two supposedly transparent rules thus avoid hiatus. According to Klausenburger (1974), this brings support to the insertion rule.

The functional unity of liaison ('epenthesis') and elision (of schwa) is highly questionable. Carton (1974: 75) is surely correct when he states: 'les liaisons ajoutées aux élisions multiplient les sutures étroites, Cela prouve, a-t-on dit, la répugnance des Français à l'égard de l'hiatus, Cette assertion est fausse. En effet, on glisse

aisément d'une voyelle à une autre, même entre voyelles identiques'. It is true that vowel sequences are not rare in French (*tu n'as pas à y aller* [ty n a pa a i ale] ('you don't have to go there')), and no surface phonetic condition bars them.

In Schane (1968), there are two rules deleting consonants: truncation and FCD (see SV.3.2). Klausenburger claims that his own theory is simpler because he has only one rule for liaison. This is of dubious validity, for several reasons: as a consequence of his claim that connective consonants are inserted, Klausenburger needs in fact *several* rules for liaison (liaison after invariable words, after adjectives in the singular, in the plural, after nouns, after verbs, with different stylistic values etc...). In my view, simplicity cannot be invoked, because Schane's (1968) theory allows a unified treatment of liaison and inflectional and derivational morphology, while this is no longer possible if final consonants are inserted rather than deleted. Moreover, Klausenburger's argument cannot apply to Schane's (1974) revised analysis (see SV.3.4), in which the truncation rule is abandoned, which implies that there is now *one* rule deleting consonants. In Schane (1968; 1974), deletion is rather general (although it has exceptions), but if connective consonants are inserted (as Klausenburger claims), liaison is a minor rule (which means that it is lexically restricted: it affects *petit* ('small'), but not *joli* ('pretty'), for instance), and the feature composition of the inserted consonant is rarely predictable (whereas consonant-deletion rules in the standard model of generative phonology constitute major -- general -- rules). The insertion rule(s) cannot be superior to the deletion rule(s) with respect to the problem of exceptions, since the former necessitate more lexical marking than the latter.

The deletion rule is opaque. Yet this argument is not decisive, even though it may not be negligible, because extrinsic ordering (see Sommerstein (1977: 184, n.17)) and opacity are allowed in the standard model (ordering is 'extrinsic' when a language-specific ordering statement prevents a rule from applying, while its structural description is satisfied. In other cases, ordering is said to be 'intrinsic'). The real questions are: 'Must we reject the possibility of extrinsic ordering (see my discussion in §VII.3), and can we justify the existence of 'protective' schwas in underlying representations ?'

Klausenburger (1974: 172-173) is more convincing when he claims that external evidence supports insertion: false liaisons (**il va-t-et il vient* ('he walks to and fro')), the frequent non-application of obligatory liaisons (*deux oiseaux* *[dø wazo] ('two birds')), wrong word analysis (**[zjø]* for *yeux* [jø] ('eyes')), because of the plural string with the indefinite article: *des yeux* [de z jø]), tend to show that connective consonants might not be interpreted as underlying by speakers.

Structural evidence also points towards the validity of insertion rules. Klausenburger (1974: 174) notes that some sequences, such as *premier ami* [pRømje R ami] and *première amie* [pRømjeR ami] ('first friend', masculine and feminine) suggest that 'a liaison consonant goes with the following syllable', because, in this case, the 'law of position' (see Léon (1978: 46)), which states that a mid unrounded vowel is [+mid-low] in checked syllables (see §IV.1.4), does not apply. This implies that a word boundary precedes the connective [R] in *premier ami*, and that the form [pRømje] is basic. This conclusion argues for the hypothesis of insertion rules.

Klausenburger (1978) is much more explicit about rule naturalness, and in this new analysis, liaison, being half phonological and half morphological, is now regarded as a 'semi-morphological' rule. Klausenburger (1978) adopts the following theoretical principles:

- (i) The Strong Naturalness Condition, which states that the underlying representation of an item is identical to one of its surface allomorphs (Vennemann 1974a: 208-209).

- (ii) The No Ordering Condition, which rules out extrinsic ordering, and means that rules apply freely whenever their structural descriptions are satisfied (see Vennemann (1974a: 202, 210) and Hooper (1976: 18-20)).

- (iii) 'The recognition of the difference between phonological rules, which are phonetically motivated and exceptionless, and morphophonemic rules, which are morpho-syntactically motivated' (Klausenburger 1978: 27).

However, Klausenburger (1978: 29) admits that the Strong Naturalness Condition is also respected in the standard analysis: 'The transformational analysis did not violate the Strong Naturalness Condition with respect to the rules of consonant deletion and nasalization, since one of the surface allomorphs was posited as basic'. The underlying form of *gros* ('big'), for instance, is /gRos/ in the standard analysis, and this morpheme has the feminine allomorph [gRos]. Note that the underlying representation of the *masculine* form is identical to the phonetic representation of the *feminine* allomorph ([gRos] = *grosse*), but

this cannot be regarded as a violation of the Strong Naturalness Condition *stricto sensu*.

Klausenburger (1978: 30) is also compelled to give up the No Ordering Condition because in his analysis schwa is elided only before true vowels. This means that non-disjunctive items with an initial semivowel, such as *l'oiseau* ('the bird'), will have an initial vowel in their underlying representation. This analysis is inspired by Milner (1973: 148-152) (see also SV.4.3). The initial vowel is converted to a semivowel after the application of elision. *l'oiseau* is derived as follows:

$l\emptyset\#uazo \rightarrow l\#uazo \rightarrow l\#wazo$

Therefore, elision is opaque before semivowels. As for the third principle (iii), it is not original, since the distinction exists in the standard theory (see Kenstowicz & Kisseberth (1977: chapter 2)). So it appears that in Klausenburger's (1978) analysis there is no real constraint on the form of rules and representations (in this, it does not differ fundamentally from the standard model).

In Klausenburger's (1978) concrete analysis, nasal vowels are underlying, and a rule of denasalization is thus posited. This process is regarded as 'morphophonemic' (28); it applies in liaison contexts ('underlying nasal vowels are denasalized in prevocalic position'), and it is phonologically conditioned. This rule accounts for the allomorph of *bon* ('good') in liaison:

bon ami ('good friend'): $b\emptyset\#ami \rightarrow b\emptyset n\#ami \rightarrow b\emptyset n\#ami$

Moreover, 'it is exceptional to denasalize in liaison contexts' (34). We must conclude that denasalization is a minor rule. In fact, Klausenburger (1978: 28-29, n.3) must also posit a second rule of denasalization. In gender inflection, two rules are intrinsically ordered:

-- Nasal-consonant insertion, which is distinct from liaison, and which is not automatic after nasal vowels (cf. *second* ('second'), *grand* ('large'), with [-nasal] consonants in liaison and in gender inflection; their feminine forms are *seconde* and *grande*: [søgõ:d], [gRã:d]).

-- Denasalization, 'both rules being conditioned by the morphological category 'feminine':

bon ('good'): /bõ/ → bõn → [bɔ̃n]

fin ('thin'): /fẽ/ → fẽn → [fin]

The second example shows that the output of denasalization is not predictable if the input is /ẽ/ (cf. *plein*, *pleine*: [plẽ], [plɛ̃] ('full', masculine and feminine)). The existence of two different denasalization rules leads to a strange situation: *bon ami* ('good friend', masculine) and *bonne amie* ('good friend', feminine), which are strictly homophonous ([bɔ̃n amil]), are derived in two different ways. In the derivation of the masculine string, 'epenthesis' (= liaison) applies, and is followed by the minor (phonologically conditioned) denasalization rule; in the derivation of the feminine string, nasal-consonant insertion and the morphologically conditioned denasalization rule apply. This is surprising insofar as the underlying representation is /bõ/ in both cases, and the outputs are

absolutely identical. Klausenburger's analysis of nasal vowels suffers from this internal contradiction.

In conclusion, it seems that Klausenburger's convincing arguments for insertion essentially rest on external evidence. Moreover, the concrete analysis is not superior to the standard analysis with respect to constraints restricting the power of the generative theory, since we have seen that the constraints which Klausenburger (1978) adopts do not play a decisive role.

V.4.3. Tranel (1981)

Tranel's (1981) work is rather comprehensive, and thus differs from most other concrete accounts. However, although it is much more detailed, it is not radically different from Klausenburger's analysis. The arguments against the standard theory are often very similar; Tranel emphasizes the evidence against a rule truncating final consonants: final abstract schwa is only an artefact, and its loss caused the restructuring of a large number of words which are now consonant-final at the underlying level (Tranel 1981: chapter 8); loan words, acronyms, and abbreviations are often consonant-final (198): *CAPES* (teacher's diploma), *agreg* (for *agregation*, teacher's diploma); final consonants are restored in phonetic representations (192-197): *sept femmes* ('seven women') used to be pronounced [sɛ fam], but is now pronounced [sɛ̃t fam]; some liaisons tend to be lost (242-246, 270-272); there are also instances of false liaisons (228-229): *d'on ne sait où* ('from nowhere') is often pronounced with a

connective [z] instead of [t]: *[d ɔ̃ n sɛ z u]; plural /z/ is pronounced only in liaison contexts (Tranel (1981: chapter 6); see also Dumas (1978)).

Tranel (1981: part II) argues at length against a nasalization rule, and claims that the loss of schwa caused the creation of many oral vowel plus nasal consonant sequences which constitute surface exceptions to a nasalization rule (*caneton* ('duckling'): [kãnətõn] > [kantõ]). Moreover, a nasalization process would pose many special problems (40-54); one of these is of course the nasality of vowels in liaison, which is difficult to account for (see §V.3.5.). Finally, Tranel (1981: chapter 9) does not regard *H aspiré* as a phonological segment in underlying structure.

Tranel's solutions, like his criticism of the standard theory, are very similar to Klausenburger's. He claims that, in most cases, natural rules cannot account for alternations. Nasal vowels are underlying, but Tranel's treatment of nasal vowels in liaison contexts and in gender inflection is slightly superior:

-- For the formation of feminine forms, he collapses the insertion of /n/ and denasalization: *bon* ('good'): /bõ/ → /bɔ̃n/.

-- In liaison, a phonological rule inserts /n/, as well as a word boundary before and after the connective consonant: *mon ami* ('my friend'):

/mõ#ami/ → mõ#n#ami

However, for *bon ami* ('good friend') and similar strings, that is, when the vowel is [-nasal] in liaison, two possibilities are envisaged:

- (i) A minor rule of denasalization follows the insertion of the connective /n/:

bõ#ami → bõ#n#ami → bɔ#n#ami

- (ii) The junctive form [bɔn] is suppletive; Tranel (1981: 120) rightly notes that if a word boundary precedes /n/, 'one incorrectly expects *[bonami] instead of [bɔnami]' (see also SIV.1.3.).

Therefore, the second solution is to be preferred: 'masculine [bɔn] is a suppletive form'. The consequence is that there is no rule of *phonological* denasalization at all. Other connective consonants are also inserted and preceded by a word boundary (#):

petit ami ('boy friend'): pøti#ami → pøti#t#ami (237-239)

Plural /z/ is inserted in the same way:

petits amis ('boy friends'): pøti#ami → pøti#z#ami (217)

In gender inflection, consonants are also inserted, but are not preceded by a word boundary:

petite ('small', feminine): /pøti/ → /pøtit/

Note that if there is no phonological denasalization rule, and if there is no constraint against nasal vowel plus nasal consonant strings (cf. *emmener*

[ãmne] ('to take away'), *vînmes* [vẽm] ('(we) came'), *bamba* [bãmba] ('bamba') etc...), we may ask why the output of liaison is, for instance: /mõ#n#ami/, and not /mõn#ami/ (*mon ami* 'my friend'), since no rule of denasalization can affect /õ/.

V.4.4. Concrete accounts: conclusion

In concrete phonology, a unified treatment of all alternations is rejected: consonants are inserted in liaison, gender inflection, verb morphology etc... by different rules. Liaison is a minor rule, except for the insertion of plural /z/. The outputs are rarely predictable: adjectives and verbs fall into several inflectional classes. In this sense, the concrete solution is less simple and elegant than the standard one (but linguistic reality might be less simple and elegant than is generally assumed by linguists).

The problem of nasal vowels in liaison is solved because nasal vowels are underlying; the quality of the mid vowel /e/ in *premier enfant* ('first child'), *chez eux* ('in their place') etc... is accounted for if the connective consonants are not word-final: #pRømje#R#ãfã#; #ʃe#z#ø#.

The concrete analysis assumes that many alternations have been morphologized, and are no longer natural: rule order is less marked. External evidence also points towards the concrete analysis.

There are, unfortunately, a few residual problems. If there are no 'protective' final schwas in underlying representations, and if *sept* ('seven') and *cette* ('this', feminine) are both stored as /set/, how can we account for their divergent behaviour before *H aspiré* ? Appeal to orthography (see Tranel (1981: 287)) is not satisfactory: even though orthography can influence phonology, the formalization must exclude any reference to the former. Moreover, listing suppletive forms like [bɔ̃n] (for *bon* ('good'): see above) in liaison is not satisfactory if the homophony with the feminine form (*bonne*) remains fortuitous.

In my view, concrete analyses suffer from the same defect as the standard model insofar as they do not propose any constraint which might really restrict the power of the theory (we have seen that 'orthodox' generative phonology respects Vennemann's (1974a) Strong Naturalness Condition in most cases, for instance: see SV.4.2, p.128).

The difference between the standard model and concrete phonology rests on structural and substantive evidence: the interpretation of data is different, but no constraint imposes this interpretation. This explains why concrete phonology merely widens the range of possible solutions, without reducing or suppressing indeterminacy.

In Chapter VII, I shall attempt to show that a set of motivated constraints must (and can) help us to decide if the alternations which we have examined are governed by natural rules or not.

V.5. Syllabic phonology

V.5.1. Introduction

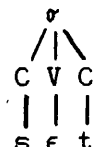
What I call 'syllabic' phonology is a series of attempts to integrate the syllable into the phonological model, which ceases to be purely segmental.

In a first historical stage, phonological structures were regarded as purely linear, and syllable boundaries were introduced into segmental strings: so the theory was initially simply enriched with a supplementary type of boundaries (\$), as in Hooper (1976: 188ff) and Donegan & Stampe (1978).

With Kahn (1976), we find a sort of 'autosegmental' approach: representations are no longer simply linear, but become multi-linear: 'different features may be placed on separate tiers, and [...] the various tiers are organized by "association lines"' (Goldsmith 1979: 202). Instead of syllable boundaries, Kahn introduces syllable nodes. These nodes are associated with the terminal elements, that is, segments. Note that in this framework, the relations between segments within syllables remain purely sequential. The word *sept* ('seven'), for instance, would be represented as follows (I use the symbol 'σ' for the syllable):



The theory of CV-phonology (Clements & Keyser 1983) represents an extension of Kahn's (1976) theory. A third tier is added, the CV-tier, in the following way:



The symbols C denotes the 'syllable margin' (i.e., the 'onset', which precedes the vowel in a French syllable, and the 'coda', which follows it; in our example /s/ is the 'onset', and /t/ is the 'coda'), and the symbol V denotes the 'syllable nucleus' (/ε/ in our example). The main advantages of CV-phonology over Kahn's (1976) theory are:

- (i) The possibility of dispensing with the *SPE* feature 'syllabic' (see Chomsky & Halle (1968: 353-355)); semivowels will be associated with a C-element, and vowels with a V-element. Apart from this, high vowels and their semivocalic counterparts (e.g., /i/ and /j/) will have identical feature compositions.
- (ii) Clements & Keyser (1983: 67-79) claim that nodes may be empty. So the C- and V-elements are allowed to dominate null segments.

Regarding the first point, I agree with Clements & Keyser that the feature 'syllabic' should not belong to the segmental tier: it is a purely distributional property (see Jakobson & Waugh (1979: 85-86)); in languages with syllabic nasal consonants and liquids, we can predict when these

segments constitute a nucleus. On the other hand, my feature 'vocalic' (see §III.1.1) is not strictly equivalent to V-elements in CV-phonology, because only vowels are [+vocalic]; syllabic nasal consonants and liquids will remain [-vocalic], in spite of their syllabicity. I also think that the possible contrasts between underlying semivowels and high vowels should be expressed in the phonemic system: the feature 'vocalic', as I have defined it, performs this task (besides, in traditional phonemics, semivowels and high vowels are often regarded as different phonemes when they contrast in the same segmental environment (French *hai* [ai] ('hated') and *ail* [aj] ('garlic')), while syllabic and non-syllabic liquids or nasals are always regarded as contextual variants of the same phonemes). In CV-phonology, such contrasts cease to be segmental and are all attributed to the CV-tier; the latter becomes contrastive rather than fully predictable from the segmental string. Personally, I prefer to view syllable structure as a fully dependent construct, and this is why I keep the feature 'vocalic'. Therefore, the segmental tier remains primordial.

The metrical theory of syllable structure assumes that the internal structure of syllables is more complex than is hypothesized in Kahn (1976) or even in CV-phonology; the advocates of this theory suggest that there are practically no co-occurrence relation between the syllable onset and the nucleus. The metrical theory also assumes that the nucleus and the coda form a constituent, because restrictions on sequences of vowel plus homosyllabic consonant are quite common. Binary branching (see the example p.139) permits a still more complex organization: onsets, nuclei, and codas can be analyzed in a similar fashion. The nucleus plus coda constituent is generally called the 'rime'. This kind of analysis is clearly inspired by

Pike & Pike (1947): see Sloat, Taylor & Hoard (1978). For details concerning metrical phonology, see Van der Hulst & Smith (1982) and Harris (1983). The word *sept* ('seven') (see above) will have the following representation in the metrical framework:



In short, the immediate-constituent analysis (see Palmer (1971: 124-134)) which is normally applied to the analysis of syntactic structures is here applied to syllable structure.

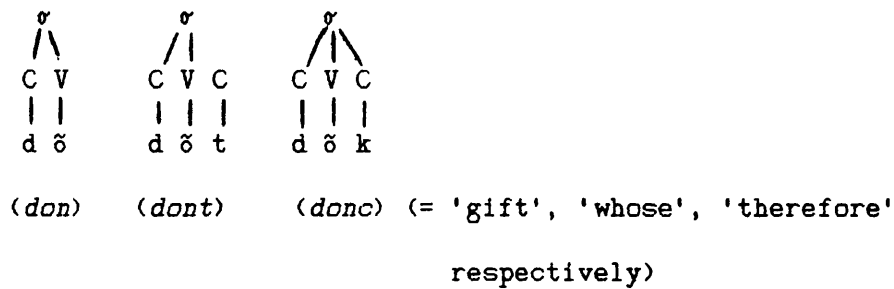
We shall now see how advocates of syllabic phonology analyse French data. As will become obvious, the questions of naturalness and abstractness remain absolutely identical in non-linear theories: we can either hypothesize that natural rules account for alternations or that denaturalization has taken place, just as in purely segmental phonology. If the first option is preferred, we can also ask whether truncation and nasalization rules, for example, are sensitive to syllable structure. So even though it may be claimed that, nowadays, 'orthodox' generative phonology, or *SPE* phonology, is no longer the dominant theory, and has been replaced by models which take prosodic and syllabic structures into account, we must not forget that the same debates about naturalness and abstractness can take place within the framework of these more recent theories, and that one can adopt the underlying representations of concrete or of abstract phonology on the segmental tier: modern phonology is no longer linear, but segments, or 'vertical' associations of features, still exist.

V.5.2. CV-phonology

Clements & Keyser (1983: 99) 'attempt to show that within this framework there is a natural account of French liaison'. They apparently support a syllabic variant of the process model, since they claim 'that nasals show the same pattern of truncation as obstruents'. However, they add (100) that 'nasal truncation is a more general rule than obstruent truncation, applying not only word finally but also word internally'. So in their theory, nasal vowels are derived from underlying oral vowel plus /n/ sequences even when they are invariant. In their view, 'French also contains a rule which deletes consonants in absolute final position', and 'we are dealing with a syllable-conditioned rule'. In this analysis, schwa does not seem to play any crucial ('protective') role, since 'the fact that some of these items end in orthographic *e* does not reflect any systematic difference in their phonological behaviour' (101, n.27): : Clements & Keyser are here talking about words which are never subject to truncation.

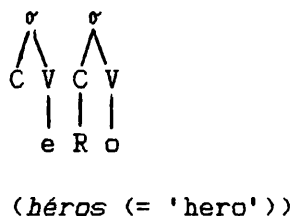
Clements & Keyser (1983: 101) clearly support the truncation rule and criticize concrete approaches: 'If, on the other hand, we take the vowel-final shapes as underlying and insert the appropriate consonants by an epenthesis rule, then we will be unable to predict which consonant will be inserted on phonological grounds' (cf. *joli* [ʒɔli] ('pretty'), *vrai* [vʁɛ] ('true') etc...). Of course, Clements & Keyser presuppose that any treatment -- insertion or deletion -- should be natural: this presupposition requires the selection of deletion rules, which yield simpler results, but it incorrectly excludes the possibility of denaturalization (what is incorrect is not the exclusion of denaturalization as such, but its exclusion *a priori* without posing the problem).

Regarding liaison, Clements & Keyser suggest that the proper solution is 'extrasyllabicity'; connective consonants are excluded from core syllabification, and remain unassociated in underlying representations (102):



In liaison contexts, 'a consonant is linked to the syllable node dominating an immediately following vowel'. So liaison is a true rule, rather than the non-application of a rule. Extrasyllabicity is a distinctive lexical property. Extrasyllabic consonants which do not undergo liaison are deleted by a context-free truncation rule (liaison bleeds truncation).

As for *H-aspiré* words, Clements & Keyser (1983: 107-108) observe that they 'behave phonologically as if they began with a consonant' and '*H aspiré* is represented as a C-element of syllable structure which dominates no consonant on the segmental tier':



They thus avoid the diacritic-feature approach, and they solve the delicate question of the feature composition of the underlying segment with a 'zero' realization on the surface.

By now, it is clear that, with a truncation rule, a syllable-sensitive nasalization rule, empty nodes, and idiosyncratic extrasyllabicity for connective consonants, Clements & Keyser (1983) propose a syllabic variant of abstract phonology.

V.5.3. Metrical phonology

For Selkirk (1982: 342), 'vowel nasalization in French can be conceived of as the attribution of the features of nasality to the constituent (VN) with consequent replacement of the consonantal segment by the features of the vowel' (= compensatory lengthening).

Noske (1982: 263) mentions 'the well-known process of consonant truncation in French', and he does not regard it as syllable-sensitive (he thus disagrees with Clements & Keyser: see SV.5.2). It is rather a rule referring to grammatical boundaries (concerning this point, see also Schane (1978)). Nasalization is a rule 'which deletes a nasal consonant in syllable-final position and nasalizes the preceding vowel'. It 'crucially refers to syllable structure' and 'is ordered before the rule which deletes the schwa' (Noske 1982: 266). Word-final schwas are allowed in underlying representations, and play their usual 'protective' role, just as in abstract segmental treatments: the underlying representation of *fine* ('thin', feminine), for instance, is /fin+ə/ (303). It is obvious that these syllabic analyses are new versions of abstract phonology.

V.6. Additional data

V.6.1. Standard French and Southern French

We have seen that in Standard French several facts cast some doubts on the validity of abstract analyses:

- (i) Several rules (truncation, nasalization) can be postulated only at the cost of abstract schwas in underlying representations:

caneton /kanətən/ ('duckling'), *petite* /pətit+ə/ ('small', feminine)

- (ii) These schwas are abstract because they are absent from phonetic representations. In word-final position, they are clearly epenthetic (see Dell (1973a: 236)). Their presence before *H aspiré* is not systematic (see SIV.2.2) and might be due to another insertion rule.

I shall now show that in Southern French a set of additional data might be accounted for by the abstract analyses, but that other facts, in the same regional variety, constitute a strong piece of evidence *against* the same accounts.

V.6.2. Evidence for the abstract accounts

In Southern French -- more precisely the variety spoken in Provence -- word-final schwas, as well as schwas in internal syllables in the context: VC_C, are not 'imaginary' segments, because they are regularly present in surface forms (Walter 1982: 186-188):

petite [pøtit^ə] ('small', feminine), *bonne* [bɔ̃n^ə] ('good', feminine),
caneton [kan^ətõ(ŋ)] ('duckling') etc...

It would not be unreasonable to posit the following underlying representations: /pøtit^ə/, /bɔ̃n^ə/, /kan^ətɔ̃n/. The usual rules of truncation (or FCD), nasalization and elision would yield the correct outputs:

une petite amie ('a girl friend'): /yn^ə#pøtit^ə#ami^ə/
 → yn^ə pøtit ami

bon ('good'): /bɔ̃n/
 → bõn (by nasalization)
 → bõŋ (by velarization of /n/ before a pause: see
 p.145 below)

The abstract treatment would have to be slightly modified in order to accommodate these data (see Walter (1982: 187)):

- (1) Nasal consonants would not be systematically deleted after nasalizing vowels preceding them; they would be velarized before a pause:

N-velarization: [+stop & +nasal] → [+velar]/_S (this rule is optional; the symbol S denotes a pause)

- (ii) They would also be assimilated to a following stop (in some idioms, these nasal consonants are also assimilated before continuants, but this situation is less frequent):

N-assimilation: [+stop & +nasal] → [α place]/_(#)[+stop & α place]
 ('place' is an abbreviation for all locational features: see §III.1.3):

du bon pain [dy bõm pẽ̃ŋ] ('good bread')

une pente [yn* pãnt*]

encore [ã̃ŋkɔR*] ('again')

- (iii) They would be deleted only before continuants (more precisely before liquids and spirants):

N-deletion: [+stop & +nasal] → Ø/_(#)[+conson. & -stop]

- (iv) Schwa would not be affected by optional deletion rules in careful speech.

- (v) The quality of nasal vowels is slightly different: /a/ would not be retracted by the nasalization rule (see §III.3), while /ɛ/ would be raised to [ẽ̃] or /i/ lowered to [ĩ̃] (instead of [ɛ̃]):

plein ('full'): /plen/ → [plɛ̃ŋ]

fin ('thin'): /fin/ → [fɛ̃ŋ]

Note that the raising of nasal vowels preceding nasal consonants is a perfectly natural process (in other contexts, nasal vowels tend to lower: see Straka (1979: 504-505), and Lass (1976: 177, 183)). It should be added that the degree of nasalization is less important in Southern French.

In the most conservative forms of Southern French, vocalic phonemes are always [-nasal] when they precede a connective [n]:

bon ami [bɔ̃n ami] ('good friend')

mon ami [mɔ̃n ami] ('my friend')

en arrivant [an aRivã(ŋ)] ('when coming here')

So in these idiolects no surface constraint could apparently be violated (see SIV.1.4).

V.6.3. Evidence against the abstract accounts

In the same conservative idiolects, the quality of vowels before connective [n] is puzzling, if we adopt abstract analyses, in the following examples:

commun accord [kɔ̃mɔ̃n akɔ̃R] ('common agreement')

un ami [ɔ̃n ami] ('a friend')

while it is quite expected in:

plein emploi [plɛn ɑ̃plwa] ('full employment')

divin enfant [divin ɑ̃fɑ̃(ŋ)] ('divine child')

Since the underlying representations of these items -- in abstract phonology -- are assumed to be: /plɛn/ for *plein* (cf. its feminine form *pleine* [plɛn]), /divin/ for *divin* (cf. its feminine form *divine* [divin]). On the other hand, the same kind of evidence (that is, the phonetic representation of the feminine counterpart of the item) leads us to posit the following underlying representations for *commun* (cf. its feminine form *commune* [kɔ̃myn]) and *un* (cf. its feminine form *une* [yn]): /kɔ̃myn/, /yn/. Of course, we could postulate the following rule:

y → œ / _n#

This lowering process would apply before the elision rule, in order to account for the phonetic representations of *commune* and *une* before a vowel ([kɔ̃myn], [yn]):

commune action [kɔ̃myn aksjɔ̃ŋ] ('common action')

une assemblée [yn asɑ̃blɛ] ('an assembly')

The underlying representations of these two items would be /kɔ̃myn+œ/ and /yn+œ/. /y/ would also be lowered after being nasalized (ĩ → [ě], ỹ → [ôě]):

commun: /kɔ̃myn/ → kɔ̃mỹn → [kɔ̃môě(ŋ)]

But while this process is apparently a natural rule, because nasal vowels tend to be lowered, the rule lowering /y/ to [œ] in the context: *_n#* is a 'crazy' rule (see Bach & Harms (1972)).

In other, less conservative idiolects, vowels preceding a connective [n] are regularly [-nasal] with certain words (*bon, plein, divin*), but [+nasal] with other words (*commun, un, mon*, for instance; with these words, the vowel may also be *variably* [+nasal] or [-nasal]). The abstract analysis can naturally postulate an exceptional overapplication of nasalization in liaison contexts (see Schane (1973c) and the discussion in SV.3), but it is undeniable that we can find surface contrasts between nasal and oral vowels in the same liaison contexts:

bon ami [bɔ̃n ami] ('good friend')

mon ami [mɔ̃ n ami] ('my friend')

There are also much more embarrassing data in Southern French. Before examining the problem of liaison with oral connective consonants in Southern French, we must study some distributional differences between Standard and Southern French, in stressed syllables (this term represents a simplification: it refers to the prominent syllable of a word, or to the syllable which is stressed when the word is the last member of a phonological phrase).

In standard French, [e] is disallowed if it is followed by one or several consonants; in such contexts, the [-rounded & +mid] vowel becomes necessarily [ɛ] ('law of position'):

premier [pRømjɛ] ('first', masculine)

première [pRømjɛ(:)R] ('first', feminine; vowel length is purely allophonic, and conditioned by stress)

However, before a word boundary, [ɛ] and [ɛ̃] contrast:

thé [tɛ] ('tea'), *taie* [tɛ̃] ('pillow case')

while the contrasts between [o] and [ɔ], or [ø] and [œ], are neutralized in favour of the [+mid-high] vowels:

sotte [sɔt] ('stupid', feminine)

sot [sol] ('stupid', masculine)

In final checked syllables, the same pairs of [+mid-high] and [+mid-low] vowels contrast:

roc [Rɔk] ('rock'), *rauque* [Ro(:)k] ('raucous')

In Southern French, the 'law of position', that is, the surface phonetic constraint governing the distribution of [+mid & -rounded] vowels, is generalized to all [+mid] vowels: [ɛ] [o] [ø] are in complementary distribution with [ɛ̃] [ɔ̃] [œ̃] in stressed syllables; [ɛ] [o] [ø] occur only if they immediately precede a word boundary, but stressed mid vowels are necessarily [+mid-low] when followed by one or several consonants:

premier [pRømjɛ], *première* [pRømjɛR*] (see above)

laid [lɛ], *laide* [lɛd*] ('ugly', masculine and feminine)

sot [sɔ], *sotte* [sɔt*] (see above)

chaud [ʃɔ], *chaude* [ʃɔd*] ('hot', masculine and feminine)

(In Standard French, *laid* is pronounced [lɛ], and *chaude* [ʃo:d]; besides, there are no final schwas).

Note that if the final vowel is schwa (that is, a phone [ø] or [œ] which usually corresponds to the grapheme *E*), stress falls on the penultimate syllable (in this description, I regard words as stressed, even though they may lose their stress in connected speech).

For Southern French, we can posit the following surface phonetic constraints:

(R.1) [+vocalic & +mid & +stress] → [+mid-high]/_#

(R.2) [+vocal. & +mid & +stress] → [+mid-low]/_[-vocalic]

(R.3) [+vocal. & +stress] → [-nasal]/_[n]

Final unstressed mid rounded vowels -- that is, final schwas -- may be [+mid-high] or [+mid-low]: [ø] or [œ] (free or stylistic variation): this is why (R.1) affects only stressed vowels. In (R.3), [n] can itself be followed by schwa (*bonne* [bɔn*] ('good', feminine)). (The notion of 'surface phonetic constraint' is borrowed from Shibatani (1973), but, in Chapters VI & VII, I shall attempt to show that there is no motivated difference between surface phonetic constraints and well-formedness conditions on underlying representations (that is, 'deep' constraints)).

Consider now what happens in liaison, in Southern French:

un gros enfant [œ̃ gRo z ʔfã(ŋ)] ('a big child')

de gros enfants [dø gRo z ʔfã(ŋ)] ('big children')

très amis [tRe z ami] ('close friends') (Stand. Fr.: [tRez ami])

heureux artiste [øRø z aRtistʔ] ('happy artist')

mon ami [mõ n ami] or [mɔn ami] ('my friend') etc...

These forms should be compared to feminine allomorphs:

une grosse enfant [ynʔ gRɔs ʔfã(ŋ)] ('a big child', feminine)

une heureuse artiste [yn øRøez aRtistʔ] ('a happy artist', feminine)

(we know that in this dialect, [+mid-high & +rounded] vowels are disallowed in stressed checked syllables).

In the plural, it may be claimed that the affix /z/ is preceded by a simple word boundary (see Dell (1973a: 243)). But in the singular, this argument does not hold: connective /z/ in *un gros enfant* is not the plural morpheme: yet the pronunciation of the pre-pausal variants is preserved in all cases. In 'orthodox' generative phonology, the surface representation of *gros enfant* (singular) is [gRoz#ʔfã], while that of *gros enfants* (plural) is [gRo#z#ʔfã]. This may have been correct historically, but we can imagine that speakers reanalyzed these forms, because of their homophony, in all dialects. If the connective consonants were word-final, the rules for [+mid] vowels would be systematically violated, while they are absolutely exceptionless in all other situations. This is clear evidence that *all*

connective consonants are preceded by a (simple) word boundary. So, if the surface structures of the above-mentioned forms are:

õ e#gRo#z#ãfã(ŋ)#

#dø#gRo#z#ãfã(ŋ)#

#tRe#z#ami#

#øRø#z#aRtist*#

#mõ#n#ami# or #mɔ̃n#ami#

(R.1), (R.2), (R.3) are no longer violated in liaison. It might be objected that these data are not relevant to Standard French, since they are drawn from a regional variety. Yet they are strongly reminiscent of some forms which I mentioned in Chapter IV, and which I repeat here for convenience:

premier ami [pRømjɛ R amil] ('first friend')

léger ennui [leʒɛ R ənuj] ('slight trouble')

chez eux [ʒe z ø] ('in their place')

and also of all nasal vowels preceding a connective [n]:

en arrivant [ã n aRivã] ('when coming')

bien habillé [bjɛ̃ n abijɛl] ('well dressed') etc...

If we did not relate the data drawn from Southern French to these forms, which characterize both Standard and Southern French, we would miss a very interesting generalization. I shall suppose that the following statement is correct:

Whenever surface phonetic constraints are apparently violated in liaison contexts, a word boundary precedes the connective consonants in surface forms.

So the structures of the surface forms above are:

#pRømjɛ#R#ami#

#leʒe#R#ãnyɪ#

#ʃe#z#ø#

#ã#n#aRivã#

#bjɛ̃#n#abiʒe#

We can find a confirmation of our hypothesis in Canadian French. In Quebec, /i/ is lowered in checked syllables (see Gendron (1966: 13-25) and Tranel (1981: 268-269)):

/i/ → [ɪ] before a homosyllabic consonant.

Yet this process does not take place in liaison: in *petit ami* ('boy friend'), the /i/ preceding the connective /t/ is not lowered. The form [ptɪt ami] is acceptable only if it is the realization of the feminine string *petite amie* ('girl friend'). So the surface structures of the masculine and of the feminine forms are different:

petit ami [#p(ø)ti#t#ami#], and *petite amie* [#p(ø)tɪt#ami#]

Thus, several strings from Southern and Canadian French provide evidence that a word boundary precedes connective consonants, but not 'feminine' consonants. Compare with the structures of the following feminine strings, in Southern French, where all surface constraints are respected:

une grosse enfant [#yn^o#gRɔs#ãfã(ŋ)#]

une heureuse artiste [#yn#øRoez#aRtist^o#]

In Standard French, there is no absolute evidence for a word boundary preceding connective consonants in:

très amis [tRɛ z ami] ('close friends')

trop heureux [tRo p œRø] ('too happy')

because [ɛ] and [o] may occur in checked syllables; but this does not mean that their structures are not parallel with those of *premier ami* ('first friend') etc...:

#tRɛ#z#ami#

#tRo#p#œRø#

In all dialects, the divergent behaviour of *mon* ('my'), *bon* ('good') etc... in liaison is easily explained. The structures are:

bon ami [#bɔn#ami#] ('good friend'), when the vowel is [-nasall], and

mon ami [#mɔ̃#n#ami#] ('my friend'), when the vowel is [+nasall].

In these examples, the surface constraint (R.3) is respected. In Southern French, (R.2) is also respected (in *bon ami*). In Standard French, (R.1) is also respected:

os (singular) [ɔs] ('bone'), *os* (plural) [o]
oeuf (singular) [oef] ('egg') *oeufs* (plural) [ø]

So no word boundary precedes [n] in [#bɔn#ami#]. If the correct structure were *[#bɔ#n#ami#], the [+mid] vowel should be [o] and not [ɔ].

I shall assume that the following conclusions are correct:

(i) There are two kinds of liaison; in most cases, a word boundary precedes connective consonants; in some other cases, it does not:

bon ami

(ii) No word boundary precedes 'feminine' consonants, because the quality of [+mid] vowels can differ in liaison and in feminine allomorphs (cf. *premier ami*, *première amie* ('first friend', masculine and feminine)).

(iii) Surface phonetic constraints are exceptionless.

(iv) Liaison, when the word boundary precedes the connective consonant, and enchaînement are two distinct phenomena: in *un gros enfant* there is liaison, while in *une grosse enfant* there is enchaînement (in enchaînement, a word-final consonant forms a

syllable with the next word-initial vowel; connective consonants are not word-final: so enchainement and liaison are distinct).

If enchainement and liaison are distinct, abstract analyses are incorrect, since they claim that the structures of *petit ami* ('boy friend') and *petite amie* ('girl friend') are identical after the elision of schwa:

/pət̪it#ami/ /pət̪it+ʔ#ami+ʔ/
 → pət̪it#ami → pət̪it#ami

While they are respectively [pət̪i#t#ami] and [pət̪it#ami]. Note that the forms *commun accord* ('common agreement') and *un ami* ('a friend') are accounted for by the constraint (R.3) if no word boundary precedes [n] in very conservative varieties of Southern French: [komoen#akɔR], [oen#ami]. Less archaic variants, with [+nasal] vowels before connective [n], will have a different structure: [komœ̃#n#akɔR], [œ̃#n#ami]. Such structures do not support a rule of nasalization, since such a process could not apply across a word boundary: on the contrary, it seems that nasal vowels are underlying, and denasalized in *commun accord*, *un ami* (in conservative variants) by virtue of (R.3). All these data support the following hypothesis:

The basic form of words, or of paradigms, is the pre-pausal variant of syntactically unmarked word forms (masculine for adjectives, for instance).

This cannot be a constraint on underlying representations: it is simply the conclusion that we are allowed to draw as far as French is concerned (in Chapter VI, we shall see that it is a consequence of the organization of the phonological model). If underlying representations are phonemic forms of words, as I shall assume, the underlying representations of *petit*, *gros* ('small', 'big') etc... can only be /pøti/, /gRo/, especially if a word boundary precedes connective consonants; similarly, the underlying form of *très* ('very'), for instance, is /tRɛ/ in Standard French, and /tRe/ in Southern French. We shall need several rules (which will be examined in later chapters) in order to derive all allomorphs. For the moment, we know that my hypothesis contradicts the basic assumptions of the abstract versions of generative phonology. It also confirms the idea that final schwa is not the feminine morpheme in Standard French, and more generally that no polysyllable in this dialect can have a final underlying schwa (such an abstract segment is absolutely useless as far as it cannot play its 'protective' role, since final consonants alternating with 'zero' are not truncated, but are rather inserted). So the representations of *petite*, *grosse* ('small', 'big', feminine) will be /pøti/, /gRos/. Word-final schwas are necessarily epenthetic. A special rule, which is lexically restricted, will insert them before *H aspiré*.

One might suggest, in order to 'rescue' the abstract analysis, that the word boundary which precedes connective consonants is inserted when a non-disjunctive word follows (= liaison context); *petit ami* ('boy friend') would be derived as follows:

/pøtit#ami/
 → pøti#t#ami

This insertion would have to be ordered before elision, in order to explain the different vowel qualities in the various dialects (Standard, Southern, Quebec) that we have examined. However, this rule would be lexically restricted, since many items would not be subject to it; compare *très amis* ('close friends') with *sept amis* ('seven friends'): [tRe z ami] and [sɛt ami] in Southern French. The vowel [ɛ] in the latter proves that [t] is word-final in the phonetic form; so *très* would undergo the rule, but *sept* would not:

très amis /tRez#ami+z/ *sept amis* /sɛt#ami+z/
 → tRe#z#ami → sɛt#ami

Connective consonants would be truncated whenever the word boundary was not inserted (so this deletion would therefore be context-free), as in the derivation of *très grand* ('very big'):

/tRez#grand/
 → tRe#gRã

The same items would be marked [+liaison] and [+truncation]: *sept* ('seven'), for instance, undergoes neither, while *très* ('very') undergoes both; the values of the two features [liaison] and [truncation] would always agree. For *bon ami* ('good friend'), no word boundary would be inserted: [bɔn#ami].

On the other hand, the derivation of *mon ami* ('my friend') would be more complex:

/mɔ̃n#ami/
 → mɔ̃n#ami
 → mɔ̃#n#ami

With nasalization preceding the insertion of the word boundary. In addition, the application of nasalization would be *exceptional*, since its structural description would not be fully satisfied in *mon ami*. The same problems that I have already mentioned arise in this analysis:

- (i) Nasalization is never transparent, or surface-true.
- (ii) An underlying representation like /tRez/ (for *très* ('very')) is always altered; its realizations are [tRe#z] or [tRe], but never *[tRez].
- (iii) Rule ordering is more complex.
- (iv) Abstract schwas are difficult to justify, as I have already argued.

Moreover, we shall see in Chapters VI and VII that this revised abstract solution does not respect general and motivated constraints on rules and representations. We should also note that the insertion of a word boundary is no more general than rules of consonant insertion in liaison contexts, but that it makes rule interactions more complex: it is therefore less

economical from this point of view. Finally, external evidence (and especially false liaisons) seems to justify my preference for consonant insertion.

The important differences between Standard French and Southern French lead me to reject the pandialectal model (see Linell (1979: 60-62)). This rejection implies that underlying representations may be different in the two varieties. It is clear, for instance, that Southern French admits word-final schwas in polysyllabic word forms, while Standard French does not. The distribution of [+mid] vowels will also be very different (note that even in dialects with word-final schwas in underlying representations, no evidence supports a consonant-truncation rule).

Speech errors and false liaisons agree with my hypothesis. These false liaisons become natural if connective consonants are not parts of the underlying representations of the words which they follow in connected speech. Wrong word analysis in child speech also supports my analysis (I have personally observed frequent errors similar to the example below):

un éléphant [œ nelefã] ('an elephant')

*le *néléphant* [lø nelefã] ('the elephant')

As connective consonants are not word-final, they are never syllable-final, and can therefore be reinterpreted as word-initial by children.

My solution implies that connective and 'feminine' consonants are inserted (by different rules). The fact that identical or very similar

consonants are inserted in both situations should certainly be captured by an adequate analysis, but I must add a restriction: substantive evidence shows that not all speakers relate the insertion of connective consonants and the insertion of consonants in gender inflection in a systematic way; I have recorded the following substandard forms:

second appartement *[søgø n apaRtømã] ('second flat')

commun accord *[kɔ̃mø t akɔR] ('common agreement')

For the speakers who uttered these sequences, the feminine forms are regularly [søgø:d] and [kɔ̃myn]. So we should allow for the possibility of different analyses of the same data by different speakers (generalizations should therefore be captured by lexical redundancy rules rather than by transformational treatments).

In Southern French, my analysis leads to the rejection of nasalization and nasal-consonant deletion; the nasal stops in *du bon pain* [dy bõm pẽŋ] ('good bread'), for example, may be the result of rule inversion: they can be epenthetic, and inserted before a pause or before stops, but (most often) not before continuants; so the rules of N-velarization, N-assimilation, and N-deletion (see pp.144-145) must be given up, and replaced by a new rule of N-insertion:

(i) $\emptyset \rightarrow [+nasal \ \& \ +stop \ \& \ +velar] / \dots [+vocal \ \& \ +nasal] _ \{$

(ii) $\emptyset \rightarrow [+nasal \ \& \ +stop \ \& \ \alpha \ place] / [+vocal \ \& \ +nasal] _ (\#) [+stop \ \& \ \alpha \ place]$

V.6.4. Conclusion

The additional set of data which I have presented in this section does not support 'orthodox' generative phonology. The rejection of the standard analysis is not motivated by any evaluation metric, and by such criteria as simplicity, elegance etc... but by factual observation. It is a matter of adequacy: the standard solutions are observationally inadequate.

In addition, substantive evidence supports rules of consonant insertion. The observationally adequate solution turns out to be more complex in several respects. However, processing is often simpler (but direct mapping is not a constraint which one can impose on the model: it is obvious that derivations must be allowed to be more complex in some cases, when complexity is motivated). Nasal vowels are underlying and the problem of nasal vowels in liaison is partially solved (we now know the proper surface forms, and we are left with the problem of formalization).

In any case, simplicity is not regarded as a crucial problem in this discussion: an analysis may be simple; it must also account for the data, but the simple standard solutions are unable to perform this necessary task.

In the next chapters, I shall show that a set of well-motivated constraints supports my conclusions: the rules which govern the alternations between 'zero' and consonants are not natural in Modern French (they are lexically restricted or morphologized).

As substantive evidence, phonetic data, and general constraints lead to the rejection of the standard model, it would be perverse to go on supporting it. It is amply demonstrated that there is no general rule deleting final consonants: we can therefore reconsider the problem of word-final schwas in a more realistic way.

I hypothesize that, historically, denaturalization and rule inversion took place. The abstract analysis is probably a better account of Middle French than of Modern French, as far as underlying forms are concerned, because the loss of word-final schwas caused the restructuring of these forms in Modern Standard French. It is therefore incorrect to assume that phonological rules, in a synchronic description, recapitulate diachronic rules which were gradually 'added'.

Linguistic changes are less 'superficial' than is supposed by advocates of the standard or abstract versions of generative phonology. Proper constraints on rules and representations should allow us to predict under what conditions rules are 'lost' or denaturalized, and underlying forms restructured.

VI

THE ORGANIZATION OF THE MODEL

VI.1. Introduction

In this chapter, I shall put forward a conception of the organization of phonology which is very different from existing models. In the *SPB* model, there is only one (phonological) component; the distinctions between phonology and morphology, and between allophony and allomorphy are obliterated; the degree of abstractness of underlying representations is virtually unconstrained; the phonemic level is rejected; it is assumed that underlying representations are morphemes, rather than words, and are, whenever possible, not suppletive. Alternations play a crucial role in setting up underlying representations, even if they are morphophonemic, or non-automatic ('minor rules'). All these views, as we shall see, are highly questionable.

Some post-*SPB* models represent a considerable improvement: non-linear theories (Clements & Keyser (1983), Harris (1983), for instance), or the recent lexicalist models of generative phonology (see Strauss (1982), for

instance) constitute interesting developments. The model that I propose is also lexicalist, which means that many rules which were traditionally regarded as transformational apply in fact in the lexicon. The model will also take syllable structure into account. In spite of these similarities with recent theories, it differs from them, insofar as its general organization is specific, and as rules, forms, and systems are severely constrained, which restricts the degree of abstractness of underlying representations.

VI.2. The form of underlying representations

VI.2.1. The phonemic level

From a handful of examples, abstract phonologists draw the following conclusions:

(i) There is no phonemic level.

(ii) Consequently, the phoneme is to be rejected; it is not a valid entity, and has no theoretical status (see Anderson (1974: 34ff), Sommerstein (1977: 116, 120), Bynon (1977: 111-112), and Linell (1979: 262), who all discuss the standard evidence adduced by Halle (1959)).

This standard evidence for the claim that there is no phonemic level is taken from Russian, in which an obstruent agrees with a following obstruent

for the value of the feature [voiced]; the rule is generally morphophonemic (that is, maps phonemes on to phonemes), but it also yields subphonemic segments: [d^h], [d^l], and [ɣ] (subphonemic segments never appear in underlying representations). Such examples can easily be multiplied. Matthews (1974: 200-201) notes that Italian has three distinct nasal phonemes: /m/, /n/, and /ɲ/. In syllable-final position, 'any nasal is simply homorganic (identical as to its place of articulation) with whatever consonant follows'. The output of this assimilatory process may be /m/ and /n/, that is, nasal *phonemes*: *impossibile* [impos^hsibile] ('impossible'); but also *subphonemic* segments: the labio-dental [m], in *infelice* [imfe^hlit^hʃe] ('unhappy'), or the velar [ŋ], in *incolto* [in^hkoltol] ('uncultivated'), the basic form of the negative prefix being /in-/, as in *inelegante* [inele^hgante] ('inelegant'). If underlying representations are morphemes, there is no level of representation corresponding to structuralists' phonemic strings, since, as Sommerstein (1977: 120) puts it, referring to the underlying and the phonetic levels of generative phonology, 'to postulate any kind of intermediate level of representation between these two would result in having to duplicate the rule'. However, several objections can be levelled against this analysis:

- (1) The same rule, in generative phonology, can be a morpheme-structure condition or a phonological rule (see Anderson (1974: chapter 15), and Kenstowicz & Kisseberth (1977: chapter 3)); so it may be either a well-formedness condition on morphemic underlying representations, or a rule which applies in derivations. This constitutes exactly the same type of duplication as that discussed above. In English, the morpheme /z/ is devoiced after a [-voiced] consonant: the word *backs* is pronounced [bæks]. In the standard

model of generative phonology, a rule $z \rightarrow s$ accounts for the structural change. However, the sibilant is also assimilated in the same fashion when it does not follow any juncture, as in *tax* [t'æks]. This time, in the standard theory, a morpheme-structure condition is invoked, because rules trigger structural changes, whereas morpheme-structure conditions are static constraints on the underlying representations of morphemes. In *tax*, the sibilant is invariant, and is therefore not subject to any rule *changing* its feature values.

(ii) The form and the function of rules can be kept distinct; the same rule, from the point of view of its form, might be conceived as a well-formedness condition when it performs a morphophonemic function, as in the Italian word *impossibile* ($n \rightarrow m$), or as a phonological rule when it performs an allophonic function, as in the Italian word *lungo* ['lungo] ('long'), with a change $n \rightarrow \eta$. The underlying representation is /'lungo/, and [ŋ] is an allophonic realization of the phoneme /n/. Function would become primordial, and take priority over the form of rules.

(iii) All examples invoked against the phonemic level involve rules which are allophonic in some derivations, but are automatic neutralizing processes in others (cf. the Italian example; allophonic rules produce subphonemic segments, while the outputs of neutralizing rules are phonemic). In my view, as the inputs to automatic neutralizing rules are no more abstract than the 'classical phoneme', underlying representations should remain phonemic. The

arguments should not be extended to non-automatic, 'minor' rules, which are clearly lexically restricted. This means that the Italian example, or analogous cases, must not allow us to posit extremely abstract underlying representations, as in the *SPE* account of English phonology (Chomsky & Halle 1968).

For several years, the two issues of the 'phonemic level' and of the 'phoneme' were confused, but Schane (1971: 503) keeps the two issues separate, because he agrees that 'the phoneme must be recognized as a phonological entity'. This new position is motivated by the observation that surface contrasts play a crucial role in phonology. However, in spite of this, he still rejects a phonemic level of representation. In short, Schane rehabilitates the phoneme 'without in any way changing the theoretical basis'. What he calls 'surface contrasts' corresponds in fact to phonemic contrasts in some cases, and to true 'surface contrasts' in other cases: the contrasts between nasal and oral vowels in American English (*cat* and *can't* pronounced [kʰæt] and [kʰæ̃t] respectively) and in French (*gai*, *gain* [gɛ], [gɛ̃] ('gay', 'profit')) are both 'surface contrasts' according to Schane. However, we saw in Chapter V that nasal vowels are underlying in French because there is no nasalization rule in this language. In American English, such a process is transparent in some derivations (/bend/ is pronounced [bɛ̃nd]: /n/ is deleted only if it precedes a [-voiced] consonant) and is therefore a plausible rule. It must be added that such words as *can't* may also be pronounced [kʰæ̃nt] in careful speech (Linell (1979: 92) writes that 'In American English [...] nasalization is an articulatory reduction rule' which does not apply in overprecise variants. Therefore '[ɛ̃] is not a separate phoneme' in English).

Schane (1971) maintains the claim that there is a rule of nasalization in French because of alternations such as *bon* ~ *bonne* [bɔ̃] ~ [bɔ̃n] ('good', masculine and feminine) etc... but in Chapter V, we saw that, in fact, the abstract analysis which postulates nasalization and truncation rules rests entirely on the putative existence of final schwas underlyingly. It was also demonstrated that the standard analysis is not observationally adequate, and that evidence for final underlying schwas is particularly weak (except in Southern French). So the alternations between nasal vowels and sequences of oral vowel plus nasal consonant, as in [bɔ̃] ~ [bɔ̃n] ('good') cannot imply that there is a general, natural nasalization rule in French.

I think, in fact, that no serious -- still less, decisive -- argument has ever been raised against the phonemic level of representation and against the theoretical status of the phoneme; Linell (1979: 267) is convincing when he writes: 'Chomsky and Halle have not demonstrated that the phoneme must be relegated from phonology'. In *SPE*, the necessity of lexical representations which are 'deeper' than phonemic ones is decided *a priori*, but is not demonstrated (for various arguments against the rejection of the phoneme, and for a discussion, see Hagege (1976: 146-153), and Linell (1979: chapter 13)). In classical versions of generative phonology, the degree of abstractness of underlying representations is motivated by:

(i) Alternations

(ii) The resulting reduction of allomorphy in lexical forms

(iii) The generality of rules. I shall now discuss these assumptions.

VI.1.2. The role of alternations

An interesting criterion for the classification of alternations is the unit which has alternants:

(i) Phonemes have several alternants, or allophones.

(ii) Words have several variants.

(iii) Morphemes have several allomorphs.

-- In French, vowels have short and long allophones, but these variations are rule-governed, and length is not distinctive; lengthening is an automatic, context-sensitive process: nasal vowels, for instance, are lengthened when stressed: the phonetic representation of *fente* ('slot') is [fã:t], when this item is at the end of a stress group (for the question of vowel lengthening in French in an abstract framework, see Escure (1976)).

-- The word *autre* ('other') can be pronounced [otχ], [ot], or [otR^h], according to the context: *donne-m'en un autre* [otχ] ('give me another one'), *un autre tableau* [ot] or [otR^h] ('another picture').

-- The morpheme *divin-* has the allomorphs [divẽ-] and [divin-]:
divin [divẽ] ('divine', masculine), *divine* [divin] ('divine', feminine),
divinité [divinite] ('divinity').

In (iii), alternations can be intra- or interparadigmatic, which means that they can affect several forms of the same lexeme (= intraparadigmatic

alternation) or several different (phonologically related) lexemes: *il connaît* [kɔ̃nɛ] ('he knows'), *ils connaissent* [kɔ̃nɛs] ('they know'), *connaissance* [kɔ̃nɛsɑ̃:s] ('knowledge').

We must establish what alternations play a role when we set up underlying forms. I shall assume that the following hypothesis is correct:

In setting up underlying representations, alternations of type (ii) play no role at all.

This hypothesis will be justified below by the claim that underlying representations are full word forms, and not morphemes. The consequence is that underlying forms will be inputs to the following rule classes:

-- Rules which introduce new segment types, i.e., subphonemic rules. In English, the aspiration rule belongs to this type: the initial segment of *pan* is aspirated: [p^hæn]; however, aspirated consonants in English are mere allophones of obstruent stops, and the underlying representation of *pan* is /pæn/.

-- Rules of external sandhi which modify the form of words in connected speech (for instance, elision in French: *le ami* → *l'ami* ('the friend')).

Of course, the theory will have to deal with the question of allomorphy, because we do not want it to suffer from the same deficiencies as structuralist theories, but I shall put forward a very different solution to this problem.

VI.2.3. The nature of underlying representations

My basic claims are that:

(i) Underlying forms are *phonemic* representations (they are not 'deeper' than the phonemic level).

(ii) Underlying forms are *words* (and not *morphemes*, as is assumed in most versions of generative phonology).

(iii) Underlying forms are fully *syllabified*.

It is clear that the *word* will be a central notion. This notion has often been neglected, and even rejected (see SVI.2.4 below). Words are natural representations, because they can be syllabified, and because they are the minimal units conveying a meaning which are also pronounceable in isolation. Morphemes are lacking in some properties:

-- They cannot always be syllabified.

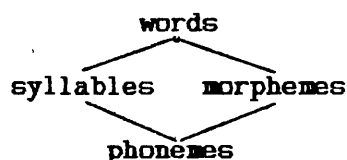
-- They carry meaning, but are not pronounceable in isolation (unless they are affixless stems, in which case they are pronounceable as words).

Words are analyzable into syllables, and it is important to observe that syllables are the minimal articulatory units: a phoneme can be pronounced in isolation only if it is also a syllable, and a morpheme can be pronounced in isolation only if it is also a word, or a syllable (for

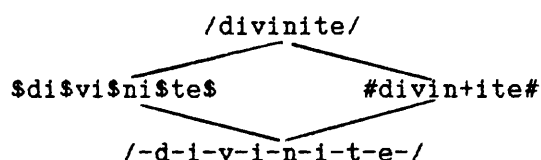
example, the morpheme *-ment* in French, which characterizes adverb formation, can be pronounced in isolation, not as a morpheme, but as a syllable). So the two central units will be the *word* and the *syllable*. Words can be analyzed on two distinct levels:

- Into syllables, on the phonological level (phonological structure).
- Into morphemes, on the morphological level (grammatical structure).

The following diagram illustrates this:



The word *divinity* ('divinity') will exemplify this double analysis:



Following Matthews (1974: chapter 2), I shall distinguish the following terms: (i) *lexemes* (ii) *words* (iii) *word forms*. In French, *vouloir* is a lexeme; *vouloir* (first person singular present indicative) is a word; *veux* is a word form. The term *lexeme* is equivalent to the term *lexical item* in generative phonology. In my view, lexical items and underlying representations do not coincide, because each word form will have its own underlying representation. In standard generative phonology, morphemes are

stored in lexical entries, and each morpheme has one underlying representation (see Kenstowicz & Kisseberth (1979: 3)). My own conception is different: it is not morphemes which are stored, but word forms. As we shall see, it is possible for a lexical entry to include several underlying forms, because in some cases, this entry will include several word forms.

In order to reduce the power of the theory, we must construct *inverse algorithms*, that is, upside down derivations: this means that, just as we derive phonetic forms from underlying ones, we can derive underlying forms from phonetic ones by 'undoing' phonological rules. So underlying forms must be extractable from phonetic forms:

-- Normal algorithm: *underlying form* \Rightarrow *phonetic form*.

-- Inverse algorithm: *phonetic form* \Rightarrow *underlying form*.

Of course, in the inverse algorithm, the input is the stylistic variant of the word form which can be characterized as the careful pronunciation. The inverse algorithm is possible only if our first condition is fulfilled, that is, if underlying forms are no more abstract than phonemic representations. Underlying forms will also be subject to various well-formedness conditions, which perform a filtering function: they must be properly syllabified, and they must respect various phonotactic rules or static constraints. In this sense, they are natural. This is also why underlying representations are not morphemes: the various phonotactic rules restrict the set of possible word forms, because, generally, their domain is not the morpheme (see Hooper (1976: chapter 9)). In fact, syllable-structure conditions will play an essential role in the field of phonotactics: if a

syllable of a word form is not well-formed, it is the whole word form which is unacceptable; but even when syllable structure is fully correct, and the whole word form perfectly acceptable, the morphemes which are part of it do not necessarily obey the phonotactic conditions of the language: in the Spanish verb *desdeñar* ('to despise'), for instance, the stem *desdeñ-* violates the phonotactic conditions of the Spanish language, as no word form, or syllable, can end in *ñ*, the palatal nasal consonant; consequently, the stem is not a natural representation, and it is difficult to retain it as a correct lexical form. The morpheme *desdeñ-* can only be conceived as part of the lexical form, or word form, *desdeñar*. The morpheme cannot be the proper domain of syllabification rules. In this particular example, the morphological analysis and the syllabic analysis do not coincide:

-- Morphological analysis: #desdep+a+r#

-- Syllabic analysis: \$des\$de\$par\$

So in order to maintain the claim that underlying representations are morphemes, it must be suggested that they are not syllabified: this is Noske's (1982) position. Unfortunately, this amounts to positing unconstrained lexical forms, since proper syllabification, which is a very interesting well-formedness condition, cannot filter morphemes. I shall therefore assume that underlying forms are filtered by well-formedness conditions (by syllable-structure conditions, for instance); otherwise, they would not be sufficiently constrained. Note that if underlying forms are phonemic word forms, and if inverse algorithms are permitted, processing becomes as direct as possible: in short, the degree of abstractness is severely limited. If underlying forms are extractable from phonetic strings,

this means that well-formedness conditions are based on surface forms: phonotactic rules, for instance, will have to be surface-true, and respect various conditions on rules (see Chapter VII for details). So the questions of the form, the level, and the domain of well-formedness conditions are easily solved in the present theory: they are imposed on word forms, and their level of application is lexical. As they are based on actual surface data, we can dispense with some duplications (such as different conditions for lexical forms and for surface forms, a situation which is highly implausible from the point of view of the learnability of structures).

Word forms are both grammatical and phonological units, as I have argued, and as Bynon (1977: 113) puts it, 'we have at word-level the maximum congruence of phonological and grammatical structure', which reinforces the validity of the claim that underlying representations are word forms.

VI.1.4. Words and morphemes

The notion of word or word form, which I consider to be essential, has traditionally been open to criticism: many linguists have either rejected the notion, or less dramatically asserted that it is impossible or difficult to define. For Martinet (1970: 115), 'il serait vain de chercher à définir plus précisément cette notion de mot'. In French, we cannot invoke stress, since the domain of stress rules is not the traditional word form, but the phonological phrase. Yet, Martinet's assertion contradicts what he writes earlier in the same work (65): 'Si nous ne tenions pas compte des pauses virtuelles, c'est à dire de la segmentation en mots [my emphasis]'. Martinet rejects the notion of word

in syntax, but does not hesitate to adopt it in phonology. More recently, Martinet (1985: 70-85) has maintained his point of view, and rejected the word as a theoretical unit. Hagege (1985: 99) adopts the same position, although 'le mot est une institution, La plupart des langues du monde ont un terme pour dire "mot" ou quelque chose d'approchant',

Traditional criteria are well known, and can often be criticized (separability, the word as a minimum free form etc... see, for instance, Palmer (1971: 41-42), and Matthews (1974: 160ff)). All these criteria are linguistic, with the exception of speakers' awareness of the notion, which is rather metalinguistic: a word has a citation form in grammars, dictionaries, or more simply in normal speech (a word form can appear in the context: '*is a word*'. In French, forms which are normally unstressed clitics in linguistic usage, such as *je, te, ne, le* ('I', 'you', negative particle, 'it') can be stressed in metalinguistic usage). My point of view can be summarized in the following fashion: the impossibility of defining the notion of word form satisfactorily does not mean that the concept is invalid, or that it has no theoretical value; educated speakers' intuitions about syllable structure and word divisions in connected speech indicate that the units which we usually call 'syllable' and 'word' are not without psycholinguistic value, and I shall regard this point as paramount.

I have claimed that well-formedness conditions are imposed on word forms: they define their pronounceability. As the syllable is the minimal articulatory unit (and most probably the minimal perceptual unit), we may conjecture that it is the domain of most well-formedness conditions (for the same point of view, see Hooper (1976: part II)). However, other

constraints can have the morpheme as their domain; in French, the following constraint bars sequences of nasal vowel plus nasal consonant before a morpheme boundary, or a word boundary:

*[+vocalic & +nasal][+consonantal & +nasal][# or +]

This constraint accounts for the denasalization of the nasal vowel of the stem of *divin* [divɛ̃] ('divine', masculine) in *divine* [divin] ('divine', feminine), *divinité* [divinite] ('divinity'). The syllable is not the relevant domain, since /i/ and /n/ are heterosyllabic in /\$di\$vi\$ni\$te\$/; yet these two phonemes belong to the same morpheme, since the morphological structure of the item is /divin+ite/. The above-mentioned sequence is acceptable when a juncture separates the two segments: (*nous*) *vinmes*, (*nous*) *tinmes*, /vẽ+m/, /tẽ+m/ ('(we) came', '(we) held').

In 'orthodox' generative phonology, many morpheme-structure constraints have to reapply once morphemes are chained together in the phonological component (see Kenstowicz & Kisseberth (1977: 136-145)). In Finnish, for example, the rules of vowel harmony (see Sauvageot (1949: 26-29)) are both static conditions on the form of stems, but also on the form of words: the vowels of the stem of *talo* /talo-/ ('house') are all [+back], by virtue of vowel harmony; if we add the inessive affix *-ssa*, all the vowels of the word will be [+back]: *talossa* /talo+ssa/ ('in the house'). If we add the same suffix to the stem of *elämä* /elämä-/ ('life'), all the vowels of the word will be [-back]: *elämässä* /elämä+ssa/. In a constrained model, this duplication is avoided: morphemes are not stored independently, and are simply parts of word forms. In some post-SPE theories, the situation is not

always clear. In Hooper (1976: part II), for instance, it is acknowledged that the morpheme is not the domain of most phonotactic conditions; yet Hooper still views underlying representations as morphemic in nature. The difficulty is solved by assuming that surface forms (= phonetic representations) are the proper level of phonotactic conditions (see also Shibatani (1973), for the notion of 'surface phonetic condition'). For Bell & Hooper (1978: 6), 'The morpheme is not the proper unit for the expression of such phonotactic constraints, but rather the syllable is their proper domain'. Linell (1979: 80-81) argues along the same lines: for him, underlying forms are word forms, and are phonemic. For Aronoff (1976: 23), 'Each word may be entered in the dictionary as a fully specified separate item'. For Clements & Keyser (1983: 27), 'Words are fully syllabified at the level of lexical representation'. If the syllable is the domain of many phonotactic constraints, and if underlying forms are fully syllabified, it follows that the proper level of these phonotactic constraints is lexical. This view of underlying representations constitutes a more radical departure from the standard model than that of Hooper (1976: 186-189), because she still regards underlying representations as morphemic, while demonstrating that morphemes cannot be properly syllabified.

Hooper (1976: 127-131), following Hudson (1975: chapter 1), does not regard minor rules as rules changing feature values, but rather as processes distributing alternants: she adopts Hudson's 'suppletive representations', with braces (or parentheses for segments alternating with 'zero'). The stem of *vivre* ('to live'), for example, would be lexically represented as, /vi(v)/, because /v/ alternates with \emptyset . The braces or the parentheses play the same role as diacritic features in that they trigger a rule distributing the alternants /v/ and \emptyset in the proper contexts. Hooper is

thus apparently able to dispense with rule features. It is obvious that such representations are excluded in a theory with underlying word-forms. We should note that suppletive representations encounter difficulties: the stem of *écrire* ('to write'), for instance, would be represented with the alternants /v/ and Ø, in the same way as *vivre*: /ekri(v)/, and yet these alternants are distributed in a different fashion:

(i) *il écrit, ils écrivent, écrire, il écrira* ('he writes', 'they write', 'to write', 'he will write'):

/ekRi/, /ekRiv/, /ekRi+R/, /ekRi+R+a/.

(ii) *il vit, ils vivent, vivre, il vivra* ('he lives', 'they live', 'to live' 'he will live'):

/vi/, /viv/, /viv+R/, /viv+R+a/.

It thus seems that, at least in this case, Hooper and Hudson cannot dispense with rule features entirely. The duplication between suppletion in lexical representations and rule features is particularly unfortunate, because Hooper and Hudson assume that the advantage of suppletive representations lies in the suppression of rule features (this difficulty characterizes a version of natural generative phonology which does not view underlying representations as word forms).

VI.2.5. Words and phonological rules

The consequence of my views is that each word form will have its own underlying representation, which does not mean that all word forms of the language, that is, all underlying representations, are listed in lexical entries (see Linell (1979: chapter 4) for a similar view). Each underlying form will be a phonemic string, and allomorphy is of no consequence. Consider now the following forms: *vert* /vɛR/ ('green', masculine), *verte* /vɛRt/ ('green', feminine), *vertement* /vɛRt*+mã/ ('sharply'); it is interesting to note that whether there are rules deleting final schwas or truncating final consonants is absolutely immaterial: the underlying representation of *vert* can only be /vɛR/, and not */vɛRt/, as is assumed in abstract analyses, because underlying forms are phonemic. According to natural principles of word analysis (see SV.2.4), the final /t/ of *verte* is the phonological sign implementing the feature value [+feminine], because rules of morphological truncation cannot produce syntactically unmarked forms: therefore, in French, there cannot be any major process deleting final consonants (in chapter VII, it will also be shown that such a process is excluded by conditions on possible rules). So whether schwa is allowed in word-final position in the underlying representation of polysyllabic items or not is of no crucial importance: schwa cannot play a 'protective' role, as it does in the standard model. In fact, there are dialects where final schwas are present underlyingly; in Southern French, the underlying representations of the adjectives *verte*, *chère*, *noire* ('green', 'dear', 'black', feminine), are: /vɛRt*/, /ʃɛR*/, /nwaR*/. If we compare these forms with their masculine counterparts: *vert*, *cher*, *noir* (/vɛR/, /ʃɛR/, /nwaR/), we realize that the implementations of the feature [+feminine] are:

- (i) The addition of a consonant and a final schwa: /vɛRtʷ/.
- (ii) The simple addition of a final schwa: /nwaRʷ/.

But even in dialects which admit final schwas underlyingly, these schwas can hardly be regarded as the main implementation of the feature [+feminine], because they are unstable signs: in connected speech, they are subject to elision before a vowel. In Standard French, word-final schwas occur in two circumstances (see Chapter IV):

- (i) When they are epenthetic: *elles sont vertes et rouges*
[ɛl sɔ̃ vɛRtʷ z e Ru:ʒ] ('they are green and red')
- (ii) Before *H aspiré*: *une légère hausse* [yn leʒɛRʷ o:s]
('a slight rise')

When epenthetic, they are purely phonetic segments breaking consonant clusters and are not conditioned by the feature [+feminine]: *un film slave*; *un ours blanc* [œ̃ filmʷ sla:v]; [œ̃ n uRsʷ blɑ̃] ('a Slavonic film'; 'a polar bear'). Before *H aspiré*, they occur only variably and constitute only secondary signs, appearing in very marginal contexts.

As regards the differences between dialects, and as I have already argued (see SIV.2.1), a pandialectal approach to phonology is erroneous, and the polydialectal approach is to be preferred: underlying forms may be different in different areas for the same words. Adaptive rules can account for the polydialectal competence of certain speakers (see Andersen (1978), for the notion of 'adaptive rule'). For example, a Northern speaker will

know that he must add final or internal schwas to his own lexical representations when he wants to imitate a Southern speaker: he is also liable to make mistakes, and to apply an adaptive rule in the wrong context (*surprise* ('surprise') will be pronounced *[syRɔpRiz^ə] instead of [syRpRiz^ə]). In fact, I have personally noted that this kind of error is particularly frequent; in Southern French, the vowel [ɛ] is disallowed in word-final position; Southern speakers tend to convert *all* their final [ɛ] into the mid-low [ɛ̃], when imitating the Northern accent (they will thus pronounce *chanter* ('to sing') *[ʃãtɛ̃] instead of [ʃãtɛ]). So external evidence confirms the validity of this approach.

VI.3. The typology of rules

VI.3.1. Classification

I propose the following classification for phonological rules:

- (i) **Structure-building rules:**
 - (a) Contrastive rules
 - (b) Redundancy rules
- (ii) **Internal-sandhi rules:**
 - (a) Phonotactic rules
 - (b) Allomorphy rules
- (iii) **Realization rules**
- (iv) **External-sandhi rules**

VI.3.2. Structure-building rules

Structure-building rules generate phonemic systems; they can be divided into the two above-mentioned subclasses (redundancy rules are also called 'segment-structure rules': see Stanley (1967) and Kenstowicz & Kisseberth (1977: 133)). A redundancy rule has the following form:

(R.1) $[\alpha F^1] \rightarrow [\beta F^{1+}]$ (where α and β represent the values of a parameter F).

Features values in underlying representations are distinctive or redundant. Redundancy rules assign non-distinctive feature values to underlying segments (that is, to phonemes). They are necessarily context-free processes. In English, for example, all vowels are redundantly [-nasal] at the phonemic level.

Suppose now that we introduce a new class of rules into the theory; unlike redundancy rules, these rules would state possible underlying contrasts. In French, sonorant segments are necessarily voiced; this can be expressed by the following redundancy rule:

(R.2) [+sonorant] \rightarrow [+voiced]

However, the value of the feature [voiced] is not predictable for obstruents: in other words, obstruents contrast for the feature [voiced] (cf. *basse* /bas/ ('low', feminine), *base* /bɑz/ ('basis')). This contrast can be expressed by the following rule:

(R.3) [-sonorant] → [±voiced] (the two values (+ and -) signal the contrast).

Note that redundancy rules generate underlying segments, but are also allowed to (re)apply in derivations, and obey general principles of rule ordering (see Chapter VII below): they can affect the outputs of other classes of rules. (R.3) is a *contrastive rule*: such rules are absent from *SPE* phonology. In Chapter VII, it will be claimed that all structure-building rules must respect general conditions on rules, which ensures that the phonemic systems which they generate have empirical foundations, and are not unduly abstract.

Redundancy rules and contrastive rules cannot be contradictory: this condition of non-contradiction between structure-building rules prevents absolute neutralization. A redundancy rule such as (R.1) cannot coexist with the contrastive rule (R.4):

(R.4) [αF[±]] → [±F^{±±}]

If a phone is not the output of a realization rule (see SVI.3.4 below) or a redundancy rule, it is necessarily produced by a contrastive rule. Contrastive rules add a paradigmatic dimension, which was lacking in *SPE* phonology, to the phonological theory. Of course, this dimension was not unknown in some variants of structuralist linguistics (see Hagege (1976: 219-226)). For Jakobson & Waugh (1979: 4), 'the 'paradigmatic' (selectional) axis keeps its relevance independently of the 'syntagmatic' (combinational) axis'.

VI.3.3. Internal-sandhi rules

Speech sounds are quite often affected by their phonological environment, which causes modifications. These modifications are generally referred to as processes of *sandhi* (Matthews 1974: 102). Sandhi is *external* when it operates across word boundaries, and *internal* when it operates within them.

In the present framework, internal sandhi necessarily applies in the lexicon. Internal-sandhi rules can be:

(i) phonotactic rules

(ii) allomorphy rules

They are word-level rules, which apply when morphemes are chained together in the process of word formation. They map phonemes on to phonemes. Phonotactic rules govern the form of underlying representations. They state the possible combinations of phonemes. Structure-building rules are paradigmatic conditions, whilst phonotactic conditions are syntagmatic conditions on the form of underlying representations. They may be static: in English, the phonemes /b/, /d/, /g/ are disallowed after an initial /s/; in this context, an oral stop is always [-voiced]: *spin* /spɪn/; *stick* /stɪk/. In SVI.2.1 (pp.166-167), we saw that a final sibilant agrees in voicing with a preceding obstruent. This rule is static for certain words: *tax* /tæks/, but it may also be dynamic, and modify the basic form of a morpheme: *looks* /lʊk#z/ → /lʊk#s/. Another example of a phonotactic rule is the devoicing of final obstruents in Dutch (see Booij (1977: 75, 80, 83); Vannes (1977: 14)):

schrijven /sxrɛ¹v+ən/ ('to write'), but (*ik*) *schrijf* /sxrɛ¹f/ ('(I) write'). The basic stem allomorph is /sxrɛ¹v/, because devoicing is quite a general rule, and the directionality of the process is clearly v → f in this particular example (the implausible rule f → v would necessitate lexical marking).

In SVI.2.1, we saw that in some cases, a rule is neutralizing for a subset of segments, but allophonic for another subset; in our Italian example, implosive nasals are homorganic with the following consonants: [m] precedes labials, [ɱ] precedes labio-dentals, [n] precedes coronals, and [ŋ] precedes velars:

impossibile [impo¹sibile] ('impossible')

infelice [infe¹litʃe] ('unhappy')

canto ['kanto] ('I sing')

lungo ['luŋgo] ('long')

/m/ and /n/ are phonemes, but [ɱ] and [ŋ] are not. Moreover, the palatal [ɲ] is excluded from syllable-final position. In such examples, we need to distinguish two series of rules:

(i) A phonotactic rule:

(R.5) N → [-dorsal & α labial] / _ \$[α labial]

(N = nasal consonant; a redundancy rule states that the [-dorsal] and [-labial] nasal consonant is /n/).

(ii) Realization rules, yielding subphonemic segments (see SVI.3.4 below):

(R.6) /n/ → [ŋ] / _ [+velar]

(R.7) /m/ → [α dental] / _ [α dental] (/m/ is realized as a labio-dental [m] before /f/ and /v/).

So the underlying representation of *tengo* ['tɛŋgo] ('I hold') will be /tɛŋgo/; why should /n/ be the source of [ŋ]? There are several pieces of evidence:

(i) /n/ alternates with [ŋ]: cf. *tenere* ('to hold'), *tieni* ('you hold'), with [n], and *tengo* ('I hold'), with [ŋ].

(ii) n → ŋ is the 'atomic' or 'primordial' process of assimilation of nasals.

For Dinnsen (1979: 31), 'Atomic rules are entirely independent rules of grammar which are presumed to be the most basic, most specific rules that can be motivated on empirical grounds'. In Czech, the nasal phonemes, just as in Italian, are /m/, /n/, and /ɲ/; before velars, we find [m], [n], and [ŋ]; it is clear that [n] and [ŋ] are in complementary distribution, and 'the velar [ŋ] functions as a contextual variant of /n/' (Jakobson & Waugh 1979: 134).

In our Dutch example, the contrast between [+voiced] and [-voiced] obstruents is neutralized in word-final position. However, the final /f/ of *ik schrijf* ('I write': see above) will be fully specified as [-voiced]. I

think that Stampe (1979: 35-38) is perfectly right when he claims that underlying forms are not archisegmental (an underlying representation is said to be 'archisegmental' when redundant feature values are left unspecified). The absence of a contrast in a specific context must be expressed once, not twice, if we want to avoid redundancy in the model itself. Neutralizations are expressed by rules; if underlying representations were archisegmental, neutralizations would also be expressed in the lexicon. This is unnecessary.

In Italian, our phonotactic rule, (R.5), will be either a static condition on underlying forms (as in *cambio* /'kambjo/ ('change')), or a dynamic process at morpheme boundaries (as in *impossibile* /im+po'sibile/ ('impossible')). This duality of functions characterizes this class of rules, and we do not have to distinguish 'rules' from 'morpheme-structure conditions' (see SVI.2.4): this solves the duplication problem (see Kenstowicz & Kisseberth (1977: 136-145)). So internal-sandhi rules produce underlying forms, or, in the case of phonotactic rules, can also filter them. Underlying representations are not *inputs* to such rules, which cannot modify them. Phonotactic rules are general, automatic and natural; they include the processes which are traditionally known as 'automatic neutralizations' (see Martinet (1970: 76-78)), as in our Dutch example (devoicing of final obstruents: see pp.186-187).

Allomorphy rules are not natural, even though they may be synchronic residues of processes which used to be natural; they are often minor rules, that is, processes whose application is rather exceptional (they are lexically restricted). They are no longer general or automatic, whereas

phonotactic rules are normally exceptionless. In Indonesian, for instance, an allomorphy rule inserts a nasal consonant when the prefix /mə -/ precedes the stem; it can also delete the initial consonant of the stem (see Lombard (1977: 38-39)):

mə+ʔisi ('to fill')	mə+pukul ('to strike')	mə+dapat ('to get')
→ mənisi	→ məmukul	→ məndapat

This rule is clearly conditioned by the prefix, and is no longer phonetically motivated. In some cases, allomorphy rules are not lexically restricted, but affect most morphemes of a language, or an entire class of morphemes: the Finnish gradation rule (see SVI.5.6) belongs to this type, as well as some palatalizations in Slavic languages (see SVI.5.3). They account for non-automatic alternations; in French, the alternations between 'zero' and consonants, in the following examples, are governed by allomorphy rules: (*je*) *connais*, (*nous*) *connaissons*, *connaissance* ('(I) know', '(we) know', 'knowledge'). The underlying forms of these three related word forms are: /kɔ̃nɛ/, /kɔ̃nɛs+ɔ̃/, and /kɔ̃nɛs+ãs/ respectively, with an alternation between /s/ and 'zero'. In *défi*, *défier*, *oubli*, *oublier* ('challenge', 'to challenge', 'oblivion', 'to forget'), whose underlying forms are /defi/, /defj+e/, /ubli/, /ublij+e/ respectively, the alternations between /i/ and /j/, or between 'zero' and /j/, are automatic and governed by phonotactic rules (before a vowel, /i/ changes into its semivocalic counterpart, or /j/ is inserted after /i/, if this vowel follows a cluster of obstruent plus liquid: see p.357).

In 'orthodox' generative phonology, underlying representations are *inputs* to internal-sandhi rules; in the view of phonology that I advocate, they are *outputs* of such rules. This point is essential.

VI.3.4. Realization rules and external sandhi

Lexical, or underlying, representations are inputs to realization rules and external-sandhi rules. Realization rules are subphonemic (their outputs are not plausible inputs) and they are traditionally known as 'allophonic' (see Martinet (1970: 74-76)). They introduce new segment types. We know that they can be 'undone' in inverse derivations (see SVI.2.3, p.174), since the latter are permitted by the theory (note that this means that the model is neutral with respect to speech production or perception). Realization rules are automatic, general, and natural, that is, phonetically conditioned: in French, vowel lengthening and voice assimilation are instances of realization rules. Nasal vowels are lengthened when stressed: *lente* ('slow') is realized [lã:t] (underlying representation: /lãt/). The /b/ of *observer* ('to watch') is devoiced before a [-voiced] obstruent (regressive assimilation), even though it may remain lenis, and distinct from /p/ in the same context (in my own idiolect).

All models of phonology generally agree on the subject of realization rules and (with some exceptions) on phonotactic rules; allomorphy rules are the main bone of contention. Realization rules are distinct from what we might call 'reductive rules', which apply after realization rules, and relate the careful phonetic variant of word forms to fast speech variants, for

instance (*je ne sais pas* ('I don't know'), when pronounced *chais pas* [ʃɛ pa], is the result of several reductive rules).

External-sandhi rules are not word-level processes; they apply in connected speech, when words are chained together to form utterances. They apply across word boundaries. In Greek, for instance, contraction applies in /to#'eleʝa/ ('I said it'), which is pronounced ['toleʝa] (see Mirambel (1977: 27)). Note that some rules (e.g., voice assimilation in French or Dutch) are both realization rules, or internal-sandhi rules, and external-sandhi rules. In Dutch, regressive voice assimilation applies across and within word boundaries. The preposition *af* /af/ ('off') becomes /av-/ when it is adjoined to a verb stem: *afbellen* /'av+bel+ən/ ('to ring off'). The final /f/ of (*ik*) *schrijf* /sxrɛ'f/ ('(I) write') is realized [v] in the sequence *ik schrijf veel* ('I write a lot'): [ɪk sxrɛ'av ve:l] (see Koolhoven (1983: 19)).

VI.3.5. Rule classes: conclusion

Realization rules and phonotactic rules are natural processes; so natural processes can either modify lexical forms or filter them.

The distinctions between various rule classes lead me to reject Vennemann's (1974b) view of underlying representations as purely phonetic rather than phonemic representations. For Vennemann, all rules are static conditions on forms. This conception has been criticized, even by advocates of concrete phonology (Linell 1979: 76-77).

Allomorphy rules account for non-automatic alternations:

(1) *met*, (*nous*) *mettons*, /mɛ/, /mɛt+ɔ̃/ ('(he) puts', '(we) put')

(∅ ~ /t/).

Lexical representations cannot be inputs to these processes, as allomorphy rules are responsible for morphemic variation, whereas lexical representations are word forms. Unlike phonotactic rules, they are not phonetically motivated (but both classes are morphophonemic). Allomorphy rules are synchronic residues of old natural rules, which have ceased to be productive and exceptionless. Phonotactic rules and allomorphy rules, which do not modify lexical representations, are not realization rules: they are rather rules of construction; in my view, they should be integrated into a word-formation component. The exact treatment of allomorphy, in a phonological theory, is also contingent upon the conception of the lexicon (the question being the nature of the items which are stored in lexical entries).

It is not incorrect to suggest that -- at word level -- morphophonemic rules, if they are exceptionless and natural, are equivalent to well-formedness conditions on underlying representations, whereas other general, natural rules, traditionally called allophony rules (= my realization rules), derive phonetic representations from underlying representations.

VI.4. The model of phonological analysis

VI.4.1. Components

We have seen that rules fall into several classes, and that underlying representations, which are full word forms, are inputs to only some of these classes of rules. I shall now present the outlines of the model of phonological analysis. I shall distinguish two different components: word formation and phonology proper. The general form of the model is as follows:

(A) WORD-FORMATION COMPONENT: morphology

Lexical rules: -- structure-building rules:

-- contrastive rules

-- redundancy rules

-- internal-sandhi rules:

-- allomorphy rules

-- phonotactic rules

↓

underlying representations

(B) PHONOLOGICAL COMPONENT:

Post-lexical rules: -- realization rules
 -- external-sandhi rules
 ↓
phonetic representations

VI.4.2. Word formation and allomorphy

Thus far, I have been explicit about post-lexical rules and their role in the phonological component. We know that underlying representations are phonemic word forms which are inputs to post-lexical rules: the string *petit ami* /pəti#ami/ ('boy friend'), for instance, will be subject to the post-lexical process of liaison, and be converted into pəti#t#ami (insertion of #t); the vowel of *grande* /gRãd/ ('large', feminine) will be lengthened when stressed ((ã:)). This means that, if we consider French verbs, forms such as *met* /mɛ/ ('(he) puts'), *mettons* /mɛt+ø/ ('(we) put'), *mettre* /mɛt+R/ ('to put'), *mettions* /mɛt+j+ø/ ('(we) put', imperfect), *mettais* /mɛt+ɛ/ ('(I) put', imperfect) etc... are underlying representations in their own right. In the standard model, the underlying representation of this verb would be a unique morpheme representing the stem: /mɛt/; in this abstract theory, what I refer to as allomorphy rules, phonotactic rules, realization rules, and external-sandhi rules are all interspersed and apply in one component only.

In the model which I am now proposing, and which might be called the theory of *constrained phonology*, I distinguish several rule classes and two

components (see above). However, we have not examined the question of the exact application of allomorphy rules and phonotactic rules, the way they affect forms and produce lexical representations (and more particularly the question of the nature of their inputs, if underlying representations are their outputs). I shall now deal with this topic, and examine the function of rules, bearing in mind that the basic lexical unit in the model of constrained phonology is not the morpheme, but the word (for a discussion of the significance of the word, see Aronoff (1976: 21-23), Bynon (1977: 113), and also Jakobson (1955), who criticizes the tendency to neglect the word, whereas in fact its role as a linguistic entity is absolutely essential. Jakobson's view appears to be more interesting than that of Martinet (1970: 115; 1985: 70-85) who, as we have seen, rejects the notion of word).

The items which are stored in lexical entries are word forms. Thus, morphemes cannot be stored (except for affixes, in a special lexicon). It can hardly be denied that morphemes have a reality of some sort; they are not 'fictions', since, even though word forms are lexical units, these units are structured, and can be analyzed into morphemes: underlying forms are not purely segmental, and morphological boundaries are also present in them. My view of the lexicon is clearly different from the standard view in *SPE* phonology, since bare stems are excluded from it (unless these bare stems constitute word forms by themselves, and are stored as word forms, not as morphemes; the English item *book*, for instance, is both a morpheme and a word form).

We must now ask the following question: 'Are all word forms of the language stored?' If the answer were affirmative, lexical entries would be highly redundant. Consider, for instance, a verb like *chanter* ('to sing'); if we know the infinitive, /ʃät+e/, we can derive absolutely all the other forms of the paradigm, because *chanter* is perfectly regular and belongs to a productive conjugation. So we can reasonably assume that only the infinitive, that is, the citation form of this verb, is stored. Unfortunately, the consequences of this view are undesirable if this principle is systematic and generalized to all French verbs. Consider now a verb like *coudre* ('to sew'); how are we to know that this verb also has a stem allomorph /kuz-/ (cf. *cous+ons* /kuz+õ/ ('let us sew'), *cous+u* /kuz+y/ ('sewn'))? We could enrich the lexical entry with rule features, as in 'orthodox' generative phonology; this solution would be inadequate when the allomorph in the citation form is itself the output of allomorphy rules, or worse, of phonotactic rules. In Maltese, for instance, the basic form (from a syntactic point of view), that is, the citation form of the verb meaning 'to write' is /kitep/. Yet this form, which is uninflected, has undergone the phonotactic (exceptionless) rule devoicing final obstruents (see Aquilina (1965: 19-20)). The phonologically basic allomorph is in fact /kitib-/, as is revealed by the inspection of the whole paradigm (cf. /kitib#na/ ('he wrote our name')). So it seems that this approach is fundamentally misguided (although it is apparently adopted by Linell (1979: 87)) and I shall reject it (for arguments against this misguided approach, see Kenstowicz & Kisseberth (1977: 18-26)). It seems plausible to propose an intermediate solution. We need not list whole paradigms; yet in some cases we need to list not only citation forms, but also partial paradigms, that is, only the forms it is necessary to store if we want to derive all the

other forms and complete paradigms. This method is typically the 'word-and-paradigm' model (see Matthews (1974: 67-68)), and I shall adopt it in constrained phonology. Of course, it can be objected that the word-and-paradigm model is incompatible with a rule-based phonology, such as generative phonology. We may also ask how speakers derive non-listed word forms. It should prove possible to capture generalizations in a word-and-paradigm model provided several conditions are fulfilled:

- This model should also share some properties with morpheme-based models ('item-and-arrangement') as well as with 'item-and-process' models (Matthews 1974: 226-227).

- Rules of allomorphy should relate the listed forms, but also permit the derivation of other forms.

In a word-and-paradigm model, we can posit the same rules as in the standard model of generative phonology (if they do not violate any constraint in the framework that I advocate): the difference will lie in the function of these rules. We can also dispense with rule features even when the rules are not general, because word forms are listed in their phonemic representations; by comparing the word forms of a paradigm (or of several related paradigms), we can infer that they are the outputs of a given rule. Therefore rules can affect forms, just as in 'orthodox' generative phonology. Yet there are differences: since full word forms are listed, allomorphy rules cannot be generative, as far as listed forms are concerned; their function is essentially analytical. However, they are not exclusively rules of word analysis: they perform a generative function when we want to derive

non-listed word forms. Our problems can be solved if we admit the following hypotheses:

- Allomorphy rules are inferred from the inspection of partial paradigms.

- The basic stem allomorph of an item can be inferred once we know the partial paradigms and the allomorphy rules which affect this item.

Speakers will necessarily assume that forms belonging to the same paradigm are related by rules, and these allomorphy rules will be inferred quite easily. As regards interparadigmatic alternations (that is, alternations affecting forms of different -- phonologically related -- lexical items, in the field of derivational morphology), speakers compare forms; the question is: 'How do they know that they are related?' It may be assumed that semantic criteria play a crucial role. Speakers may also make errors, and fail to relate lexemes belonging to the same 'family' (*parler/parole* ('to speak/speech'), for instance), or relate lexemes whose etymological sources are different (*sang/sanglier* ('blood/boar')). As rules are inferred, speakers' internalized grammars will be different, especially in the field of derivational morphology. Relating forms of a lexeme and relating lexemes are two distinct operations, even if the method is analogous, because the various forms of a lexeme belong to the same lexical entry, whereas different (related) lexemes belong to distinct entries, and relatedness is closer within paradigms. Moreover, related lexemes are often subject to semantic drift (cf. *docte* ('learned') and *docteur* ('doctor')). This is why analogy affects intraparadigmatic alternations (that is, alternations affecting the word forms of a single lexical item) much more often.

Historically, examples are legion: *aime, amons* > *aime, aimons* ('(I) love', '(we) love'), but *amour* ('love'), the related noun, was not affected (see Skousen (1975: chapter 3) for other examples).

Let us now illustrate our method with a concrete example: suppose that in French verb morphology, allomorphy rules insert a stem-final consonant in the following environments, for verbs of the third conjugation (i.e., irregular verbs, or verbs belonging to non-productive types):

(i) In the environments [+plural] or [+subjunctive], and before a [-consonantal] segment.

(ii) Before the segment /R/.

Suppose also that the partial paradigm of *coudre* ('to sew') includes the following forms: /kud+R/ (infinitive), /ku/ (present indicative singular), /kuz/ (present indicative third person plural), and /kuz+ø/ (present indicative first person plural). If we inspect the partial paradigm, we realize that *coudre* is subject to the above-mentioned allomorphy rules (which can insert different consonants in the two contexts: /z/ is inserted in context (i), and /d/ is inserted in context (ii)). These rules have the form:

Ø → [-vocalic]

So their input is 'zero'. We shall conclude that 'zero' is the basic alternant in both cases: we are now in a position to infer that, if *coudre*

has the allomorphs /ku-/, /kuz-/ and /kud-/, the basic stem allomorph of this verb is /ku-/, with the basic alternants, which are identified with the inputs to rules. Listing (in constrained phonology) becomes equivalent to adding rule features (in the standard theory); we are now able to 'reconstitute' the formation of listed word forms, and generate non-listed forms, by selecting the basic stem allomorph as operand, and by applying allomorphy rules and phonotactic rules to it. The form *cousais* ('(I) sewed'), for instance, will be derived very easily:

ku-+ε → kuz+ε

Analogy plays a crucial role, because *cousons* is listed in the partial paradigm (lexical entry), which allows us to infer the rule inserting /z/ before a [-consonantal] segment. This is why speakers will not (normally) produce the form **coudais*: the segment /d/ is inserted only before the affix /R/, as is revealed by the infinitive. It should be added that in some cases, speakers are liable to produce incorrect forms, such as **nous moudons* ('we grind'), instead of *nous moulons*. This speech error belongs to a specific type: the selection of the wrong allomorph; the verb *moudre* ('to grind') has three stem allomorphs: /mu/, /mud-/, and /mul-/. Before a vowel, it is the third of these allomorphs which must be selected; however, some speakers are tempted to reduce allomorphy, and to generalize the allomorph /mud-/ to all contexts, except for the present and imperative singular. Note that this analogical levelling is quite plausible, because some verb paradigms function in the same fashion (*pendre* /pãd+R/ ('to hang'), for instance: *je pends* /pã/ ('I hang'), *nous pendons* /pãd+õ/ ('we hang')). This problem will be dealt with in SVI.4.4 in a more detailed way.

Although morphemes are not listed, they play a role because word forms are structured, and because they are the operands of word formation or word analysis. Rules also play their roles, just as in 'orthodox' generative phonology. This model of constrained phonology actually shares properties with three models of morphology (see Matthews (1974: 18, 226-227)):

-- With the word-and-paradigm model, because forms are listed, the word is the central unit, and analogy plays an important role (Matthews 1974: chapter 4).

-- With the item-and-arrangement model, because forms are structured, and word forms are chains of morphemes (Matthews 1974: chapter 5).

-- With the item-and-process model, because forms are analyzed, but they are also derived as in the standard version of generative phonology (Matthews 1974: chapter 7). Moreover, dynamic processes modify basic forms.

Consider, for instance, the paradigm of the verb *battre* ('to beat'); we can store the following forms in the lexical entry (the infinitive /bat+R/ will represent the whole paradigm, because it is the citation form of the word):

/bat+R/ ('to beat')

/ba/ ('(he) beats')

/bat/ ('(they) beat')

/bat+y/ ('beaten') (the past participle is listed because we cannot

predict that its affix is /-y/).

The word forms in the lexical entry are listed and also structured. They can be analyzed, since morpheme boundaries are present underlyingly. They can also be reconstituted; the form /bat+R/, for example, will be derived as follows:

ba-+R → bat+R (the addition of the affix /-R/, which is a morphological operation, triggers the insertion of a stem-final /t/, which is an allomorphy rule).

Other word forms of the paradigm of *battre* will be generated in the usual fashion: *(nous) battons* ('(we) beat'), for instance, will be derived through the insertion of a stem-final /t/ before a vowel (compare *cousons* above).

Each of the three above-mentioned models is only partially correct: the theory of morphophonology which I am now proposing is a synthesis, and presents the advantages of each model. Rules perform a double function: word analysis, and word formation, which can be subdivided into reconstitution and generation. I have attempted to show how rules of allomorphy, or more generally lexical rules, can be integrated into morphology (this corresponds to several recent developments: see Molino (1985: 28), who writes that 'il apparaît que les règles de production peuvent être considérées comme des extensions analogiques de relations entre des mots déjà existants' and 'Il s'agit [...] de règles induites à partir des exemples connus'). An important characteristic of the model of constrained phonology is the notion of *inference*; in the case of /bat+R/, for instance, the examination of the listed word forms in the lexical entry allows us to infer that the verb is subject to rules of consonant insertion in specific contexts, and also that its basic stem

allomorph is /ba-/, because the 'zero' alternant is the input to these rules of insertion ($\emptyset \rightarrow t$). Basic stem allomorphs and allomorphy rules are inferred, rather than listed and triggered by rule features respectively. Underlying representations can remain natural, that is, they can respect phonotactic rules or conditions, without any loss of generality. Note that archisegmental underlying representations would violate phonotactic rules, and would have to be rejected for this reason alone. In functionalist phonology (see Martinet (1970)), the phonemic representations of the German word *Rad* [rɑ:t] ('wheel') is /rɑ:T/ (Malmberg 1971a: 72, 95). In this form, the symbol /T/ represents the 'archiphoneme' or 'incomplete phoneme' (Jakobson & Waugh 1979: 28), because in German the contrast between voiced and unvoiced obstruents is neutralized (cancelled) in word-final position. In such archiphonemic or archisegmental representations (see also Hooper (1975)), the final obstruent /T/ is assumed to be [0 voiced] (i.e., unspecified for the feature [voiced]) instead of [-voiced], as required by the neutralizing (phonotactic) rule of final devoicing (see Bynon (1977: 90ff)). Note also that we can introduce a slight distinction between underlying representations and lexical representations: each word form, whether it is listed in a lexical entry or not, will have a phonemic underlying representation. Lexical representations will constitute a subset of underlying representations, more precisely the underlying representations of the word forms which are listed (partial paradigms).

The notion of inference clarifies the role of alternations insofar as these alternations are not purely allophonic. I claimed that allomorphy plays no role when speakers set up underlying representations (see SVI.2.2); in these circumstances, it is legitimate to ask whether alternations play

any role at all in linguistic analysis. The answer is now clear: they allow speakers to infer the basic stem allomorphs, and allomorphy rules, from the inspection of a subset of underlying representations. This theory avoids the drawbacks of the three above-mentioned models of morphology:

- In the word-and-paradigm model, word forms are not analyzed, and the relationship between forms is not explicit; besides, there are no rules in the generative sense.

- The item-and-arrangement model (or morpheme-alternant theory) belongs to the taxonomic trend of structuralism. In this model, morpheme alternants are listed, but there are no rules. In some versions of this model, there are also contradictions between phonology, with the word as the basic unit, and morphology or syntax, with the morpheme as the basic unit (we have seen that this contradiction is patent in Martinet's (1970) work: see SVI.1.4).

- The item-and-process model lays the emphasis on rules, which take priority, but tends to neglect the differences between various rule classes; in 'orthodox' generative phonology, these differences are obliterated with the rejection of the phonemic level (see SVI.2.1). Weakly suppletive forms are not listed (when they should be, because no natural rules relate alternants: in *travail* /tRavaj/ ('work'), *travaux* /tRavo/ ('works'), for instance, the rule $aj \rightarrow o$ is not phonetically motivated). For minor rules, rule features are preferred to the listing of alternants; this may represent an improvement over listing without

rules, as in the other two models, but this approach is misguided when it neglects the word as a lexical unit.

Hudson (1975) and Hooper (1976) tried to improve the morpheme-alternant theory by adding rules to the listing of alternants, but I have already pointed to the inadequacies of the revised version of the item-and-arrangement model (see SVI.1.4; their rules distribute alternants without being allowed to effect structural changes: in Kenstowicz & Kisseberth (1979: 180-196), the morpheme-alternant theory and suppletive representations of morphemes with braces as in Hudson (1975) are criticized in a very convincing manner). The model of constrained phonology combines the following properties:

- Word forms are lexical units.
- Several forms of a word can be listed.
- Rules relate forms, analyze, or derive them.

In order to derive and analyze all forms properly, in addition to the normal lexicon, in the form of a dictionary, we need a 'secondary' lexicon containing the list of inflectional and derivational affixes, and the contexts in which they appear.

Allomorphy rules can help speakers to derive new forms, to construct them, to memorize them, to relate the forms of a paradigm, and, in short, to complete paradigms; so from a more formal perspective, they act as redundancy rules filling in the blanks of partial paradigms (that is, the word forms of paradigms which are not stored in lexical entries).

In the present model, phonological and syntactico-semantic criteria cannot conflict: a form like *coudre* /kud+R/ ('to sew') is syntactically unmarked and is the citation form of the verb: yet, the basic stem allomorph is /ku-/ from the point of view of morphophonemics. In other theories, one has to choose between the two types of criteria. Linell (1979: 84-87) prefers syntactico-semantic criteria, which poses serious problems from the point of view of allomorphy, since uninflected forms, which are often basic from a syntactic perspective, are frequently subject to rules, such as the deletion of word-final consonants (for examples, see Kenstowicz & Kisseberth (1979: 109-115)). Linell's example, the Finnish word form *käsi* ('hand', nominative, uninflected citation form), is in fact the output of a rule assibilating /t/ before /i/, and of a rule raising /e/ to /i/ before # (see Sauvageot (1949: 52, 56-57)). The possessive form *kätteni* /kæte+ni/ ('my hand') reveals the basic stem allomorph: /kæte-/, because the structural descriptions of assibilation and raising are not satisfied: then the basic stem allomorph is preserved in this form. So it can be argued that the basic stem allomorph is /kæte-/, if we select phonological criteria. Therefore, the two types of criteria conflict: this kind of conflict is avoided in constrained phonology. In this model, /kæsi/ will be the citation form of the paradigm, and will be basic from a syntactico-semantic point of view; the stem allomorph which is basic from a phonological point of view will be /kæte-/, but this allomorph will not be listed as such: it will be inferred from the inspection of the paradigm of *käsi* (for details, see §VI.5.6).

VI.4.3. Inflectional and derivational morphology

The model I am proposing does not make any crucial distinction between inflectional and derivational morphology, contrary to some post-*SPE* theories, such as those of Hooper (1976: 14-17), who has 'MP-rules' for inflection, and 'via-rules' for derivational processes (see also Vennemann (1972) for the notion of 'via-rule'), and Leben (1979), in whose theory of 'upside down' phonology, the outputs of 'upside down' rules (inverse algorithms) can be quite abstract and unconstrained (like the inputs in the standard model). Leben compares different words and 'undoes' standard rules. In French, the lexical representations of *lit*, *litterie*, *aliter* ('bed', 'bedclothes', 'to confine to bed'), for instance, would be /li/, /lit+Ri/, /a+lit+e/, and we would undo the rule of consonant truncation (see SV.3):

li → lit

It is easy to see that the outputs in Leben's theory are similar to the inputs in the standard abstract theory, and that the rules are assumed to be identical: it is their mode of application, and their function which are different. Unfortunately, Leben can only parse words, or analyze them -- his rules suffer from a serious defect: they cannot be generative and produce new items. His method is only a 'procedure for determining whether the words can be related' (183). Word relatedness is only an aspect of the theory of morphology, but Leben's 'upside down' phonology is hardly able to treat other interesting aspects, such as word formation itself. It suffers from another shortcoming: it says nothing about inflectional morphology; I cannot see the interest of a procedure for determining word relatedness when we

already know that the word forms of a paradigm are related, since the problem of relatedness in inflectional morphology is (by definition) a pseudo-problem. I accept the idea that derived items are stored individually, but it would be absurd to store all inflected forms, and still more to store them separately. In the theory of constrained phonology, allomorphy rules are constrained and do not simply constitute an analyzer. The outputs are also constrained, since they are phonemic, and respect various conditions on representations: the inputs are automatically constrained, since they are inferred from the inspection of paradigms and constrained rules. In Leben's analysis of English vowel-shift rules, the outputs of his inverse algorithm are identical to the abstract vowels of the *SPE* analysis: the output of the derivation of the item *Christ*, for instance, is /kri:st/. In sum, outputs and inputs are of a different nature (inputs are phonemic, but outputs are 'deeper', that is, more abstract); in my view, allomorphy rules should map phonemes on to phonemes.

In constrained phonology, the same allomorphy rules operate in inflectional and derivational morphology: the rule which inserts a consonant before a vowel or a semivowel in French verb morphology (cf. *couds*, *cousons*: /ku/, /kuz+ø/ ('(I) sew', '(we) sew')) also inserts a consonant before a derivational affix:

(1) *connait*, (*nous*) *connaissons*, *connaissance*, /kɔ̃nɛ/, /kɔ̃nɛs+ø/,

/kɔ̃nɛs+ãs/ ('(he) knows', '(we) know', 'knowledge')

(1) *bat*, (*nous*) *battons*, *bataille*, /ba/, /bat+ø/, /bat+aj/

('(he) beats', '(we) beat', 'battle') etc...

As the same rules apply in inflectional and derivational morphology, it is quite unjustified to distinguish two categories of rules of allomorphy, as in Hooper (1976: 14-17).

VI.4.4. Morphophonemic ambiguity

In the standard version of generative phonology, underlying representations are morphemes, and are not suppletive in most cases, even if an item has several surface allomorphs. With such a conception of lexical entries, it is difficult to account for morphophonemic ambiguity, which is responsible for so many linguistic changes. In my model, surface allomorphs are listed, since they are parts of word forms. Let us now try to define morphophonemic ambiguity. Consider, for example, the alternations between 'zero' and a consonant in the following paradigms:

(*je*) *couds*, (*nous*) *cousons*, (*ils*) *courent*: /ku/, /kuz+ø/, /kuz/

('I) sew', '(we) sew', '(they) sew')

(*je*) *crois*, (*nous*) *croyons*, (*ils*) *croient*: /kRwa/, /kRwaj+ø/, /kRwa/

('I) believe', '(we) believe', '(they) believe')

In the first person plural, two different rules insert the /z/ of *cousons* and the /j/ of *croyons*. The contexts of the first rule have already been mentioned (before a vowel or a semivowel, and in the morphological context [+plural]). The rule inserting /j/ applies only before a vowel or a semivowel, but not in the morphological context [+plural] (cf. *croient*, /kRwa/). A form like /kRwaj+ø/ is therefore morphophonemically ambiguous,

because, *a priori*, when we compare only /kRwa/ and /kRwaj+ø/, two different rules can theoretically have inserted /j/ (the one which applies before a vowel or a semivowel, but also in morphological contexts, or the one which applies exclusively before a vowel or a semivowel). Suppose now that some speakers choose the 'wrong' rule: this 'wrong' rule will then apply also in the third person plural, and this misinterpretation of the data will cause an analogical change: (ils) *croient*, /kRwa/ > */kRwaj/. In fact, I have observed that this change is not infrequent in colloquial French, and my theory predicts it. This is what I call morphophonemic ambiguity. A theory in which basic stem allomorphs are inferred can account for analogical changes in a very natural way: the inspection of partial paradigms reveals immediately if there is any risk of such a change taking place. These changes cannot be explained in the standard model, because basic forms are not inferred, but are supposed to be listed as such. Similarly, rules are not inferred, but instead, lexical items are marked for rule features: then, it is difficult to imagine why speakers should modify these features or suppress them. If we examine underlying representations in 'orthodox' generative phonology, the very fact that analogical changes take place remains puzzling: this examination is quite fruitless. The source of the problem in the standard model lies in the conception of lexical entries: basic stem allomorphs are listed instead of being inferred, and inversely, phonemic word forms are derived instead of being listed; therefore, we have to inspect the outputs of derivations to account for analogical changes, and in a very awkward manner. In the theory of constrained phonology, we simply inspect lexical units: restructuring is a purely lexical matter and derivations of forms are completely irrelevant.

It is true that analogical levelling or analogical extension can both cause a simplification of paradigms and a greater complexity in the formal expression of rules (a good example is the analogical levelling which affected verb paradigms in Chicano Spanish: see Saltarelli (1974) or Harris (1974: 17-22)). Unfortunately, the standard model can express only rule complexity, not paradigmatic simplicity. In my view, rule complexity is less important, because rules are always inferred, while word forms are listed: underlying representations, or lexical representations pre-exist. What is regarded as surface allomorphy in 'orthodox' generative phonology is in fact more costly than rule complexity. A theory which cannot express this fact is inadequate.

In Finnish, Skousen (1975: 66) mentions interesting examples of analogical changes:

impi ('virgin'), genitive *immin* > *immi*, *immin* (-mm- being the weak grade of -mp- in a checked syllable: see p.258)

In this example, the change in the citation form (nominative: *impi*) was possible only because *immi* is also a plausible citation form, that is, because there are items with invariant -mm- in all forms of the paradigm (example: *tammi* ('oak'), genitive *tammín*). Such changes do not take place when there is no morphophonemic ambiguity (Skousen's examples are all illustrations of morphophonemic ambiguity).

The theory of constrained phonology also explains why different speakers can analyze the same data in a different way: their inferences can

be different (since word forms take logical priority over rules and basic stem allomorphs).

VI.4.5. Phonotactic rules

Phonotactic rules, like allomorphy rules, perform the following functions:

- They are generative, in the production of non-listed forms, or in the re-constitution of listed forms.
- They allow us to analyze forms (that is, to analyze listed underlying representations).

They also perform a third function: they filter underlying representations, which are the outputs of the word-formation component, and which must respect well-formedness conditions (phonotactic constraints imposed on word forms). Note that if alternations between allomorphs do not influence the form of underlying representations, they do condition the form of phonotactic rules; in German, voiced obstruents must not occur before a word boundary; yet, the rule will be:

(R.8) [-sonorant] → [-voiced]/_#, rather than:

(R.9) [+consonantal & +voiced] → [+nasal]/_# (see Linell (1979: 125))

Alternations (cf. *Rad*, *Rades* /rɑ:t/ ~ /rɑ:d+əs/ ('wheel', nominative and genitive)) reveal this (there are no alternations between a non-final /d/ and a final /n/, for instance).

Unlike allomorphy rules, phonotactic rules are not inferred from the inspection of partial paradigms, because they are not lexically restricted, but on the contrary, they are quite general and even very often exceptionless (in the standard model, these phonotactic rules do not require exception features). On the other hand, phonotactic rules, like allomorphy rules, allow us to infer the basic alternants, which are the inputs to these rules, as usual.

VI.5. Applications of theoretical principles

VI.5.1. Word analysis and underlying representations

In Hale (1973: 414ff), we find a now famous account of some data in Maori. These data are interesting, because they show that the usual procedure of evaluation fails to select the proper analysis. In Maori, a Polynesian language, the passive forms of verbs keep a stem-final consonant before a suffix, but the same consonants are lost before a word boundary. The following pairs of forms exemplify alternations:

<i>verb:</i>	<i>passive:</i>	
<i>awhi</i>	<i>awhitia</i>	('to embrace')
<i>hopu</i>	<i>hopukia</i>	('to catch')
<i>aru</i>	<i>arumia</i>	('to follow') etc...

The simplest analysis, even in a synchronic grammar, would consist in postulating the following underlying forms: /awhit/, /hopuk/, /arum/. The passive suffix would thus be invariant: /-ia/. Within the classical framework of generative phonology, this analysis is quite plausible, and the stem-final consonants would be truncated before # (note that such a process would be exceptionless). However, Hale provides several pieces of evidence which all point towards a different solution: only [tia] is a productive passive marker; non-passive forms have been restructured, and their underlying forms have no final consonant. According to Hale, a constraint which originally governed the form of surface representations was extended to underlying representations.

This example is particularly interesting, for the following reasons:

- The procedure of evaluation must be rejected, since it fails.
- The rule truncating final consonants is still surface-true, and yet final consonants are absent from the underlying representations of non-passive forms.

-- The standard version of generative phonology has to postulate that a surface constraint was transferred to underlying forms, in order to explain otherwise puzzling pieces of evidence.

'Orthodox' generative phonology is unable to separate the following issues:

- (i) The putative existence of a rule deleting final consonants.
- (ii) The nature of the underlying representations of stems.
- (iii) The underlying representations of unaffixed verb forms.

The second issue, in my own terminology, is actually the nature of basic stem allomorphs. There is an important difference between standard generative phonology and constrained phonology: for the former, underlying representations are stems; for the latter, they are word forms. In standard generative phonology, if there is a rule deleting final consonants, this implies that the underlying representations of unaffixed verb forms, which will be identical to the underlying representations of stems in this theory, will be: /awhit/, /hopuk/ etc... In short, they will have a stem-final consonant, especially if the rule is surface-true. In constrained phonology, facts are envisaged in a very different manner: underlying representations are phonemic word forms; the rule truncating consonants exists, since we can verify its validity. However, the underlying representations of unaffixed verb forms will have to be: /awhi/, /hopu/, /aru/, without the final consonants (in the phonetic forms, there is no trace of these consonants, which would not be recoverable in the inverse algorithm: see SVI.2.3). So in spite of the generality of the truncation rule, the

underlying representations have no final consonant. At best, the rule, which is lexical, and applies in the word-formation component (it belongs to the phonotactic type), relates various forms of paradigms. Now, a second and different issue is the analysis of passive forms: does the morpheme boundary precede or follow /t/ or /k/ etc... in *awhitia*, *hopukia*? In the constrained framework, both analyses are equally correct, and no formal procedure can help us to select one or the other. This is why the external evidence adduced by Hale (1973) plays a crucial role and leads us to posit the following underlying representations for passive forms: /awhi+tia/, /hopu+kia/ etc... Although no constraint can eliminate the other alternative, this analysis presents several undeniable advantages, which are ignored by advocates of standard generative phonology: it may increase affix allomorphy, since the passive suffix will have more variants, but it considerably decreases stem allomorphy. It seems that two factors played a role:

- (i) The tendency to prefer affix allomorphy to stem allomorphy, which is logical, since it is less costly (affixes are more frequent than stems in complex word forms, and therefore their allomorphs are easier to learn).

- (ii) The frequent process of 'apocope of stems in favour of suffixes' (Kruszewski 1978: 66).

However, this cannot be absolute, and all depends on the number of allomorphs (note also that, if underlying representations are word forms, speakers can place the morpheme boundary in different positions and, apart

from this divergence, set up the same underlying forms for non-passive and passive verbs). Hale (1973) also shows that, in a related language, Lardil, the morpheme boundary follows segments alternating with 'zero': /murkuni/, /murkunima+n/ ('nullah', a sort of watercourse; see also Kenstowicz & Kisseberth (1979: 109-115)). In my model, the underlying representations of the unsuffixed form is not */murkunima/, because this form would violate phonotactic rules. The deletion rules, which are lexical, relate word forms. However, the basic stem allomorph is /murkunima-/. In Lardil, if the juncture preceded the segments alternating with 'zero', affix allomorphy would become tremendously complex.

The crucial point is this: while the data are baffling for the standard model, and lead linguists to posit new principles, they are quite natural if underlying representations are phonemic word forms.

VI.5.2. Phonemic representations

In Spanish, we find alternations which are generally considered to be purely phonetic in the most abstract accounts of the phonology of this language (see Harris (1969)). For the following pairs, we may posit a rule of velar softening:

apical, *ápice* ('apical', 'apex'); *fonólogo*, *fonología* ('phonologist', 'phonology').

The phonetic representations of these items are: [api'kall], ['apise] or ['apiθe] (dialectal variation), [fo'noloɣo], [fonolo'xia] (in *fonólogo*, [ɣ] is the intervocalic realization of /g/). Velar softening converts /k/ and /g/ into /s/ or /θ/, and /x/ respectively before front vowels. As /k/ and /θ/ or /s/ contrast before a front vowel (that is, the environment of velar softening), as well as /g/ and /x/, it is clear that the rule is not automatic and general. There are many instances of velars before front vowels: *qui*, *que*, *quitar*, *quedar* ('who', 'which', 'to remove', 'to stay'), with an initial [k] before [i] or [e]: [ki], [ke], [ki'tar], [ke'ðar]. In order to maintain the claim that velar softening is maximally general, abstract phonologists posit a rule of delabialization for such items with syllables [ki] or [ke]; the source of these syllables would be, according to them, /k^wi/, /k^we/, with a labio-velar consonant (see Harris (1969: 163ff)). Of course, velar softening would be ordered before delabialization in the theory of linear ordering (see Chomsky & Halle (1968: 340-350)). Some instances of /o/ in Spanish undergo a rule of diphthongization: *cuento*, *contar* ['kwento], [kon'tar] ('I count', 'to count'); in such items, diphthongization counterfeeds delabialization (which means that delabialization must not apply after diphthongization, although its structural description is satisfied). It is clear that rule order in standard generative phonology is particularly complex, but this analysis must be rejected for other reasons. (For Hooper (1976: 59-64), it must be rejected just because counterfeeding should not be permitted in natural generative phonology: in Chapter VII, I shall show that this kind of interaction *must* be permitted.) In constrained phonology, I observe that:

- (i) Diphthongization is an allomorphy rule, which is not general; compare *cozer* ('to cook'), which is subject to it, and *cozer* ('to sew'), which is not: *cuece* /'kweθe/ ('he cooks'), *cose* /'kose/ ('he sews').
- (ii) /k/, /θ/ (or /s/), and /g/, /x/ contrast before front vowels.
- (iii) Velar softening is an allomorphy rule, which is not general.
- (iv) There is no alternation between labio-velars and velars justifying a rule of delabialization.

So the underlying representations of the above-mentioned words will be: /api'kal/, /'apiθe/, /fo'nologo/, /fonolo'xia/, /ki/, /ke/, /ki'tar/, /ke'dar/, /'kwento/, /kon'tar/.

There is an important difference between natural generative phonology and constrained phonology, concerning the formal treatment of rules like velar softening in Spanish. For Hooper (1976: 62-63), it is a *via-rule*, which is context-free, and expresses the alternations between consonants in the field of derivational morphology, but not inflectional morphology; this *via-rule* is assumed to be bi-directional: $k \leftrightarrow \theta$, or $g \leftrightarrow x$. This formulation is certainly counterintuitive: the alternants /θ/ and /x/ appear before front vowels, and it is undesirable to omit this context. In constrained phonology, velar softening will have exactly the same form as in standard generative phonology, but its function will be radically different: its function is not generative, and it relates different word forms (it is a lexical rule).

VI.5.3. Rule classes in constrained phonology

Palatalization is a well-known and frequently attested phenomenon in several Slavic languages. For Chomsky & Halle (1968: 420), 'although usually presented as fossilized historical processes, the palatalizations are, in fact, productive in most modern Slavic languages'. Chomsky & Halle discuss palatalizations in relation to markedness, claiming that 'the marking conventions [...] contribute significantly to determining the concept "rule plausibility"'. They deal with rules converting velars into palato-alveolars, for instance, or alveolars:

$k, g, x \rightarrow tʃ, dʒ, ʃ$, or:

$k, g, x \rightarrow t^h, d^h, s$

We may ask in what sense these rules are productive. In order to answer this question, we shall examine the situation in Russian. In this language, there is an underlying contrast between palatalized ('soft') and velarized ('hard') consonants: see Garde (1980: 20-25). This phonemic opposition is neutralized (cancelled) in some contexts: in learned words, only palatalized consonants may appear before the vowel /e/ or the semivowel /j/ (Garde 1980: 66-67), and this neutralization causes alternations between basic hard consonants and their soft counterparts: /vāda/ ('water'), /bʲizvodʲjā/ ('absence of water'). In these examples, the hard /d/ alternates with the soft /dʲ/. In my theory, this process is very clearly a lexical, phonotactic rule which relates alternants, and is automatic; it may be termed 'palatalization'. Note that /e/ and /j/ are [+front], and that a palatalization process before these segments is perfectly natural, since it is phonetically conditioned.

In the same language, there are other palatalizations, including the following:

(i) Hard consonants become soft before the imperative marker /-i/

(Garde 1980: 110):

/ʒ'iv'u/ ('I live') /ʒ'ivʲ+i/ ('live')

(ii) Dorsals become palato-alveolars before the diminutive suffix /k/, or the verb ending /-oʃ'/, and hard consonants become soft (111):

/ʒ'iv'u/ ('I live') /ʒ'ivʲ+oʃ'/ ('you live')

/p'ik'u/ ('I bake') /p'itʲ+oʃ'/ ('you bake')

(iii) The same change affects dorsals before the comparative suffix /-i/:

/kr'ep'kʲ+ij/ ('firm') /kr'ep'tʲ+i/ ('more firm')

In order to understand the status of such rules, we must take the following data into account:

(i) The phoneme /i/ may follow hard consonants:

/b'itʲ/ ('to be') (/i/ has a retracted allophone in this context)

/ʒ'itʲ/ ('to live') (with a retracted /i/ as well)

- (ii) Plain dorso-velar and palatalized dorso-velar consonants contrast very marginally (see Garde (1980: 59-61)); I shall regard this opposition as quasi-phonemic (see Korhonen (1969) and Linell (1979: 98)).

Apart from a few exceptions, the palatalized dorso-velars appear before /i/, /e/, and the plain dorso-velars in all other contexts: this rule is obviously phonetically conditioned and natural. What is important is the possibility of sequences of dorsal consonant plus front vowel: /r'uk^ji/ ('hands'), /k^jis^t/ ('brush'); such sequences are very frequent and cannot be treated as exceptional. Note that the contrast between soft and hard dorsals is neutralized before /i/ and /e/, whilst for other pairs of consonants, it is neutralized before /e/ but not before /i/. It is clear that we have just examined two different classes of palatalizations:

- (i) Phonotactic rules converting [-dorsal] consonants into their soft counterparts before /e/ and /j/ (but not before /i/), and converting [+dorsal] consonants into their palatalized counterparts before /i/, /e/ and /j/.
- (ii) Allomorphy rules converting [-dorsal] consonants into their soft counterparts in some grammatical environments, or [+dorsal] consonants into [+coronal & +palatal] consonants in grammatical environments as well.

In the alternations that I have mentioned, the phonotactic rules and the allomorphy rules cause the same structural changes when the consonant in

the input is [-dorsal], but the type of conditioning is quite different; when the rule is phonotactic, this conditioning is phonetic, and in other cases, it is not. When rules affect velars, structural changes are different:

(i) The neutralizing rule palatalizes dorso-velars.

(ii) The allomorphy rules convert them into palato-alveolars.

It is very important to keep the two classes of rules distinct for the following reasons:

-- In some cases, their structural changes are identical.

-- Some allomorphy rules are phonetically plausible.

This shows that phonetic plausibility is not a sufficient criterion. Note that a form like /ʒ'itʃ/ ('to live') is crucial: such an example (and similar ones with a retracted allophone of /i/ after a hard consonant) reveals that the changes caused by the imperative marker /-i/, or by the comparative marker /-i/ are not natural, but are grammaticalized, in spite of the feature value [+front] of their vowel. Grammatically conditioned rules are in fact phonetically plausible only to a certain extent: dorsal stops become /tʃ/ and /ʒ'/, and the dorsal fricatives become /ʃ'/; in Russian, although the phoneme /tʃ/ is soft, /ʃ'/ and /ʒ'/ are actually velarized, and 'palatalization', in such conditions, is merely a conventional term, from a synchronic point of view (historically, these palato-alveolar fricatives used to be [+palatal], and contrasted with palatalized /sʃ/ and /zʃ/; their subsequent velarization reinforced the contrast, as palato-alveolars and palatalized alveolars are acoustically very similar (concerning this issue,

see Veyrenc (1970: 40-41) and SIII.1.3, p.24). Note also that dorsals become palato-alveolars before the comparative affix /-i/, but not before the imperative marker /-i/: /p^jik+u/ ('I bake'), /p^jik^j+i/ ('bake'); in this context, it is the phonotactic rule which applies. Concerning grammatically conditioned rules, Garde (1980: 108) notes: 'Certaines alternances ne peuvent être analysées comme une propriété des morphèmes qui les subissent. On remarque qu'elles atteignent régulièrement tout morphème, quel qu'il soit, qui se trouve placé au voisinage d'un certain autre morphème'. So such alternations are perfectly productive, but they are also grammatically conditioned, and this point is essential: they are not natural rules; in some cases, grammatically conditioned palatalizations are not phonetically plausible at all (cf. the non-natural palatalization before the suffix /-oʃ^{*}/).

Finally, we must note that rules are attributed to a given class only after the inspection of various forms, allowing us to posit the proper structure-building rules. The contrast between hard and soft consonants before the phoneme /i/ reveals that the palatalization of consonants before the imperative marker /-i/ cannot be an automatic neutralization. Formal principles and constraints take priority over phonetic plausibility. It is clear that substantive criteria are not logically related to rule classification.

In the next section, I shall illustrate the theory of rule classes with an example drawn from Portuguese. We shall see that in some cases the boundary between phonotactic rules and allomorphy rules is 'fuzzy'; this is not surprising, because these two classes of rules apply in the word-formation component, and both belong to the lexical type.

VI.5.4. Varieties of lexical rules

Portuguese has the following system of oral vowels (see Teyssier (1976: 17-28)):

i u
 e ë o
 ε ä ɔ
 a

(the symbols ë and ä denote central vowels).

The vowel /ë/ appears exclusively in unstressed syllables. In post-tonic syllables, only a subset of these vowels is possible:

i u
 ë
 ä

In pre-tonic syllables, all vowels are possible except /e/ (Teyssier 1976: 27):

i u
 ë o
 ε ä ɔ
 a

It is obvious that such defective distributions will entail alternations, which will be governed by neutralizing rules. We can posit the following rules of vowel reduction for post-tonic syllables (see examples below):

- (R.10) a → ä
 e, ε → ë
 o, ɔ → u

/e/ is also reduced to /ë/ when it is pre-tonic (other phonotactic rules take precedence over the reduction rules: see Teyssier (1976: 21-23)). Before a nasal consonant, /a/ is normally raised to /ä/, even if it is stressed:

- (R.11) a → ä / [+consonantal & +nasal]

chamo, *banho* ('I call', 'I bathe'), for example, have the following underlying representations: /'ʃämu/, /'bäpu/. However, although this process is very general, it has a few exceptions; the most remarkable of these exceptions is responsible for the following contrasts in the paradigms of verbs in *-ar*:

- cantamos* /kä'tämuʃ/ ('we sing')
cantámos /kä'tamuʃ/ ('we sang')

(R.11) is phonologically conditioned, and we face a dilemma: either we classify it as an allomorphy rule, in which case it will be difficult to explain its productivity, because it is not grammaticalized (productive allomorphy rules are generally grammatically conditioned), or we classify it

as a phonotactic rule, in which case we shall have to admit that such rules are not always exceptionless. In view of some data in other languages which lead me to think that this is the correct alternative (cf. my account of Russian palatalization of velars in SVI.5.3; see also Ringen (1980) for exceptions to vowel-harmony processes in Uralic languages), I shall regard (R.11) as a phonotactic rule. The validity of this choice would be confirmed if there were a variety of Portuguese which had eliminated exceptions: in fact, such a variety exists -- Brazilian Portuguese. Concerning (R.11), Teyssier (1976: 19) writes: 'Au Brésil, cette règle de distribution ne souffre aucune exception'. So, *cantamos* and *cantámos* are homophonous in Brazil, and both undergo the natural rule: [kã'n'tãmus] (the [n] is epenthetic). However, in this geographical variety, the process has a different status: as [a] and [ã] never contrast, (R.11) is a realization rule, and [ã] is always an allophone of /a/; the underlying representations of both verb forms will be /kã'tãmus/. (R.11) is a natural rule both in Portugal and in Brazil; the raising of a vowel before a nasal consonant is physiologically motivated (see Straka (1979: 505)), but we know that this criterion (the form of a rule, and its phonetic plausibility) is not sufficient. It is natural because it belongs to the class of phonotactic rules or of realization rules, naturalness being a property of these classes of processes.

(R.10), which reduces post-tonic vowels, causes several automatic alternations. On the other hand, the subsystem of pre-tonic syllables shows that /a/, /ɛ/, /o/ and /ɔ/ may occur in this context; therefore, in pre-tonic syllables, there is no neutralization of the contrasts between /a/ and /ã/, or between /o/, /ɔ/, and /u/. /e/ is reduced to /ɛ/, but /ɛ/ may also occur

in pre-tonic context. In spite of this, the following alternations are particularly frequent in Portuguese:

stressed: /a/ ~ pre-tonic: /ä/
 " /ɛ/ ~ " /ë/
 stressed: /o/, /ɔ/ ~ " /u/

Here are examples of these alternations:

paro /'paru/ ('I stop'), *paramos* /pä'rämuʃ/ ('we stop')
levo /'levu/ ('I raise'), *levamos* /lä'vämuʃ/ ('we raise')
choro /'ʃoru/ ('I cry'), *choramos* /ʃu'rämuʃ/ ('we cry')

In view of the distribution of vowels, and of the partial system in pre-tonic position, these alternations are necessarily governed by allomorphy rules, and not by phonotactic rules. Data reveal that these rules are not general (see Teyssier (1976: 25-26)):

(i) Some /o/ are invariant in paradigms; they occur in stressed syllables and pre-tonic syllables: *ousar* /o'zar/ ('to dare'), *ouso* /'ozu/ ('I dare'), *louvar* /lo'var/ ('to praise'), *louvo* /'lovu/ ('I praise'), *ouvir* /o'vir/ ('to hear'), *ouves* /'ovëʃ/ ('you hear').

(ii) Some /ɔ/ are invariant: *corar* /kɔ'rar/ ('to blush'), *coro* /'kɔru/ ('I blush'), *adoptar* /ädɔ'tar/ ('to adopt'), *adopto* /ä'dɔtu/ ('I adopt').

(iii) Some /ε/ are invariant: *pregar* /prɛ'gar/ ('to preach'), *prego* /'prɛgu/ ('I preach').

(iv) In non-verbal words, /a/, /ε/, /o/, and /ɔ/ occur in pre-tonic context: *doutor* /do'tor/ ('doctor'), *director* /dirɛ'tor/ ('director'), *adopção* /adɔ'sãw/ ('adoption'), *padeiro* /pa'däjru/ ('baker') etc...

In a verb like *baptizar* ('to baptize'), the first /a/ is always unstressed: /bati'zar/ but on the other hand, a stressed /e/ is converted to /ë/ in pre-tonic context: *chego* /'ʃegu/ ('I arrive'), *chegar* /ʃë'gar/ ('to arrive').

In order to account for alternations (see p.229), we can posit the following allomorphy rules:

(R.12) a → ä

ε → ë

o, ɔ → u

The next rule, (R.13), is a phonotactic rule, and is automatic, contrary to (R.12):

(R.13) e → ë in pre-tonic syllables (cf. the paradigm of *chegar*)

(R.12) governs the alternations in the paradigms of *parar*, *levar*, *chorar* ('to stop', 'to raise', 'to cry': see above). Many paradigms have still more complex alternations, because, in addition to (R.12), they undergo a raising rule in the stressed syllables of some forms:

stressed: /ɛ/ ~ /e/ ~ unstressed: /è/

" /ɔ/ ~ /o/ ~ " /u/ (for verbs in *-er*)

" /ɛ/ ~ /i/ ~ " /è/

" /ɔ/ ~ /u/ ~ " /u/ (for verbs in *-ir*)

The following will serve as examples:

dever: /'dɛvè/ /'devu/ /dè'ver/ ('he must', 'I must', 'must')

sofrer: /'sɔfrè/ /'sofru/ /su'frer/ ('he suffers', 'I suffer', 'to suffer')

ferir: /'fɛrè/ /'firu/ /fè'rir/ ('he injures', 'I injure', 'to injure')

dormir: /'dɔrmè/ /'durmu/ /dur'mir/ ('he sleeps', 'I sleep', 'to sleep')

The structural changes are:

(R.14) $\epsilon \rightarrow e$

$\text{ɔ} \rightarrow o$ for verbs in *-er*

(R.15) $\epsilon \rightarrow i$

$\text{ɔ} \rightarrow u$ for verbs in *-ir*

As all the alternants appear in stressed syllables, the environments of the rules are grammatical. These processes are allomorphy rules, but unlike (R.12), their conditioning is not phonological (see Teyssier (1976: 157-167) for the grammatical environments).

Several points deserve our attention in this description: in the same language, very similar alternations are governed either by phonotactic rules or by allomorphy rules; the rules $a \rightarrow \bar{a}$, $\epsilon \rightarrow \bar{e}$, o or $\text{ɔ} \rightarrow u$ are automatic neutralizations in post-tonic syllables, but are allomorphy rules in pre-tonic syllables; this shows that the function of rules takes priority over their phonetic plausibility. The same reduction of vowels is as plausible in post-tonic as in pre-tonic syllables, since in both cases it can be interpreted as the weakening of vowels in unstressed position. However, the rules are surface-true only in a subset of these unstressed syllables, which results in a different status for the reduction process in the two subsets of unstressed syllables.

Mention should also be made of the frequency of vowels in unstressed position, and more precisely in pre-tonic syllables; in this context, the weak vowels / \bar{a} / / \bar{e} / / u / are certainly more frequent and more expected than the strong vowels / a / / ϵ / / o / or / ɔ /. This leads me to conclude that the boundary between allomorphy rules and phonotactic rules is very tenuous. The allomorphy rule (R.12) is certainly not surface-true in all cases; there are many violations of it, but it is difficult to deny that it yields less complex structures, if we take the context into account and also if we compare the allomorphy rule (R.12) to the very similar phonotactic rule (R.10). Once more, we shall find confirmation of this in dialectology. In the system of Brazilian Portuguese, facts concerning vowels are different; in stressed syllables, the subsystem is:

i u
 e o
 ε ɔ
 a

And the partial system in pre-tonic syllables is:

i u
 e o
 a

In this context, there is also a neutralizing rule:

(R.16) $\epsilon \rightarrow e$
 $\text{ɔ} \rightarrow o$

This rule suffers no exception in this dialect. It is clear that, while the Portuguese of Europe has kept the complex mid-low vowels in pre-tonic syllables, the Portuguese of Brazil has eliminated them, and has generalized some strong phonotactic tendencies. In short, in the European variety, the application of the allomorphy rule (R.12) does not increase the complexity of the grammar, which is rather unexpected because, generally, allomorphy rules are not phonetically motivated. This leads me to conclude that *some* allomorphy rules are quasi-phonotactic: note that, whatever their status, they remain lexical processes which apply in the word-formation component and are fully integrated into morphology; these data also reveal that the

difference between natural and non-natural rules is not always so clear-cut as is assumed in Hooper (1976).

VI.5.5. Degree of abstractness

The most well-known example of abstract analysis remains the account of English vocalic alternations in *SPE* (for other more or less abstract solutions or treatments of this question, see: Hoard (1972), Fidelholtz & Brown (1974), Krohn (1974), Nichols (1974), Lass (1976), Sommerstein (1977), Viel (1981)). Investigations in this field have produced an impressive number of competing analyses, probably because the standard model of generative phonology is virtually unconstrained.

In this section, I shall simply propound the only possible analysis within the framework of constrained phonology (if we leave details aside). Let us consider the usual examples: *telegraph*, *telegraphic*, *telegraphy*, whose underlying representations are (in my analysis): /'tel₁grɑ:f/, /,tel₁'græf₁k/, /t₁'legrəf₁/ (British Received Pronunciation). These alternations between 'full' and 'reduced' vowels are conditioned by stress. A phonotactic rule will reduce vowels in unstressed syllables, but this rule will relate the above-mentioned forms (so the reduced vowels are present underlyingly, and vowel reduction is a lexical rule, applying in the word-formation component).

Let us now examine more complex alternations (the examples are borrowed from Chomsky & Halle (1968: 184)):

divine /a¹/, *divinity* /ɪ/

serene /i:/, *serenity* /ε/

profane /e¹/, *profanity* /æ/

I shall posit straightforward allomorphy rules with the following effects:

(R.17) a¹ → ɪ

i: → ε

e¹ → æ

Chomsky & Halle (1968: 179) reject rules with such effects for reasons of simplicity: 'The rule is quite complex, expressing no underlying generalization. This suggests that the operation of the rule be subdivided into several stages, each of which can perhaps be expressed in some fairly general form'. In fact, these alternations are not natural, or phonetically conditioned, but the authors of *SPE* treat them as if they should be: this is why they reject rules whose structural changes are not phonetically plausible.

One of the advantages of the constrained theory is the treatment of invariant vowels: the underlying representations of *nice*, *fine* will be /na¹s/, /fa¹n/, and not /ni:s/, /fi:n/.

In *SPE*, we find a great many abstract underlying representations which are very remote from surface forms: *courage* /koræge/ (Chomsky & Halle 1968: 213), *right* /rɪxt/ (233-234), for instance (for criticism, see Mounin (1972: 210-211)). The degree of abstractness of invariant items is often justified by alternations in other paradigms: this is quite impossible in constrained phonology. In the same way, 'gaps' cannot be invoked (whether in the phonemic system, or in the distribution of phonemes), and the underlying representation of *calm*, for example, will be /kɑ:m/ in constrained phonology (and not /kælm/, as in Chomsky & Halle (1968: 214, 216-217)).

Of course, the construction of forms can be reconstituted; the derivation of the word *division* (underlying representation: /dɪ'vɪʒən/) is:

dɪ'va^adɪən (for the affix, cf. *communion*)
 → dɪ'vɪdɪən (a^a → ɪ)
 → dɪ'vɪzɪən (spirantization)
 → dɪ'vɪʒəɪn (palatalization: note that this rule is surface-true
 in *artificiality*)

Alternations in Modern English represent an excellent example of rule denaturalization. Velar softening, for instance, applies in quite implausible contexts; let us consider the pair *criticize*, *critical* with the following phonemic representations: /'krɪtɪsəz/, /'krɪtɪkəl/. In *SPE*, velar softening (k → s) will apply before diphthongization and vowel-shift rules (219-220):

kr₁t₁k+i:z
 → kr₁t₁s+i:z
 → kr₁t₁s+a¹z

In my constrained version of generative phonology, velar softening applies before the vowel /a¹/, which is not a natural environment for such a process (the basic stem allomorph is /kr₁t₁k-/, and the basic form of the affix is /-a¹z/; the natural environment for velar softening is front vowels).

VI.5.6. Word forms, morphemes, and paradigms

In this section, I shall show how we can infer the application of lexical rules, as well as the basic stem allomorphs, from the inspection of word forms and alternations. I shall illustrate these aspects of the model of constrained phonology with examples drawn from Finnish.

In traditional Finnish grammars (see for instance Aaltio (1971)), four word forms are listed in nominal paradigms: the nominative singular, the partitive singular, the genitive singular, and the partitive plural. Consider the following example (käsi 'hand'):

käsi, kät+tä, käde+n, käs+i+tä

As usual, no diacritic features are necessary for lexically restricted rules: they can be inferred from the inspection of partial paradigms. Thus, the

following rules are operative in the formation of the items that we have just mentioned:

(R.18) Gradation: /t/ becomes /d/ in a checked syllable with a short nucleus.

(R.19) Assibilation: $t \rightarrow s/_i\#$ and $t \rightarrow s/_+i$

(R.20) $e \rightarrow \emptyset/_+t$ and $e \rightarrow \emptyset/_+i$

(R.21) $e \rightarrow i/_\#$

(R.22) Vowel harmony: the vowels of affixes agree in backness with the root vowels (concerning all these rules, see Sauvageot (1949), McCawley (1963a; 1963b), Harms (1964), Skousen (1975)).

The inputs to rules will represent the basic alternants: they are /t/ and /e/, for the stem; /t/ alternates with /d/, and with /s/; /e/ alternates with 'zero' and /i/. We can thus infer that the basic stem allomorph is /kæte-/. Of course, as the rules which I have postulated are quite analogous (in this particular instance) to the rules which are generally postulated by 'orthodox' generative phonologists, the basic stem allomorph in constrained phonology is absolutely identical to what is normally considered to be the underlying representation in the standard theory, that is /kæte/ (see Kenstowicz & Kisseberth (1977: 208-209)). However, the difference is capital: in the present model, /kæte-/ is not an underlying representation, which means that it is not stored as such in the lexicon: it is merely inferred from the inspection of paradigms. I must add that this basic stem allomorph will play a very important role in the construction of word forms which are not listed in the lexical entry. If we adjoin the essive affix

/-næ/ to the stem, for example, no rule applies, apart from (R.22), and the basic stem allomorph is not modified: the new word form will be /kæte+næ/ (vowel harmony has modified the vowel of the affix). This form is inflected, since /-næ/ is an inflectional suffix. If we now add the possessive suffix /-ni/ to the nominative, we are able to prove that (R.19) and (R.20) are not conditioned by any grammatical feature; the output will be /kæte+ni/ ('my hand'), and none of these two rules applies, although this form is also a nominative.

We are able to form non-listed word forms of the paradigm, but also to reconstitute the formation of listed word forms: in the nominative /kæsi/, (R.21) and (R.19) apply; note that the former feeds the latter (this shows that allomorphy rules are ordered, just like post-lexical rules). In /kæt+tæ/, (R.20) and (R.22) apply. In /kæde+n/, it is (R.18), and in /kæs+i+næ/, it is (R.20), (R.19), and (R.22). Now, what is the status of the above-mentioned rules? Vowel harmony belongs to the phonotactic class, in spite of exceptions (this shows once more that some natural, phonotactic rules tolerate exceptions; these exceptions tend to be regularized, and phonotactic rules, with exceptions or not, tend to be transferred in foreign-language learning; see Linell (1979: 212-213) and Ringen (1980: 40-41, n.9)). Vowel harmony is quite productive in native items. The other rules are allomorphy rules, even if some of them are very general; gradation, for example, which actually affects all obstruent stops of the language, is productive, but is no longer a well-formedness condition on underlying representations.

Allomorphy rules can also relate word forms of different paradigms, which belong to the same 'family'; consider, for instance, the following noun, *kiitos* ('thank'), and verb, *kiittää* ('to thank'):

kiitos /kiit+os/ ('thank' nominative)
kiitoksen /kiit+okse+n/ (genitive)
kiitosta /kiit+os+ta/ (partitive)
kiittää /kiittæ+æ/ ('to thank', infinitive)

From the comparison of the two items, we can infer that the basic stem allomorph is /kiitt-/, with a geminate /tt/; gradation (R.18) applies in the formation of all word forms of the noun *kiitos*: this is due to the fact that in all the forms of the noun, the final consonant of the stem is in a checked syllable (note that gradation simplifies geminates in checked syllables with a short nucleus. This is known as quantitative gradation, in contrast with qualitative gradation, as in /kæde+n/; the question whether quantitative and qualitative gradations constitute two separate rules is secondary: see Anderson (1974: 82-89)).

One of the advantages of the model of constrained phonology over the standard one is the possibility of limiting our investigation to the paradigm of *kiitos*, ignoring the related verb *kiittää*; in this case, the allomorph which will be selected as basic is /kiit-/ in all forms of the nominal paradigm. In 'orthodox' generative phonology, this would not be possible, and the unique underlying representation would have to be /kiitt/.

VI.5.7. Word forms or suppletive representations

In this section, I shall attempt to answer the following question: 'As regards the nature of underlying representations, are the theories of constrained phonology and of natural generative phonology equivalent, and are they mere notational variants?' It is possible to demonstrate that in some cases the method of suppletive representations (see Hudson (1975: chapter 1)) does not work (for a description of this method and for an argument against it in French morphology, see SVI.2.4).

In Maltese, an Arabic language, object pronouns are adjoined to verb forms; I shall hypothesize, following Puech (1983: 174) that an internal word boundary precedes such pronominal suffixes, as in /'n+id#br#ok/ ('I pick you up'). Many alternations reveal that the suffix of the second person singular has the following allomorphs:

/-ik/, /-ek/, /-ok/

Examples of alternations are:

- (a) 'ser?#ek ('he robbed you')
- (b) 'n+izbh#ok ('I paint you')
- (c) ki'tib#l#ek ('he wrote to you')
- (d) ma#kitib#'l#ik#f ('he did not write to you')

In (c) and (d), the object pronoun is preceded by a special morpheme (-l-) which makes the pronoun indirect. In (d), /ma-...-f/ is the discontinuous

negation, whose second part attracts stress. It is clear that the basic form of the object pronoun is the allomorph /-ik/; when no further affix is added, this object pronoun is unstressed, and a general rule lowers a pre-final unstressed /i/ to /e/ (see Brame (1974: 46-47)). (c) is derived as follows:

kitib#l#ik

→ kitib#l#ek

There is another rule, which produces the allomorph /-ok/: it is a process of vowel harmony which converts /e/ to /o/ if the last syllabic nucleus of the stem is itself /o/ (rounding harmony). Finally, a rule of syncope deletes a vowel in the following context: VC(C)_CV; this process of syncope accounts for the alternation between /o/ and 'zero' in the stem: /n+idəbr#ok/, /n+idəbor/ ('I pick up'). Lowering, vowel harmony, and syncope are lexical rules. I shall postulate the following derivation:

n+idəbor#ik

→ n+idəbor#ek (lowering)

→ n+idəbor#ok (vowel harmony)

→ n+idəbr#ok (syncope)

Note that lowering feeds vowel harmony. As to syncope, it must absolutely apply after vowel harmony: it is a case of counterbleeding, and vowel harmony is not transparent in this derivation (but it is transparent in many other forms which are irrelevant to the present discussion: cf. /mart#ek/ ('your wife'), /ɔht#ok/ ('your sister'); these examples are

borrowed from Aquilina (1965: 100-102); these forms prove the validity of the harmonic process; for a slightly different analysis, see Brame (1972: 31-32)).

Using the method of suppletion with braces, the underlying representation of /n+idɜbr#ok/ in natural generative phonology would be:

$$n+idɜb \begin{Bmatrix} o \\ \emptyset \end{Bmatrix} r \# \begin{Bmatrix} i \\ e \\ o \end{Bmatrix} k$$

As regards the stem, \emptyset is selected if a vowel follows #. The alternants of the suffix obey strict rules of distribution:

-- /i/ is the basic ('elsewhere') alternant (that is, the unconditioned alternant).

-- /e/ occurs in unstressed final syllables, before a final consonant.

-- /o/ occurs in the same context, but after another /o/ in the stem.

Let us now try to derive the correct form in natural generative phonology. We eliminate the unstressed /i/ before a final consonant. At this stage, we are unable to select either of the alternants of the suffix which are left (/o/ or /e/) until the proper alternant of the stem is selected; we are therefore compelled to proceed as follows: before a vowel-initial suffix, \emptyset will be selected for the stem, and we obtain an intermediate form with the two alternants /e/ and /o/:

$$n+idɜbr \# \begin{Bmatrix} e \\ o \end{Bmatrix} k$$

Since no /o/ precedes the suffixal alternant, we can but select /e/, and we obtain */n+id3br#ek/. It is thus impossible to derive the correct form, /n+id3br#ok/. This example shows that the suppletive representation of alternations, and rules distributing alternants without changing feature values, do not yield satisfactory results.

VI.6. Conclusion: a lexicalist approach

I conclude this chapter with a word about my general conception of morphology. For Lasnik (1981: 162), 'a morphologically realized affix must be a dependent at surface structure', but, in my view, this assertion is partly tautological: an affix is 'morphologically realized' or is not an affix at all. Affixes, especially in the field of inflectional morphology, are generally implementations of morpho-syntactic features, and it is true that some features are not always 'morphologically realized'. In French, nouns can be [+plural] or [-plural], but for regular items, these feature values have no affixal implementation: (*une*) *table*, (*des*) *tables*, /tabl/ ('table', 'tables') in both cases, whatever the value of the feature [plural]. It is therefore important to distinguish features from affixes, that is, morpho-syntactic properties from their phonological realization. We can even add a stronger constraint on affixes: they should necessarily be bound morphemes, at any level of structure.

In this chapter, I have claimed that underlying representations, which are word forms, may be inflected, are syllabified, have a prosodic pattern, and conform to phonotactics. Moreover, they are no more abstract than

classical phonemic representations. This view is compatible only with a lexicalist approach to phonology, morphology and syntax.

VII

A SET OF CONSTRAINTS

VII.1. Introduction

In chapter V, I showed that the standard model is wrong when it assumes that natural rules can account for alternations between 'zero' and a consonant in French. I also noted that most studies of this problem in the field of concrete phonology are in fact as unconstrained as 'orthodox' generative phonology (criteria being more substantive than formal).

This chapter will be devoted to the problem of constraints. These constraints can restrict:

- (a) The set of possible rules.
- (b) The set of possible representations.
- (c) The set of possible underlying segments.
- (d) The set of possible rule interactions.

A constrained theory of phonology is more interesting if the four types of constraints are interrelated: in short, a constrained theory should be integrated, and there should be logical relations between the four types.

Constraints are also assumed to be universal: I postulate that language-specific constraints do not make sense; in this, I follow the now well-established tradition of Chomskyan linguistics (see Chomsky & Halle (1968)).

I shall present an integrated theory, with examples borrowed from various languages. In particular, I shall show that a subset of constraints, which are motivated by the notion of learnability of rules and representations, entails the existence of other constraints, which are logical consequences. The existence of these initial constraints allows us to dispense with others which were put forward in the past, and which are generally either too strong or too weak, such as the True Generalization Condition (Hooper 1976: 13), the Strong Naturalness Condition (Vennemann 1974a: 208) and the Alternation Condition (Kiparsky 1982: 59-60).

VII.2. Constraints on rules and representations

VII.2.1. The universal condition on rules

The form and the very existence of the universal condition of rules are inspired by Saussure's (1972: 190) precepts: 'Les entités abstraites reposent toujours, en dernière analyse, sur les entités concrètes', and also: 'Aucune abstraction grammaticale n'est possible sans une série d'éléments matériels qui lui sert de substrat'. This is why, in generative phonology, the relation between underlying and phonetic representations is natural (see Chomsky & Halle (1968: 169-170)).

Unfortunately, current practice in generative phonology does not always conform to Saussure's precepts.

The universal condition must depend crucially on the learnability of rules: the effects of a rule must be observable in some way. If they are not, the rule is not learnable by speakers: in short, it is not a possible rule. In this sense, the universal condition is natural.

Before proceeding further, we must remember that rules, in generative phonology, have specific forms; more precisely, the same rule can be formulated as in (a), (b) or (c):

(a) $X \rightarrow Y/W_Z$

(b) $WXZ \rightarrow WYZ$

(c) WXZ

↓
Y

For example, a rule voicing intervocalic consonants will have the three following possible forms:

(a) $C \rightarrow [+voiced]/V_V$

(b) $VCV \rightarrow VC[+voiced]V$

(c) VCV

↓

[+voiced]

Some rules (for example metathesis) can only be formulated as in (b). Any rule which has the form (a) can also have a notational variant (b) or (c).

I shall assume that all rules can be reformulated as in (b), because this is more practical, as we shall see, for the expression of the universal condition on rules.

In (b), WXZ is the structural description of the rule, and WYZ is its structural effect. It is this structural effect which must be observable in surface forms. However, we must also ask the following question: 'Should the structural effect of the rule be observable in *all* surface forms which are the final stages of derivations, it being understood that at some stage of these derivations, the structural description of the rules is satisfied?' To put it in a nutshell, should the rule always be surface-true? The answer is negative: rules cannot always be surface-true, but they are surface-true in at least some derivations (that is, in at least some phonetic representations). Even in structuralist theories, which are not reputed to be particularly abstract, it is tacitly assumed that rules are not necessarily surface-true in all derivations (of course, the terms 'rules', 'derivations', 'surface' etc... are absent from these theories, but structuralist language can be translated into generative terminology). For Trubetzkoy (1976: 64-65), rules cannot always be surface-true; he posits a source /znajut/ for the phonetic form [znajt] ('they know') in Russian: /u/ is fronted after /j/, and /j/ is deleted. The fronting rule becomes opaque after this deletion, but since it is transparent in other derivations, it respects the universal condition on rules. I shall therefore require rules to be surface-true in *some* derivations, but not in *all* of them. The advantage of this formulation is that it can include all classes of phonological rules, and even lexically restricted or 'minor' rules, since, by

definition, these rules are limited in their application. The universal condition on rules has the following form:

A rule R of the form $VXZ \rightarrow VYZ$ is possible if there are surface strings VYZ which are produced by this rule R.

The precision 'which are produced by this rule R' is not trivial; consider the putative rule of nasalization in French (the rule which is postulated in the standard model: see Chapter V):

(R.1) $V \rightarrow [+nasal] / _ [+consonantal \ \& \ +nasal] \left\{ \begin{array}{l} \#\# \\ (\#)C \end{array} \right\}$

$\left\{ \begin{array}{l} \#\# \\ (\#)C \end{array} \right\}$

This rule would be surface-true if there were phonetic strings of the form:

V C C or: V C #C or: V C ##
 [+nasal] [+nasal] [+nasal]

There are actually such surface strings in French: *vingt-deux* [vɛ̃dø] ('twenty two'), *longue nuit* [lɔ̃ɲ nuɪ] ('long night'). However, these strings are not produced by nasalization: in these examples, /t/ and /g/ are converted into [n] and [ɲ] respectively, between a nasal vowel and a nasal stop; the strings are therefore produced by another rule. In fact, in Standard French, nasalization is never surface-true, and is not a possible rule of this language. Nasalization, in the standard model of generative phonology, is always followed by a rule deleting the nasal consonant which is supposed to condition it:

/plan/ (<plan, 'project'>)

→ plãn

→ plã

When a nasal vowel is followed by a nasal consonant which might have conditioned nasalization, it is a putative case of overapplication of this rule when its structural description is not satisfied, because the nasal consonant itself is followed by a vowel (nasalization is supposed to apply when the nasal consonant is not in the context of liaison, that is, when it cannot be a connective consonant): *mon ami* [mõ n ami] ('my friend'). The universal condition confirms our observations in Chapter V: this constraint agrees with structural and external evidence. If there is no possible rule of nasalization, it follows logically that nasal vowels are underlying. Note that the universal condition cannot exclude the following rules in French (see Chapter V):

-- Deletion of final consonants

-- Deletion of final schwa before a word boundary

-- Deletion of final schwa of polysyllables before a vowel

These rules, if they existed, would be surface-true in some derivations; suppose that the underlying representation of *grande* ('big', feminine) has a final schwa, as is assumed in the standard account of French phonology; the elision of the final vowel would be surface-true in the output of *grande aventure* [gRãd avãty:R] ('great adventure'). Similarly, the universal condition cannot exclude an underlying representation /avɔkat/ for *avocat*,

and /avɔkat+ə/ for *avocate* etc... However, as we shall see later, another constraint will exclude such underlying representations.

The universal condition disallows the possibility of a rule of nasalization in French; the same condition disallows the possibility of a general process of nasalization in Polish; this means that there is no realization rule of nasalization in this language, and that there are underlying vocalic nasal segments in Polish.

In Polish, there are two nasal vowels: /ẽ/ and /õ/ (for the data, see Corbridge-Patkaniowska (1979)). In keeping with the analysis just presented, I shall attempt to show that these vowels are phonemes of Polish. Their distribution is rather limited, since, when they are not in final position, they occur exclusively before fricative consonants: /s'õçat'/ ('neighbour'). They also occur freely before a word boundary: /p'iʃ'ẽ/ ('I write'), contrasting with /p'iʃ'e/ ('he writes'), /p'ar'ẽ/ ('a couple'). They are disallowed in the following contexts:

(i) Before /l/ or /w/ (which is equivalent to the /l'/ of older generations of speakers: /l' > /w/).

(ii) Before a stop or an affricate.

In context (ii), we often find instead a sequence of oral vowel plus nasal consonant: /p'win'on'tɛ/ ('to flow'), /gwem'b'okʲi/ ('deep'), /p'an't'ek/ ('Friday'). It should be added that a final /ẽ/ (but not /õ/) is often optionally denasalized (in colloquial speech): /p'iʃ'ẽ/ may be pronounced

[pʲi]ʃ[ẽ] -- the exact realizations of nasal vowels are in fact [ẽ] and [õ] -- or [pʲi]ʃ[e]). This optional denasalization counterfeeds the otherwise productive rule palatalizing dorsals before front vowels, or more precisely before oral front vowels which are not followed by a nasal stop: compare [k'in'o] ('picture house) with [kend'w] ('which way') ([w̃] is the retracted realization of /i/ after a hard consonant) or [gẽɕ] ('goose') (This interaction reveals that rule order is not intrinsic, since counterfeeding must be permitted in this example, whereas most theories of intrinsic ordering reject the possibility of counterfeeding. This contradicts Hooper's (1976: 59-64) theory of rule ordering, which disallows this kind of interaction).

The distribution of nasal vowels and of sequences of oral vowel plus nasal stop led Trubetzkoy (1976: 64) to regard the former as realizations of the latter. However, this analysis suffers from serious shortcomings; it presupposes a rule nasalizing vowels, and deleting nasal stops following them, before fricatives or a word boundary. This rule would have to perform both operations at the same time, because the two processes never occur separately: a separate rule of nasalization would violate the universal condition on rules, because nasal vowels are never followed by nasal stops in Polish. It is true that a rule with such a double effect is surface-true in some cases (cf. [s'õɕat']), but, in spite of this property, it cannot be postulated, because it is not a possible realization rule of Polish: in this language, it is clear that nasal vowels are phonemes. Realization rules are exceptionless: surface exceptions can be the result only of rule interaction. Consider now the following forms: [d'om'] ('house'), [s'am'] ('alone'), [ɕerp'ep] ('august'), [ɕed'em'] ('seven'), [s'wop] ('elephant'), [p'an'] ('sir').

The problem with such forms is that the rule does not apply when it should. For Gussmann (1980: 54), this is due to the presence of a final 'lax' vowel in underlying representations; nasalization would be counterfered by the deletion of final 'lax' vowels. Unfortunately, these 'lax' vowels are never recoverable, since there is no trace of them in phonetic forms. Moreover, there is no motivation whatever for a contrast between 'tense' and 'lax' vowels in Polish, because there is no opposition between long and short vowels, and the system of oral vowels is triangular:

i	u
e	o
a	

We can but conclude that this abstract analysis is not correct, and that there are underlying nasal vowels in Polish. Of course, phonotactic rules will have to account for the distributions of vowels or of phonemic sequences. Allomorphy rules will also account for non-regular alternations, but the essential point is the absence of a realization rule of nasalization in Polish.

In French and Polish, theoretical principles have led me to posit the existence of nasal vowels in the underlying systems. The next example, borrowed from Rumanian, will illustrate a different situation, where a realization rule is opaque in some cases, although rules apply freely, in a feeding interaction (we know that a rule feeds another rule when it creates the proper conditions for its application: see Kiparsky (1982: 37)).

For Jakobson (1976: 45-46), the dorso-palatals and the dorso-velars in Rumanian constitute separate phonemes, contrasting in identical contexts:

chiu [cu] ('shouts'), *cu* [ku] ('with'), *chiar* [car] ('even'), *car* [kar] ('cart')

However, only dorso-palatals may appear before front vowels: *chem* [cem] ('I call') (see Lombard (1974: 5-6)). It seems doubtful that this is the result of a phonotactic (neutralizing) rule; I shall rather interpret this palatalization as a post-lexical realization rule, and posit the underlying representations /kju/ /kjar/ for [cu] [car]. This allows us to simplify the system, since we can thus dispense with dorso-palatal phonemes. The rule will be:

(R.2) [+dorsal] → [+palatal] / _[-consonantal & +front]

A further rule will delete the semivowel /j/ between a palatal consonant and a vowel:

/kju/ → cju → [cu]

or a word boundary:

/okj/ → ocj → [oc] (for *ochi* ('eye'))

Note that the sequences -kj- are recoverable in the inverse algorithm (see SVI.2.3; the [+palatal] value of [c] is the trace of /j/ in surface forms). As to palatalization (R.2), it is surface-true before front vowels:

chem (/kem/ → [cem])

This process is therefore perfectly acceptable, although it entails a certain degree of abstractness which would be disallowed by some theories of concrete phonology (see, for instance, Hooper (1976: 13)). Similarly, I shall regard [ç] as the realization of the sequence -hj- in, for instance, the word *monahi* ('monks'):

/monah+j/ → [monaç]

This interpretation of data conforms to the chart of consonants in Murrell & Ștefănescu-Drăgănești (1970: 335-338). It should be added that this palatalizing process, (R.2), which is a realization rule, is quite distinct from the allomorphy rule converting /k/ and /g/ into palato-alveolars before certain affixes, as in *fugi* ('to run'):

/fu'g+i/ → [fu'dʒi] (see Lombard (1974: 38-42))

This process, as can be observed, is clearly a lexical rule, since /k/ and /g/ contrast with palato-alveolars before front vowels as well as before back vowels in Rumanian:

ariciu /a'ritʃu/ ('hedgehog')

curte /'kurte/ ('courtyard')

argint /ar'dʒint/ ('silver')

unghie /un'gie/ ('fingernail')

VII.2.2. The recoverability condition

The recoverability condition is a constraint on possible representations, or, more precisely, on the relation between underlying and phonetic representations. It can be formulated as follows:

The underlying representation of a form must be recoverable from its phonetic representation.

This means that underlying representations are extractable from phonetic representations. They can be inferred from them by means of an inverse algorithm (see Chapter VI), without any ambiguity. Only one underlying representation can correspond to a given phonetic representation. Moreover, the recoverability condition is motivated by learnability, but this time the learnability of representations. Several theoretical hypotheses underlie the recoverability condition, but first, let us illustrate it with a few examples.

In any framework, it is difficult to deny that the underlying representation of *joli* ('pretty') is /ʒɔ̃li/ (no rule affects the underlying form, even in the standard model). Consider now two other word forms: *gris*, *petit* ('grey', 'small'). Their phonetic forms are [gRi] and [pøti]. These word forms are related to *grise*, *petite*: [gRi:z], [pøtit], which are their feminine counterparts. This has led many phonologists (see Chapter V) to posit underlying representations /gRiz/, /pøtit/ for the masculine forms (see Schane (1968)). In the same way, in the standard model, *cher* ('dear') is underlyingly /ʃɛR/, but the underlying representation of *vert* ('green') is

/vɛRt/, because of the feminine *verte* [vɛRt]. Here are the proper derivations in abstract phonology:

/ʒɔli/ → [ʒɔli]

/gRiz/ → [gRi]

/pətit/ → [pəti]

/ʃɛR/ → [ʃɛR]

/vɛRt/ → [vɛR]

In Chapter VI, we saw that in my framework alternations between different word forms, or derivationally related paradigms, play no role in setting up their underlying representations. The members of the following pairs are different word forms:

petit, petite [pəti], [pətit]

gris, grise [gRi], [gRi:z]

vert, verte [vɛ:R], [vɛRt]

Therefore, the underlying representations of *joli*, *gris*, *petit*, *cher*, *vert*, in constrained phonology, are: /ʒɔli/, /gRi/, /pəti/, /ʃɛR/, /vɛR/ respectively.

It cannot even be objected that the word form *petit* has two allomorphs:

(1) [pəti]

(11) [pətit-] in liaison contexts

and that its underlying representation might be /pətit/ (with a truncation rule yielding the first allomorph in the proper contexts), because, in

Chapter V, I showed that, in fact, the connective element [t] is preceded by a word boundary. This implies that the word form *petit* has no final consonant in its underlying representation. It is true that some word forms may have several phonetic realizations; some of them characterize different speech styles: in such cases, the underlying representation of the word form will be extractable from the variant occurring in careful speech.

In certain situations, rules of external sandhi modify the underlying representation of a word form: in Corsican, for instance, initial consonants undergo a lenition process after unstressed vowels; *capu* ('head') is normally pronounced ['kabu], but after the definite article *u* (and more generally after any unstressed vowel), it is modified, and the string is pronounced [u#'gabul] (k → g). It is certain that in such cases, the underlying representation will be based on the form ['kabu] (for details on sandhi processes in Corsican, see Dalbera-Stefanaggi (1978: 51-56)).

We can envisage, in the case of several different modifications in connected speech, a more complex situation, and underlying representations based on several careful variants of a single word form (note that we are now considering alternations affecting one word form, and not alternations between different word forms). In any case, the derivations in the standard analysis of French (see above) violate the recoverability condition: the underlying representations of *gris*, *petit*, *vert*, in this analysis, are not recoverable from their phonetic representations, since when we examine the latter, we cannot know if a final consonant has been deleted, and if one has, we cannot deduce which one (there is no trace of final consonants in surface forms).

The recoverability condition is strictly related to the possibility of an inverse algorithm (see Chapter VI). An underlying representation is recoverable only if the upside down derivation is applicable, once we know the rules of the language; this inverse derivation will consist only of post-lexical rules, and not lexical rules, which apply in the word-formation component. This relation shows that the theory is not atomistic: various constraints are logically related to one another.

The recoverability condition entails another constraint, the condition on structure-preserving rules (this expression is borrowed from Emonds (1970), who used it in syntax). Structure-preserving rules, in the present theory, are rules whose outputs are plausible inputs. Lexical rules are typically structure-preserving processes, as their outputs are phonemic segments (they map phonemes on to phonemes). In Finnish, for instance, the raising of /e/ before #, and assibilation of /t/ before a final /i/ (see §VI.5.1) are structure-preserving, because their outputs might be inputs (basic alternants). The standard example, *käsi* ('hand'), undergoes these rules:

/kæte-/ → kæti → /kæsi/

The syllable *-si-* might be basic, and actually, it is basic in other paradigms: in the paradigm of *lasi* /lasi/ ('glass'), this syllable is invariant (compare: /kæsi/, genitive /kæde+n/, /lasi/, genitive /lasi+n/; this morphophonemic ambiguity has caused analogical changes in some paradigms: see Skousen (1975: 71-75)). In the standard generative analysis of French, consonant truncation is a structure-preserving rule: the deletion of the

final /t/ of *petit* ('small') yields an output which is a plausible input (cf. *joli* ('pretty'), with no final consonant in the underlying form). Here is now the exact form of the condition on structure-preserving rules:

Underlying representations cannot be the inputs to obligatory structure-preserving rules, except if the latter are external-sandhi rules.

We know that underlying representations are inputs to post-lexical rules, but are the outputs of lexical rules. This means that obligatory realization rules cannot be structure-preserving. It is certain that some optional realization rules are structure-preserving (reductive rules in fast speech can produce forms which might themselves be underlying; the German word *Abend* ('evening') in *guten Abend*, the greeting expression, can become [ɑ:mt], and this reduced variant in fast speech is a plausible underlying form of German).

The condition on structure-preserving rules is not an independent constraint: it is logically related to the recoverability condition; if underlying representations were inputs to obligatory word-level structure-preserving rules, they would not be recoverable, because the outputs of such rules would be plausible underlying representations. Note that this condition excludes underlying representations with final consonants in Maori (see SVI.5.1), since the following rule is clearly structure-preserving:

$C \rightarrow \emptyset / _ \#$

It is undeniably a rule of Maori, but it is a lexical process, and more precisely a phonotactic rule which essentially filters underlying forms. The condition does not exclude its existence in Maori, but it excludes it from the set of post-lexical rules.

The reference to external sandhi is important; external-sandhi processes involve the contexts preceding or following the word form in connected speech. If the context is simply #, without anything preceding # before the word, or following # after the word, we are dealing with something different: the rule deleting final consonants in Maori (see above) is not a process of external sandhi, according to this criterion. In Southern French, the underlying representation of the determiner *cette* ('this', 'that') is /set^ə/ (the final schwa, in this regional variety, is justified, since it is pronounced before a pause, or a consonant). The final vowel is deleted in the context of elision and liaison: *cette idiote* ('that stupid girl') is pronounced [set idjɔt^ə]. The deletion of schwa is an (obligatory) structure-preserving rule, since /set/ is a plausible underlying representation (cf. *sept* /set/ ('seven')), but it is also an external-sandhi rule, and the condition on structure-preserving rules cannot prevent its application (the context of the rule is: # and what follows #). Note that [set^ə] and [set] are two possible realizations of the same word form.

The recoverability condition and the condition on structure-preserving rules are natural constraints on representations, or more precisely, on the relationship between underlying and phonetic representations. If derivations proceed normally from underlying structure to phonetic structure, any derivation, in the phonological component (which I distinguish from the

word-formation component), can be reversed and apply 'upside down', from surface phonetic structure to underlying structure. These upside down derivations yield correct and unambiguous results only if word-level structure-preserving rules are prevented from affecting underlying representations. In upside down derivations, post-lexical rules, as we have seen, are 'undone'. An example in French is the word form *vert* ('green'), whose phonetic realization is normally [vɛ:R]; in the upside down derivation, the lengthening rule (which applies before some voiced continuants ([v, z, ʒ, R]), when the vowel is stressed) is undone:

$$[vɛ:R] \rightarrow /vɛR/$$

As regards the problem of dorso-palatal consonants in Rumanian (see SVII.2.1), note that the structures underlying them are perfectly recoverable, even when the rule is opaque: the underlying forms of [car], [cu], or [oc], can only be /kjar/, /kju/, or /okj/; there is no ambiguity. This shows that even when rules are not transparent in all derivations, the recoverability condition can be respected: the constraints which are postulated allow abstractness to a certain extent, and in specific situations. In Rumanian, the presence of [c] in a surface form denotes the deletion of /j/ if [c] is followed by a [-front] vowel; in this case, we can undo the deletion of /j/, as well as palatalization:

$$[cu] \rightarrow cju \rightarrow /kju/$$

When a [+front] vowel follows [c] (*chem* [cem] ('I call')), we simply undo palatalization, which is conditioned by this vowel ([cem] → /kem/).

VII.2.3. Telescoping

Kenstowicz & Kisseberth (1977: 64) write: 'It often happens that the intermediate steps in a series of historical changes are lost [...] in a synchronic grammar'. According to Kenstowicz & Kisseberth, two successive changes $A \rightarrow B$, and $B \rightarrow C$ can be telescoped and the resulting rule will be $A \rightarrow C$, when 'there is no evidence for the intermediate stages synchronically' (65). A telescoping condition must therefore, in my view, state that each step in a derivation must be independently justified. But how do we know that it is justified? The universal condition on rules provides an answer: each step in a derivation must respect this universal condition, and be surface-true in at least some strings. When a rule ceases to respect the universal condition, it is lost and telescoping may occur in the case of two rules $A \rightarrow B$ and $B \rightarrow C$. The telescoping condition must therefore be regarded as a natural consequence of the universal condition on rules. Note that the mapping of underlying representations on to phonetic forms becomes as direct as possible (although rules still apply sequentially).

A good example of telescoping is the synchronic residue of the Great Vowel Shift in English; in *SPE*, rules, in a synchronic analysis of Modern English, violate the telescoping constraint (see Chomsky & Halle (1968: 188)), because the intermediate stages are not justified (they are motivated by simplicity). For Chomsky & Halle, the source of the diphthong [a¹] is /i:/; this /i:/ undergoes several rules: /i:/ → i:j → e:j → æ:j etc... In a constrained theory, we are forced to postulate an allomorphy rule relating two alternants: /a¹/ and /i/ (cf. *divine*, *divinity*), but the diphthong will be derived in a straightforward manner: its source can only be /a¹/; no

intermediate step between this diphthong and the short vowel /ɪ/ can be postulated (for a discussion of vocalic alternations in English, see SVI.5.5). In *SPE*, there are many other instances of complex derivations with intermediate steps which violate the telescoping condition, because constraints on rules do not play a crucial role in abstract phonology.

VII.2.4. A constraint on underlying segments (phonemes and systems)

In this section, it is hypothesized that a phonemic system can be internalized by speakers only on the basis of surface forms, because allomorphy plays no role in the construction of underlying representations. In abstract versions of generative phonology, independently of allomorphy, considerations of simplicity, elegance, and symmetry, led linguists to reduce the apparent irregularities of phonemic patterns (see the notion of 'pattern congruity' in Hyman (1975: 93-97)). This has an undesirable consequence in some cases: we can have to posit context-free rules (which are not structure-preserving). The question is: 'Can speakers posit obligatory context-free rules?' In the framework of constrained phonology, the answer can only be negative. Obligatory context-free rules of the form $X \rightarrow Y$ have no empirical justification. They can increase the degree of abstractness of phonemic systems in an arbitrary manner, and to an unconstrained extent. We must therefore find some way of excluding obligatory context-free rules. We already know that the condition on structure-preserving rules cannot perform this task, because context-free rules are not necessarily structure-preserving. More or less explicitly, Sapir (1921: 55) had in mind such a constraint which ruled out 'imaginary

segments'. McCawley (1979: 4) is right, I think, when he writes that 'Sapir has two inventories of segments, the full phonetic inventory, and the 'organic' or 'phonologic' inventory, the latter inventory being a subset of the former'. I shall call this the *subset constraint* for convenience. This subset constraint, however, can easily be reformulated in a more precise manner, which Leben (1979: 179) propounds: 'Any phoneme /P/ with the realizations (P₁, P₂... P_n) must be nondistinct from at least one of its realizations'. McCawley compares two sets, and Leben's formulation states why one inventory must be a subset of the other; so it is clear that this formulation should be preferred (in both formulations, the scope of the constraint is the underlying system, but not the form of underlying representations. Of course, constraints on systems reduce the set of possible underlying representations).

Let us now examine a case of an irregular pattern, which generally motivates a context-free rule in abstract phonology; in Norwegian, there are several [+high] vowels: /i/, /y/, and /ü/ (and their long counterparts); /ü/ is a central vowel, and there is no /u/ or /u:/ in Norwegian. The phonetic representations of *smil*, *ny*, *hus* ('smile', 'new', 'house'), for instance, are: [smi:l], [ny:], and [hü:s] respectively. Historically, the source of /ü/ is the [+back] vowel /u/: /u/ > /ü/; this change caused asymmetry in the phonemic pattern ('case vide': see Martinet (1955: 80-81)). The pattern can be regularized if we postulate a context-free rule which is the synchronic version of the historical change: /u/ → ü. So the source of [ü], in a synchronic grammar, would be /u/, and the historical change would affect only the realizations of vowels, but not their underlying sources (it would be a case of 'rule addition': see Bynon (1977: 114-121)). In constrained

phonology, such a rule is disallowed by the subset constraint, and I shall admit the possibility of irregularity in phonemic patterns.

In Dutch, we have another good example of asymmetry; in this language, there are short and long vowels, and the short and the long vowels also differ for tongue height: short vowels are lower than long vowels; the short counterpart of /a:/ is more retracted. In the standard theory of generative phonology, one would be tempted to posit rules lowering short vowels, or to resort to the feature *tense*, and to attribute the difference in height to the contrast between tense and lax vowels. In fact, the vocalic system of Dutch is:

i:	y:	u:
ɪ		
e:	ø:	o:
ɛ	œ	ɔ
a:		ɑ

In constrained phonology, we shall accept the possibility of asymmetry in underlying systems, as well as the existence of gaps in phonemic patterns: /ɪ/ has no [+rounded] counterpart (there are no /ɨ/ or /ω/ in Dutch, and the members of the pairs /i:/, /ɪ/; /e:/, /ɛ/ etc... differ by two features: length and tongue height).

In the consonant system of Dutch, there is another example of asymmetry. Among obstruents, there is a voice correlation: *sap* /sɒp/ ('juice'), *zaak* /za:k/ ('business') etc... The system of obstruents is:

p f t s ʃ k x

b v d z ʒ

There are thus two exceptions: the velars /k/ and /x/ have no voiced counterpart in Dutch ([g] and [ɣ] are allophones of /k/ and /x/ respectively: *genoeg* ('enough'), for instance, is pronounced [ɣə'nu:x]).

In Czech, we find a similar phenomenon; in this language, there is also a voice correlation among obstruents: /p/, /b/, /t/, /d/ etc... Yet /x/ has no exact voiced counterpart, whilst Czech has a voiced glottal spirant, /ɦ/, which has no unvoiced counterpart. Historically, the glottal spirant is the result of a weakening process affecting voiced velars (compare Russian /kn'iga/ with Czech /kpiňa/ ('book')). Abstract phonologists may be tempted to regularize the system, and to posit a phoneme /ɣ/, and a context-free rule: /ɣ/ → [ɦ]; once more, this analysis is disallowed in constrained phonology, and I shall admit the existence of a phoneme /ɦ/, as well as of gaps in the phonemic pattern of Czech.

The recoverability condition, associated with the subset constraint, guarantees that the mapping of underlying representations on to phonetic representations is as direct as possible (processing cannot be simpler). This is very important from a psycholinguistic point of view. I shall now try to answer the following question: 'Is the subset constraint independent or can it be derived from another constraint?' It would very interesting to demonstrate that it is only a logical consequence of some other condition, and that it is not independently necessary: the grammar would thus be optimal. The universal condition on rules states that a rule of the

form $WXZ \rightarrow WYZ$, is possible if there are surface strings WYZ . Now, a context-free rule can be formalized as follows:

$$[\alpha F^1] \rightarrow [\beta F^{1+}]$$

where α and β represent values, and F^1 , F^{1+} features. We can state that a rule respects the universal condition if $[\alpha F^1]$ and $[\beta F^{1+}]$ are associated in some surface strings. In this sense, the universal condition becomes able to constrain context-free rules as well as context-sensitive rules. Suppose now that we enrich the universal condition with the following specification:

Obligatory context-free rules may not alter underlying feature values.

In other words, these rules can only be 'blank-filling' or redundancy rules. The subset constraint, which applies to phonemic systems, becomes a natural consequence of the universal condition on rules. This means that a constraint on rules can restrict the phonemic system: this illustrates the interrelations between constraints on rules, representations, and systems. The universal condition, in its first form, was not really satisfactory, because it applied only to context-sensitive processes. Note that the corollary runs as follows:

Context-free rules altering underlying feature values are necessarily optional.

It seems that we can thus dispense with the subset constraint.

I shall now examine a somewhat more complex situation, in Catalan. Once more, the problem is the putative existence of an imaginary segment. In Catalan, some alternations have led abstract phonologists (e.g., Anderson (1974: 69-70)) to posit the existence of a phoneme /v/; we know that in Catalan, just as in Spanish, the sound [v] never occurs in phonetic forms (see Gili (1974: 16, 17, 21)). The phoneme /b/ has two phonetic realizations: in some environments (for example, between vowels or between a vowel and a liquid), it is spirantized, and its allophone is [β]. Yet in some cases, [β] alternates with [f] or with the semivowel [w]: *meu* [mew], *meva* ['meβə] ('my', masculine and feminine); *blau* [blaw], *blava* ['blaβə] ('blue', masculine and feminine); *serf* [serf], *serva* ['serβə] ('slave', masculine and feminine). In the standard model, one could posit the following underlying representations for these morphemes: /mev/, /blav/, /serv/ (see Anderson (1974: 69-70)). Three rules account for the phonetic forms:

(R.3) /v/ → w/_C or #

(R.4) /v/ → f/r_#

(R.5) [+labial & -sonorant & +voiced] → β/V_V, or V_liquid

(R.5) affects both /b/ and /v/ (a clear case of absolute neutralization); (R.3) and (R.4) are phonotactic rules in the model of constrained phonology, whilst (R.5) is a realization rule, because [β] is a subphonemic segment. We can observe that /v/ never occurs as such in surface forms, but also that none of the above-mentioned rules is context-free: therefore, there is no violation of the constraint which states that context-free rules must not be obligatory. However, there is a violation of the universal condition on rules in this abstract analysis, because there are contrastive rules in the

constrained model (see Chapter VI); these contrastive rules must respect the universal condition, and if /v/ is a phoneme of Catalan, the contrasts between /v/ and other [+labial] consonants must be surface-true in at least some surface forms; in fact, they are never surface-true, which disallows the possibility of the following contrastive rule:

(R.6) [+labial & -sonorant & -stop] → [±voiced]

This is the consequence of the absence of any contrast between /f/ and its voiced counterpart; in fact, in Catalan, the examination of surface forms leads me to posit the following redundancy rule:

(R.7) [+labial & -sonorant & -stop] → [-voiced]

This rule simply states that [v] never occurs in surface forms (see above). We know that redundancy rules and contrastive rules, which both belong to the class of structure-building rules, cannot be contradictory: this definitely excludes (R.6), since (R.7) respects the universal condition, but (R.6) does not. Besides, (R.5) is a realization rule; this means that it is a post-lexical process, and that we must be able to apply the inverse algorithm. As (R.5) converts /v/ and /b/ into [β], it is absolutely impossible to respect the recoverability condition: the source of [β] might be /v/ or /b/. There are thus two reasons for rejecting the abstract analysis, with the phoneme /v/. This rejection does not necessitate the adoption of the subset constraint: the universal condition, and the recoverability condition, which are independently motivated, are quite sufficient.

In abstract phonology, it is only alternations which motivate the phoneme /v/; we know that such alternations do not play the same role in constrained phonology. My analysis will be radically different. There is no phoneme /v/. In some paradigms (*meu, meva*), the semivowel /w/ is converted into /b/ by an allomorphy rule when a vocalic suffix is added; in other paradigms (*serf, serva*), which are much less frequent, a basic /f/ is converted into /b/ in the same conditions. As to /b/, it is weakened to [β] by a realization rule (this rule is (R.5)). The underlying representations of the items given as examples above are: /mew/, /'mebə/, /blaw/, /'blabə/, /serf/, /'serbə/.

VII.2.5. Ghost segments, latent phonemes

The terms 'ghost segment' and 'latent phoneme' are used by generative phonologists and structuralists respectively to designate underlying segments without any phonetic manifestation. In some analyses of Catalan (see §VII.2.4), /v/ is an 'imaginary segment', and not a 'ghost segment', because it has a phonetic realization, whilst the realization of a ghost segment is 'zero'. A ghost segment does not leave any phonetic trace in surface forms, and this must be distinguished from cases where a phoneme is deleted, but recoverable. In Rumanian, the /j/ of *chiar* ('even', 'indeed') /kjar/ is recoverable from the phonetic form [car]; in Brazilian Portuguese, the realization of the word form *diálogo* /'djalugu/ is normally ['dʒaluɣu] (see Teyssier (1976: 34) and Hooper (1976: 113-116)), and there is a trace of /j/ on the initial palato-alveolar consonant (/t/ and /d/ are palatalized before /i/ and /j/; /j/ is then deleted).

Some structuralists do not hesitate to posit latent phonemes when this seems to be justified; for Malmberg (1971b: 236-237, n.20), 'Finnish provides us with another good example of a phoneme manifested only indirectly through its secondary effects. It is the so-called final aspiration. It is no longer 'pronounced' in modern Finnish'. Now, what motivates a latent phoneme in Finnish? First, some word forms ending in /e/ cause the gemination of the following consonant: *tule* [tule], ('come'), *tänne* [tænnel], ('here'), but [tulettænnel] ('come here'). The latent phoneme is supposed to close the final syllable and to trigger the rule of consonant gradation which weakens a consonant in checked syllables with a short vocalic nucleus (see Collinder (1965: 67-73)); gradation is transparent in the pair *pappi*, *papin* /pæppi/, /pæpi+n/ ('priest', nominative, genitive), for instance, but not in the pair *tarve*, *tarpeen* /tærve/, /tærpee+n/ ('need', nominative, genitive), because the weak grade of /p/ (i.e., /v/ in *tarve*) is in a phonetically free syllable. For this reason, Malmberg postulates the presence of a latent phoneme at the end of the word form /tærve/; in this form, the latent phoneme leaves no phonetic trace, but the consonant of the partitive affix (</-ta/>) is geminated in *tarvetta* /tærvet+ta/ ('need', partitive); (compare with *tulta* /tul+ta/ (partitive of *tuli* ('fire'))). Austerlitz (1968: 1337-1338) agrees with Malmberg. Sauvageot's (1949: 32) opinion is quite similar: 'Lorsque l'on rencontre la graphie -e, il s'agit donc presque toujours de mots à finale consonantique bien que la consonne ne soit plus perceptible à l'oreille'. This assertion clarifies the situation: the so-called final aspiration is nothing but a 'ghost segment', whose phonetic realization is 'zero'. The historical source of the final latent phoneme is */k/: 'in Standard Finnish this -k has, *in pausa*, changed into a faint glottal stop or disappeared' (Collinder 1965: 45). Malmberg is not explicit about the phonetic composition of the latent phoneme (which, for him, is probably the 'zero' phoneme); for Sauvageot

(1949: 17-18), it is a glottal stop (in fact, this glottal stop has been preserved in some dialects).

In the abstract generative analysis, we are compelled to posit a ghost segment with a specific feature composition: generally, in such cases, linguists will select the glottal stop, because it occurs in regional varieties. /tarve/, for instance, will be derived in the following manner:

tarpe?

→ tarve? (gradation)

→ tarve (? → Ø)

This analysis is impossible in constrained phonology, because it is impossible to justify a final /ʔ/ in Standard Finnish on the grounds that the segment occurs in non-standard varieties. Besides, no contrastive rule (see SVI.3.2) can express the opposition between /ʔ/ and other segments, and respect the universal condition on rules (see SVII.2.1). Moreover, the rule deleting /ʔ/ is context-free. Deletion and insertion rules can be interpreted as rules changing the underlying value of the feature [segment]:

Insertion: [-segment] → [+segment]

Deletion: [+segment] → [-segment]

According to the principles of constrained phonology, such rules cannot be both obligatory and context-free (see SVII.2.4); so the rule deleting /ʔ/ is disallowed, and we must find a different solution. Harms (1964: 39-40, 50-54) assigns a diacritic feature to stems and affixes. The symbol [+X] will

designate this feature in the present section: *tarve* /tarve[+X]/. This feature characterizes a non-segmental position; it triggers gradation, which is a lexical rule, and gemination, which is a post-lexical rule of external sandhi, or a lexical rule of internal sandhi, in, for instance, the derivation of *tarve* (nominative) and *tarvetta* (partitive):

tarpe[+X]	tarpe[+X]+ta	
→ tarve[+X]	→ tarve[+X]+ta	(gradation)
	→ tarvet+ta	(gemination)

So as regards rules, [+X] behaves exactly like a consonant. When it follows a short vowel, it thus triggers gradation of the preceding consonant, and it also triggers the gemination of the consonant following it. This analysis does not violate any of our constraints.

In Turkish, there is a similar situation, and we can use the same device. A ghost segment, the historical */ɣ/ (see Deny (1955: 33)), lengthened homosyllabic vowels preceding it; thus */aɣa/ ('aga', 'elder brother') was changed to /aa/ (= \$a\$a\$), and /daɣ/ ('mountain') to /da:/. Words like /da:/ still behave as if they had a final consonant with respect to affix allomorphy: for example, the dative suffix has the form /-a/ after a consonant, and the form /-ja/ after a vowel (a rule of epenthesis inserts /j/ in order to break the hiatus (Deny 1955: 145)). However, the dative of /da:/ (= one syllable) is /da+a/ (= \$da\$a\$) instead of the expected */da:+ja/. If the basic stem allomorph of /da:/ is /da[+X]/, with the diacritic feature [+X] characterizing a non-segmental position, we can

account for its behaviour: [+X] will lengthen a vowel, if it is not itself followed by a vowel:

/da[+X]/ → /da:[+X]/ (= underlying representation of the nominative)

but /da[+X]a/, with two short /a/, is the underlying representation of the dative. The allomorph of the suffix is /-a/, because [+X] blocks the insertion of /j/. [+X] will also account for anomalous cases of vowel epenthesis. A vowel is normally inserted to break some unpronounceable consonant clusters in words such as *fikir* ('idea'):

/fikʲr-/ → /fikʲir/ (the allomorph without the vowel appears in the inflected form *fikri* /fikʲr+i/ (objective case): this allomorph /fikʲr-/ is clearly basic)

In some cases, epenthesis overapplies: its application takes place when its structural description is (apparently) not satisfied. The form /awz/ ('mouth'), for instance, has clearly undergone the epenthesis rule, since the pre-final vocalic segment does not appear in the possessive form /a:z+um/ ('my mouth'), and the expected citation form of this item would normally be */a:z/. We must now explain the relationship between the actual citation form and the form with the possessive suffix. I shall suppose that the basic stem allomorph is /a[+X]z-/, with the feature [+X]; the phoneme /w/ will break the 'pseudo-cluster' ([+X]z):

/a[+X]z-/ → /a[+X]wz/

Epenthesis must not apply in /a[+X]z+wɪm/, which undergoes lengthening: /a:[+X]z+wɪm/; this lengthening is regular, as the segment following [+X] is not a vowel.

In Maltese, several puzzling facts in the morphology of the language led Brame (1972) to posit the existence of a ghost segment, the voiced pharyngeal /ʕ/. As in Finnish and Turkish, I shall postulate a diacritic feature [+X], which I shall assign to segments, or to non-segmental positions. In Maltese, many roots are triconsonantal: the root of /kitep/ ('he wrote'), for instance, is 'k-t-b'; the root of /ħafer/ ('he forgave') is 'ħ-f-r'. The third person singular (masculine) perfect /kitep/, for example, is formed as follows: the vowel /i/ is inserted after the first and the second consonants, and we obtain the basic stem allomorph /kitib-/. The perfect /kitep/ is the citation form; the final /b/ is devoiced by a general phonotactic rule, whilst /i/ is lowered in the context: _C#. The basic form, /kitib-/, will undergo syncope if a vowel is added (in the example, -u is the plural suffix):

kitib+u ('they wrote')
 → kitb+u (syncope)
 → kidb+u (assimilation)

The non-perfect stem, which appears in the imperative and the imperfect, is the output of a metathesis rule inverting the first consonant and the first vowel:

kitib- ħafir- (/i/ is converted into /a/ after /h/)
 → iktib- aħfir-

The usual rules yield the following forms:

iktep aħfer (singular imperative)
 igdb+u aħfir+u (plural imperative)
 n+iktep n+aħfer (first person singular imperfect)
 n+igdb+u n+aħfir+u (first person plural imperfect)

In the perfect, the addition of the suffixes -t, -na, -tu (first person or second person singular, first person plural, and second person plural respectively) creates consonant clusters, which triggers the deletion of the first vowel:

kitib+na ħafir+na
 → ktib+na ħfir+na

A rule of metathesis takes precedence over the syncope of the medial vowel if the second consonant is [+sonorant]; the basic allomorph of /ʃorop/ ('he drank') is /ʃorob-/ (devoicing affects the citation form, as usual); the non-perfect stem is /iʃrob-/. The first person singular and plural imperfect will be /n+iʃrop/ and /n+iʃorb+u/ respectively; the plural form is derived as follows:

n+iʃrob+u
 → n+iʃorb+u (metathesis)

Consider now the paradigms of /ʔaat/ ('he stood') and /deer/ ('he appeared'), compared with /kitep/ ('he wrote'):

kitep	ʔaat	deer	(third pers. sing. masc. perf.)
iktep	oʔoot	ideer	(sing. imperative)
igdb+u	oʔood+u	idr+u	(plural imperative)
n+iktep	n+oʔoot	n+ideer	(first pers. sing. imperfect)
n+igdb+u	n+oʔood+u	n+idr+u	(" " plural ")
ktib+na	ʔaad+na	deer+na	(" " " perfect)

Apparently, these forms lack the second root consonant, and the vowels form bimoric nuclei. However, there are several anomalies; we know that a morphological process of metathesis produces the non-perfect stems (iktib-, for instance). /ʔaat/ and /deer/ are apparently subject to this rule, but the vowel following the first root consonant remains long in /oʔoot/, /ideer/. If the rule applied normally, we would expect */oʔot/, */ider/ (the changes in vowel quality need not concern us here). The vowel is long in /oʔood+u/, but disappears in /idr+u/, as in /igdb+u/. Other verbs, like /sama/ ('he heard'), lack the third root consonant; its forms are:

sama

isma

isima+w

n+isma

n+isima+w

smaj+na (for the morphological analysis, see above)

Here, the anomalies are the presence of the second /i/ in /isima+w/, /n+isima+w/, and of /j/ in /smaj+na/. Consider also the past participle /mi+smuuh̥/. In the formation of such participles, /uu/ is inserted between the second and the third root consonants: the past participle of /kitep/ is /mi+ktuup/. What is strange in /mi+smuuh̥/ is the appearance of /h̥/ (the unvoiced pharyngeal) in the position of the third root consonant, which is missing in /sama/.

Brame (1972: 45-46) notes that the stress pattern of /ʔaat/ and similar verbs is anomalous. According to the usual stress rules of Maltese, the second syllable should be stressed in /n+oʔoot/, for instance, whilst in fact it is not (the first syllable is stressed). He also observes that verbs which behave like /ʔaat/ are subject to prothesis after a consonant or a pause, if their initial segment is [+sonorant]; prothesis is a phonotactic rule or an external-sandhi rule which has the following form:

(R.8) $\emptyset \rightarrow i/C \text{ or } \S(\#)_ [+consonantal \ \& \ +sonorant][C]$

Prothesis overapplies when the sonorant consonant is followed by a vowel (Brame 1972: 47):

laaʔ+t ('I licked')
 → ilaaʔ+t

Note that marking such verbs as exceptionally undergoing prothesis would not work, because they are subject to it only when their stem is associated with consonant-initial suffixes, and provided these suffixes are preceded by

a morpheme boundary (+), but not by a word boundary (#) (regarding the distribution of + and # before the various classes of suffixes, I follow Puech (1983: 223-231). 'Inflectional' suffixes are *subject* pronouns, and are preceded by +, whilst 'pronominal' suffixes are *object* pronouns, and are preceded by #. See also SVI.5.7).

laaʔ+na ('we licked', first person plural perfect)

→ ilaaʔ+na

but:

laaʔ#na ('he licked us') (no prothesis)

This shows that the situation is particularly complex.

Other anomalous facts suggest that traditional exception features (characterizing morphemes) would not work: the possessive morphemes /#a/ ('her') and /#om/ ('their') become /#^ha/, /#^hom/, when they follow the unvoiced pharyngeal /h/:

ru^h#a ('her soul')

→ ru^h#^ha

Still more interestingly, the missing third root consonant of verbs like /sama/ ('he heard') reappears not only in past participles, but also when it precedes the morphemes /#a/ and /#om/ (in Maltese, the same morphemes perform the function of possessives and of object pronouns):

tefa#om (= verb stem + object pronoun: 'he threw them')

→ tefa^h#om

→ tefa^h#^hom

The appearance of /^h/ at the end of such words feeds the rule inserting /^h/ after another /^h/ (cf. /ru^h#^ha/). The prepositions /ta/ ('of'), /ma/ ('with') trigger the same processes:

ta#a ('of her')

→ ta^h#a

→ ta^h#^ha

The article /l/ is subject to prothesis, which is quite normal:

l#mara ('the woman')

→ il#mara

Yet prothesis overapplies when /l/ precedes some nouns:

l#eerf ('the wisdom')

→ il#eerf

but it should be added that, while normal applications are obligatory, overapplications are only optional (all these examples are taken from Aquilina (1965) and Cremona (1970)). All these anomalies or exceptions led Brame (1972) to posit a ghost segment; the trouble with such solutions is the feature composition of the segment. The usual argument is the

phonological gap: Maltese has an unvoiced pharyngeal, which has no voiced counterpart (while there is a voice correlation in the language: see Aquilina (1965: 19)). Brame (1972) puts forward the idea that the ghost segment is the voiced pharyngeal. However, I suspect that the real basis of Brame's argument is etymological: it happens that, historically, Maltese, like Arabic, had the voiced pharyngeal, whose loss caused disorders in the morphological system (especially in a Semitic language with consonantal roots; most varieties of Arabic have preserved the voiced pharyngeal: see Cantineau (1960)). Several counterarguments lead me to reject Brame's line of reasoning: speakers' competence is not etymological, and what is crucial is the absolute lack of phonetic evidence supporting the existence of a voiced pharyngeal in the modern language. Another fact is decisive: a ghost segment cannot account for the divergent behaviour of /ʔaat/ and /deer/, and similar verbs. In fact, Brame (1972) examines only verbs following the pattern of /ʔaat/, not of /deer/.

In any case, my constraints force me to reject the possibility of an imaginary segment (or of two, if we want to account for the pattern of /deer/). Instead, I shall use the same method as for Finnish and Turkish: a diacritic feature [+X] will characterize phonemes, or the missing root consonants in verb patterns. In some cases, another feature, [Z], will account for the different behaviour of these missing root consonants. I shall hypothesize that verbs such as /aamel/ ('he did'), /deer/, /sama/ etc... belong to the same class of verbs as /kitep/ and similar verbs with the three root consonants. The first root consonant is missing in /aamel/; the second root consonant is missing in /ʔaat/, /deer/, and the third root consonant is missing in /sama/. The feature [+X] plays the same role as the

missing root consonant with respect to all phonological rules: it will be responsible for all overapplications of otherwise regular processes, as well as for various anomalies. So the underlying representations of the above-mentioned verbs are in fact:

[+X]	[+X]	[+X]	[+X]
↓	↓	↓	↓
/aameɪ/	/ʔa at/	/de er/	/sama /

([+X] is attached to vowels or to non-segmental positions)

We can posit the following conventions:

(i) [+X] = [+consonantal] with respect to rules

(ii) [+Z] = [+sonorant] " " "

[+Z] is associated with [+X] in /aameɪ/, /ʔaat/, /sama/, but [-Z] is associated with the same feature in /deer/. We can thus account for all anomalous forms:

ʔa[+X]ad- (= basic stem allomorph)
 → oʔ[+X]od (morphological metathesis)
 → oʔood (vowel copy)
 → oʔoot (devoicing)

Note that a copy of the adjacent vowel is associated with [+X] in the sequences C[+X]VC, or CV[+X]C. The feature [+X] is not lost, and continues to characterize the same position, whether the latter is 'filled' or 'empty'. The derivation of /oʔood+u/ ('stand') is therefore:

- oʔ[+X]od+u
- oʔo[+X]d+u (metathesis)
- oʔood+u (vowel copy)

The sequence $-[+X]o-$ undergoes metathesis, since $[+X]$ is associated with $[+Z]$: compare /n+iʃrop/ ('I drink'), /n+iʃorb+u/ ('we drink'). In /oʔoot/, the usual rules stress the first syllable, as in /iʃrop/ ('drink'), /iktep/ ('write'), since $[+X]$ is equivalent to $[+consonantal]$. $[+X \ \& \ +Z]$ triggers metathesis in /oʔood+u/, but in /idr+u/ ('appear'), $[+X \ \& \ -Z]$ cannot:

- de[+X]er (basic stem allomorph)
- id[+X]er (morphological metathesis, formation of the non-perfect stem)
- id[+X]er+u (affixation)
- id[+X]r+u (syncope: compare with iktib+u → iktb+u → igdb+u)

The derivation of this form is straightforward: between two consonants, no phoneme can be associated with $[+X]$. The derivation of /isima+w/ ('hear') is particularly complex, and the output is misleading:

- sama[+X] (basic stem allomorph)
- isma[+X] (morphological metathesis)
- isma[+X]+u (affixation)
- isim[+X]+u (metathesis)
- isima+u (insertion of /a/)
- isima+w (semivocalization)

This verb undergoes metathesis, like /i orb+u/, because /m/ is [+sonorant], and because [+X] is equivalent to [+consonantal]. Note that a phoneme /a/ is inserted in the position of [+X] before a final /u/; this /u/ is converted into a semivowel after a vowel. After a vowel other than /a/, [+X & +Z] in final position is associated with the pharyngeal /ħ/:

mi+smuu[+X]

→ mi+smuuħ (past participle of /sama/)

We can now understand why /laaʔ+na/ ('we licked'), for instance, is subject to prothesis:

la[+X]aʔ+na

→ l[+X]aʔ+na (syncope)

→ laaʔ+na (vowel copy)

The first /a/ keeps the feature [+X], and the structural description of prothesis is satisfied, by virtue of the convention ([+X] = +conson.). The first vowel of the stem is deleted by the rule which produces /ktib+na/ ('we wrote'), from /kitib+na/. Then, as usual, the second /a/ is copied in the position of [+X]. The first vowel is not deleted when the suffix is not inflectional: so /kitib-/ is not affected when /#na/ is added, and we obtain /kitib#na/ ('he wrote our name'). In the same way, the first /a/ of /laaʔ/ is preserved if /#na/ is adjoined to it: /la[+X]aʔ#na/. In this context, between two vowels, no phoneme is associated with [+X]. In the same form, the structural description of prothesis is not satisfied. After /a/, in word-final position, the features [+X & +Z] will be associated with the phoneme

/h/ if the feature [+X] follows; on the other hand, /h̃/ is associated with [+X] if /h̃/ precedes:

ruh̃#[+X]a ('her soul')	ta[+X & +Z]#[+X]a ('of her')
→ ruh̃#h̃a	→ tah̃#[+X]a
	→ tah̃#h̃a

So all exceptions are accounted for without increasing the degree of abstractness, and without violating any of our constraints on rules and representations. Ghost segments have no phonetic content: they are nothing but ghosts.

VII.3. Constraints on rule order

VII.3.1. Possible types of interaction

After examining various constraints on rules, representations, and systems, we must now deal with the difficult question of rule interaction. I shall first show that this question is logically related to the universal condition on rules. I shall then propound a few basic principles of rule ordering. Although I defend a constrained theory, I am convinced, in the light of linguistic facts, that rule order is not always predictable or intrinsic, or necessarily unmarked. However, I am also convinced that rule order must be constrained in some way: some types of interaction are certainly impossible (for a definition of extrinsic ordering, see Sommerstein (1977: 184, n.17): '*Extrinsic ordering* is the term used for ordering governed by

specific statements about specific rules in specific languages, as opposed to sequential application that is not so governed but follows from the conformation of the rules themselves and/or some universal principle').

VII.3.2. The universal condition on rules and rule ordering

As we saw in SVII.2.2, the universal condition on rules does not require rules to be surface-true in all derivations, but only in some of them. This entails that, if some rules are not necessarily surface-true, rule interaction can cause some rules to be opaque in at least some cases; as opacity is not predictable, rule ordering has to be extrinsic.

Suppose that we define the transparent order (that is, the order which ensures transparency of rules) as unmarked, and more natural, and the opaque order as marked; then it is clear that rule order may be either transparent or opaque (on the notions of transparency and opacity, see Kiparsky (1978: 224-229)). If rules and representations are severely constrained, and especially if underlying representations are phonemic word forms, the possibility of extrinsic ordering cannot increase the degree of abstractness in a dangerous fashion (extrinsic ordering could be a factor of abstractness only if allomorphy played a crucial role in setting up underlying representations).

I shall now discuss the possibility of extrinsic ordering with an example drawn from Maltese. In this language, we find an interesting case

of variation. The standard variety of Maltese has the following (lexical) rules:

- (i) syncope
- (ii) metathesis
- (iii) prothesis (see SVII.2.5)

For convenience, I shall mention the effects of these rules again: syncope deletes a vowel in the context: VC(C)_CV; metathesis inverts a sequence of [+sonorant] consonant plus vowel, when a consonant precedes this sequence, and a CV sequence follows it; prothesis inserts /i/ before a consonant cluster whose first member is [+sonorant]:

- kitib+u ('they wrote')
- kitb+u (syncope)
- kidb+u (assimilation)

- n+i}rob+u ('we drank')
- n+i}orb+u (metathesis)

- kitib#l#na ('he wrote to us')
- kitib#il#na (prothesis)
- kitb#il#na (syncope)
- kidb#il#na (assimilation)

- n+i{rob#l#kom ('I drank for you')
- n+i{rob#il#kom (prothesis)
- n+i{orb#il#kom (metathesis)

In all these examples, verb stems are preceded or followed by affixes; these affixes are either inflectional (that is, usual verb endings which denote the category 'person'), and preceded by +, or pronominal (that is, post-verbal object pronouns), and preceded by an internal word boundary (see SVI.5.7 and SVII.2.5). The three rules apply when affixation produces complex verb forms. The basic stem allomorphs in my examples are /{orob-/ and /kitib-/, but they are generally modified by one or several lexical rules. In the standard variety, metathesis bleeds syncope, as in /n+i{orb+u/, because it is more specific. Prothesis feeds syncope, and metathesis. However, for some speakers (see Puech (1983: 227-228)), the situation is different, and syncope and metathesis are not allowed to apply after prothesis, which counterfeeds them: /kitib#il#na/, /n+i{rob#il#kom/. It should be added that these varieties have not lost the counterfed rules, whose application is quite regular, and exceptionless in verb morphology, provided it is not prothesis which creates the conditions of their applicability:

- n+i{rob+uu#l#kom ('we drank for you')
- n+i{orb+uu#l#kom (metathesis)

I am led to conclude that the standard language and these non-standard varieties differ strictly in rule interaction. As these data are difficult to refute, it is clear that ordering is extrinsic. Rule order in the non-standard variety seems to be marked, since the application of rules is not

free; this constitutes an innovation from a diachronic point of view, and reveals that an innovation is not necessarily a simplification. This type of change (reordering) might be motivated by the minimization of processing, or by analogical levelling (it reduces allomorphy, or more exactly, it tends to preserve the basic stem allomorph; if this interpretation is correct, then analogical change entails reordering, and analogy interferes with representations, rules, and rule orders).

VII.3.3. Is ordering linear?

For Chomsky & Halle (1968: 341), 'Rules are applied in linear order, each rule operating on the string as modified by all earlier applicable rules', and (344) 'To apply a rule, the entire string is first scanned for segments that satisfy the environmental constraints of the rule. After all such segments have been identified in the string, the changes required by the rule are applied simultaneously'. We may ask whether this conception of rule application is correct.

Anderson (1974: chapters 10, 11) shows that the hypothesis of linear ordering, as developed in *SPE*, cannot be maintained. Anderson provides several counterexamples to linear ordering. The most famous of them is drawn from Icelandic. Anderson demonstrates in a very convincing manner that in Icelandic the two rules of syncope and umlaut interact in a different fashion in different derivations. The order is syncope/umlaut in (a), and umlaut/syncope in (b) (for the forms of the rules, see Anderson (1974: 142)); umlaut affects /a/, which it converts into /ø/, when the next

syllabic nucleus is /u/; syncope deletes a vowel in the following context:

C_C+V):

- (a) *katil+um* ('kettle', dative plural)
 → *katl+um* (syncope)
 → *køtl+um* (umlaut)
- (b) *baggul+i* ('parcel', dative singular)
 → *bøggul+i* (umlaut)
 → *bøgg+l+i* (syncope)

In (a), syncope feeds umlaut, whilst in (b) umlaut is counterbled by syncope (if syncope had applied before, umlaut would no longer be applicable). Anderson's demonstration means that the standard theory of rule application is not correct, and that rules should be ordered in a pairwise fashion. Moreover, in Anderson's theory of *local ordering*, rule order may be marked or unmarked, and general principles govern unmarked interactions. Explicit ordering statements are required only when general principles are violated, that is, when rule order is marked (in (a) and (b) -- see above -- a principle of maximal applicability would predict that the two different interactions are both unmarked). However, Anderson's (1974: chapters 10, 11, 12) theory of local ordering and the theory of linear ordering both presuppose that the only possible relation between two rules A and B is the following: either A is ordered before B, or B is ordered before A. Although Anderson adopts pairwise ordering, for him there cannot be any other type of relation between two rules, unless their order is immaterial (for the idea that rules are ordered in a pairwise fashion, see Anderson (1974: 137-

138, 164, 166, 218)). In Anderson's view, 'the grammar of a language contains only language-particular statements of the type 'A precedes B', and not statements of the type 'A does not follow B'' (196, n.5). Yet as Sommerstein (1977: 176-177) notes, the ordering of A before B can have two different meanings:

(i) the structural descriptions of A and B are satisfied at the same stage, and only A applies

(ii) B potentially feeds A, but A must not apply, although its structural description is satisfied, once B has applied.

In (i), A bleeds B, while in (ii) B counterfeeds A. From now on, I shall call relation (i) 'precedes', and relation (ii) 'does not follow', and I shall regard these relations as different. Following Sommerstein (1977), I shall regard (i) as a case of 'precedence', and (ii) as a case of 'blockage'.

It is also patent, in the description of many languages, that several pairs of rules can be left unordered, because their order of application is absolutely immaterial. If the structural descriptions of two rules A and B are never satisfied at the same stage of any derivation, or if these two rules never potentially feed each other, they must be left unordered, and more generally, two rules can be left unordered (with respect to each other) if either order yields identical outputs in all derivations. It follows that the rules of a language are only *partially* ordered (see Sommerstein (1977: 176-180)).

As in linear order, rules apply sequentially; as in Anderson's (1974: 137-138) theory of local ordering, only pairs of rules are ordered. However, the originality of the theory of partial ordering lies in the distinction between *precedence* and *blockage*. Thus, there are two kinds of explicit ordering statements:

- (i) Precedence statements of the form 'A precedes B'.
- (ii) Blockage statements of the form 'A does not follow B'.

If no statement involves two rules A and B, two situations are possible:

- (i) The two rules never interact.
- (ii) The two rules interact, but their interaction obeys general principles.

In this second respect, my own theory of partial ordering differs from that of Sommerstein: according to Sommerstein (1977: 177), explicit statements 'may be regarded as restrictions on a rule's freedom of application; the natural situation for a rule [...] is to apply wherever its structural description is met'. So, although some of my own principles of partial ordering are inspired by Sommerstein's, I am led to modify his principles in some respects: free application is far from being necessarily natural in all situations. The theory must also be able to answer the following question: 'Why are marked orders allowed at all?'

At this stage, I shall hypothesize that:

- Rule order is sequential, but is not linear.

- Ordering is partial, and rules are ordered in a pairwise fashion.

- There are two kinds of explicit ordering statements: 'precedence' and 'blockage' statements.

- General principles govern rule interactions; in certain situations, the natural interaction will be obligatory (see the English example below, in SVII.3.8); in other situations, the general principles may be violated. The possibility of marked orders is therefore limited.

- When the general principles are violated, we need an explicit ordering statement.

- The violation of general principles must have a functional explanation.

VII.3.4. General principles of rule ordering; natural rule orders

In some cases, blockage does not necessitate any ordering statement, because it is the only possible interaction. Consider the following situation; formally, two rules (R.11) and (R.12) apply in the same context:

(R.11) A → B/X_Z

(R.12) B → C/X_Z

(R.11) cannot feed (R.12), since, if this were the case, the two would merge into a single rule, by virtue of the telescoping constraint (see SVII.2.3):

(R.13) A → C/X_Z

The interaction between the two rules must therefore be an instance of 'dragging' order (A becomes B, and primary B becomes C, in the same environments, but secondary B, whose source is A, does not become C). This is the only order which preserves the existence of (R.11) and (R.12) in the grammar: Anderson (1974: 208, 217, 230) calls this the principle of *self-preservation*, and I shall adopt it. Let us illustrate the application of this principle, which allows us to predict blockage of sandhi rules in Corsican dialects; in Northern Corsican, initial consonants are weakened after unstressed vowels; unvoiced obstruents are normally voiced in this context, while some voiced obstruents (the voiced stops) are spirantized (see Dalbera-Stefanaggi (1978: 56-58)):

pane ['pane] ('bread'), but *u pane* [u#'bane] ('the bread')

cane ('dog') ['kane], but *u cane* [u#'gane] ('the dog')

babbu ['babu] ('father'), but *u babbu* [u#'wabu] ('the father')

It is clear that a [b] which is a weakened /p/ will not undergo spirantization (b → w). So the spirantization of /b/ will be blocked after the voicing of /p/: p → b → *w. On the other hand, the deletion of [w] between

two [u] is fed by spirantization, as in the derivation of *u butiru* ('the butter'):

u#bu'diru
 → u#wu'diru
 → u#u'diru

This interaction is permitted, since the deletion of [w] cannot prevent spirantization from respecting the universal condition on rules, as in [u#'wabu].

In Corsican, the self-preservation principle governs interaction between external-sandhi rules, that is, post-lexical processes. The same principle will be valid for interaction between lexical rules; in Finnish, quantitative gradation simplifies geminate stops in checked syllables, while qualitative gradation weakens simple stops (see Sauvageot (1949: 19-26)). Consider, for example, the genitives of *pappi* ('priest'), *äiti* ('mother'), and *apu* ('help'), that is, *papin*, *äidin*, *avun*:

pappi+n æiti+n apu+n
 → papi+n æidi+n avu+n

Whilst /pp/ is simplified to /p/, /p/ becomes /v/ in the same context, but quantitative gradation counterfeeds qualitative gradation:

pappi+n → papi+n → *pavi+n

Feeding, that is, free application, would amount to a single process: $\{pp, p\} \rightarrow v$. Insofar as there are two distinct processes -- $pp \rightarrow p$ and $p \rightarrow v$ -- blockage is obligatory, and predictable. It is governed by the principle of self-preservation.

It should be added that although the principle of self-preservation suffers no violation, we must not forget that rules may be obligatory or optional. Suppose that (R.12) is optional: then, it could apply optionally after (R.11): its optionality would guarantee the preservation of the two processes, since some phonetic representations would justify both rules. This means that if, for example, (R.12) were optional, but were also blocked after (R.11), we would then need an explicit blockage statement. The blockage of (R.12) after (R.11) necessitates an explicit statement if (R.12) does not follow (R.11), and if the second process is optional; on the other hand, the same blockage is not language-specific, and is predicted by the general principle of self-preservation, if (R.12) is obligatory. Finally, (R.12) may also follow (R.11), provided it is optional; if, historically, (R.12) becomes obligatory, the telescoping constraint will cause the suppression of (R.11) and (R.12), and their replacement by (R.13).

In the Portuguese dialect of Mirandese (see Brown (1974)), we find an instance of the interaction that I have just alluded to: a rule has been added to the language, but its optional application after another rule which already existed in the dialect considered must be blocked by an explicit statement, because the principle of self-preservation cannot be operative in such a case. In this dialect, three rules interact:

- (i) Monophthongization of /^he/, /^ho/.
- (ii) Raising of /e/, /o/.
- (iii) Centralization of /i/, /u/.

We can formulate the three rules as follows:

(R.14) ^he, ^ho → e, o

(R.15) e, o → i, u

(R.16) i, u → i, ü

The chronological order is: (R.14), (R.15), (R.16). (R.14) fed (R.15); so, [e] and [o] whose sources were /^he/ and /^ho/ were optionally raised to [i] and [u]. On the other hand, only etymological /i/ and /u/ were centralized, and the new rule, (R.16), which is optional, must be blocked by an explicit statement after the application of (R.15). This situation is very interesting in several respects. First, theories of intrinsic ordering are clearly invalidated: when (R.15) entered the language, it was fed by (R.14), but when (R.16) entered it, it was counterfed by (R.15); this shows that in some cases a new rule is left unordered, while in other cases it is involved in an ordering statement. In each case, this is unpredictable. Secondly, theories of linear and of partial ordering differ when confronted with the same data; some current notions in the theory of linear ordering have to be reconsidered in the light of the theory of partial ordering. One example is the notion of rule insertion as a type of linguistic change (see King (1973) Bynon (1977: 118-120), and Sommerstein (1977: 238-239)). In the dialect of Mirandese, when (R.16) began to apply, it was inserted before (R.15) in terms of linear ordering (so as to prevent its application after

it, and to guarantee the counterfeeding interaction): in other words, it was inserted, instead of being added at the end of derivations. Rule insertion makes sense only within the framework of linear ordering, since, in partial ordering, processes are ordered in a pairwise fashion; we can thus only state that a new rule enters the language; as regards rule interaction, either it will be left unordered (like (R.15)), or it will be involved in pairwise ordering statements (like (R.16)).

VII.3.5. Multiple application

In some cases, self-feeding is theoretically possible, and poses exactly the same problems as interactions between different rules; a rule potentially feeds itself, and we must ask whether it will apply several times, or only once. In Finnish, suppose that quantitative gradation and qualitative gradation (see SVII.3.4 above) are two subparts of the same process; then the blockage of the latter after the former is predicted by the principle of self-preservation: if /pp/ were simplified (pp → p), and then spirantized (p → v), this would amount to a single rule (pp → v). In other cases, however, the principle of self-preservation is not operative, and there are several possibilities. In Maltese, assimilation applies several times (it is iterative) in /igdb+u/ ('write', plural imperative), for example:

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iktb+u
→ ikdb+u  (assimilation)
→ igdb+u  ( "      " )

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This means that the rule is not blocked after itself, and applies freely several times. On the other hand, we can also imagine a different interaction between the various applications of the same rule. In Hidatsa (Kenstowicz & Kisseberth 1977: 178-179), a word-final vowel is deleted:

cixi ('jump')	ikaa ('look')	kikua ('set a trap')
→ cix	→ ika	→ kiku
	→*ik	→*kik

Deletion affects only underlying final vowels, but not derived forms; so the rule does not feed itself, but we do not need an explicit blockage statement, if we adopt the following principle, formulated by Joshi & Kiparsky (1979: 244):

'A rule cannot be conditioned twice in a derivation by the same context'.

If, in a given language, more than one final vowel is deleted, the rule will be: $V_1 \rightarrow \emptyset / _ \#$, rather than: $V \rightarrow \emptyset / _ \#$ (the subscript meaning that from one to n vowels can be deleted simultaneously). The constraint disallowing self-feeding seems to be correct from a logical and formal point of view, and allows us to dispense with explicit statements in such cases, and also with specifications of directionality. Note that in Finnish, the issue is the potential multiple application of one rule to the same segment ($pp \rightarrow p \rightarrow *v$), but, as in Hidatsa, in the same context. On the other hand, in Maltese, each application affects a different segment, but the context changes: /b/ causes the voicing of /t/, and then /d/ causes the voicing of /k/. In Swedish,

Anderson (1974: 133) notes that '/-gdt-/, then, undergoes assimilation of its middle element, but this does not then produce further assimilation of the cluster-initial consonant' and in this case we need an explicit blockage statement, since the contexts of the two potential applications are different, and neither the principle of self-preservation nor the constraint disallowing self-feeding are operative.

In more complex situations, a rule can apply iteratively, and also in a directional fashion; in such cases, we shall have to specify the directionality of the rule. In Slovak, a rule called 'rythmic law' (see Kenstowicz & Kisseberth (1977: 179-180)) applies from right-to-left; this process shortens a vowel when the preceding vowel is long:

pi:s+a:v+a: ('write', frequentative)
 → pi:s+a:v+a
 → pi:s+av+a

The rule does not feed itself, since the two applications are not triggered by the same segment. The first application is opaque (opacity is due to the second application). In Gidabal (Kenstowicz & Kisseberth 1977: 180-182), the same rule applies from left-to-right, and is always transparent:

gunu:m+ba:+da:ŋ+be: ('is certainly right on the stump')
 → gunu:m+ba+da:ŋ+be:
 → gunu:m+ba+da:ŋ+be

The theory of partial ordering can handle these data very easily, if we enrich it with specifications of directionality; note that the examples in

Slovak and Gidabal show that this directionality is not predictable. I suggest that directionality should require an explicit statement only when the interaction between the different applications of the same rule results in opacity; so the interaction in Gidabal is unmarked, and the situation in Slovak is marked: an explicit statement is necessary only in Slovak.

There are many other instances of directional rules; vowel harmony in Finnish or Turkish, for example, applies rightwards, but directionality does not have to be specified, because vowel harmony is conditioned by the preceding vowel: it is a progressive process (see Sauvageot (1949: 26-29)), and each application of the rule feeds the next one:

kæte+ttomα+ssα ('handless', inessive)
 → kæde+ttomα+ssα (gradation)
 → kæde+ttømα+ssα (vowel harmony)
 → kæde+ttømæ+ssα (vowel harmony)
 → kæde+ttømæ+ssæ (vowel harmony)

In Finnish, a vowel agrees in backness with the preceding vowel (and /i/ and /e/ are neutral, which means that they are not affected by the rule, and do not condition it): so the third vowel, /o/, will agree in backness with the first vowel, /æ/ (the second vowel being neutral); the fourth vowel, /α/, agrees in backness with the third vowel, /ø/, etc... We also note that gradation, in Finnish, applies from left-to-right: in the derivation of the word *pudota* /pudo+t+α/ ('to fall'), for example, gradation applies twice:

puto+t+ta[+X]
 → pudo+t+ta[+X]
 → pudo+t+α[+X]

The basic allomorphs of this word form are quite justified; /pudo+t+α/ belongs to a special class of verbs, which is characterized by the presence of an infix -t- or -α- between the stem and the inflectional suffix. In other forms of the paradigm, we find the stem allomorph /puto-/ (cf. *putoan* /puto+α+n/ ('I fall')), which justifies the strong grade /t/ for the basic form. In the imperative, the weak grade /d/ appears in a checked syllable, which is quite normal: *pudotkaa* /pudo+t+kαα/. What is puzzling is the selection of the same weak grade in the infinitive /pudo+t+α/, since this time, the weak grade /d/ appears in a free syllable, whilst this rule is supposed to apply exclusively in checked syllables (see SVII.3.4 above). This apparent anomaly disappears if we assume that at a certain stage of the derivation, the /t/ of the stem stands in a checked syllable. Now, in Finnish, the allomorphs of the infinitive suffix are:

- /+tα/ as in *juosta* /juos+tα/ ('to run').
- /+dα/ as in *saada* /sαα+dα/ ('to get').
- /+α/ as in *lukea* /luke+α/ ('to read').
- /+nα/, /+lα/ or /+rα/ as in *tulla* /tul+lα/ ('to come') etc...

It is clear that there are two basic allomorphs: /+α/ which occurs after a stem ending in a short vowel, as in /luke+α/, and /+tα/ elsewhere. This second allomorph undergoes several modifications, which are all due to applications of gradation; It should be added that the infinitival suffix

triggers the rule of external sandhi which causes the gemination of the next consonant, and this fact justifies a final diacritic feature [+X] (see SVII.2.5). /sαα+dα/ will be derived as follows:

sαα+tα[+X]

→ sαα+dα[+X] (gradation is conditioned by [+X])

The allomorphs /+nα/, /+lα/, /+rα/ are also the results of the gradation rules. In the derivation of /pudo+t+α/, the /t/ of the stem is therefore voiced in a checked syllable, and at the next stage the geminate /tt/ is simplified because of the feature [+X], which is an instance of overapplication. The consequence of this double application of gradation is the opacity of the first application, since its context is destroyed by the second application, and since the weak grade /d/ now stands in a free syllable. As the rightward application of gradation entails opacity, we shall have to specify it in the grammar of Finnish, even if opacity is not automatic; in the next example (*opinnon*, genitive of *opinto* ('study')) , the same rightward application results in transparency:

oppi+nto+n

→ opi+nto+n (gradation)

→ opi+nno+n (gradation)

The cluster -nt- becomes -nn- in the context of gradation; note that the output of the first application of gradation, the simplified geminate, -p-, stands in a checked syllable, even after the second application of

gradation: this reveals that a specific interaction can be marked in some derivations, but unmarked in others.

VII.3.6. Proper inclusion precedence

Another principle can also impose the precedence of a rule A over a rule B, when the structural descriptions of the two rules are satisfied at the same stage of a derivation: this is also known as the principle of *proper inclusion precedence*, which is formulated by Koutsoudas, Sanders & Noll (1974: 8):

'For any representation R, which meets the structural descriptions of two rules A and B, A takes applicational precedence over B with respect to R if and only if the structural description of A properly includes the structural description of B'.

In short, the more specific rule takes precedence; in English, a redundancy rule states that vowels are [-nasal]; however, vowels can be nasalized in the vicinity of [+nasal] consonants (see Malécot (1960)): this process of nasalization is context-sensitive, and is more specific than the context-free redundancy rule. It will therefore take precedence over it.

VII.3.7. Free application

When the principle of self-preservation does not impose a (natural) counterfeeding interaction, and when a rule A potentially feeds a rule B, the natural, more expected interaction is the one which allows the maximal applicability of rules: rule B applies after rule A. This kind of rule order is particularly frequent, and can even produce opacity. The application of rule B can destroy the environment of rule A, if A and B have the following forms:

(A) $X \rightarrow Z/_W$, and (B) $W \rightarrow \emptyset/Z_$

In the formation of the Finnish word form *käsi* /kæsi/ ('hand', nominative), feeding order is unmarked and does not result in opacity:

kæte-
 → kæti (raising: e → i/_#)
 → kæsi (assibilation: t → s/_i#)

On the other hand, in the Rumanian examples that I mentioned in SVII.2.1 (*chiar*, 'even' or 'indeed'), feeding order produces opacity:

kjar
 → cjar (palatalization of /k/ before /j/)
 → çar (deletion of /j/ after [ç])

In this example, the issue is the interaction between two post-lexical rules, but in the same language, we find the same kind of interaction between two lexical rules. In Rumanian, stem-final velars are often converted into palato-alveolars before /i/, /e/ or /j/ in a suffix. Compare the various forms of the following verbal paradigm (*fugi*, 'to run'):

fugi /fu'dʒ+i/ (infinitive)
fug /fug/ (first person singular present)
fugi /fudʒ/ (second " " " " " ")
fuge /'fudʒ+e/ (third " " " " " ")

The form /fug/ reveals the basic stem allomorph of the verb: /fug-/; the allomorphy rule of palatalization is transparent when the suffixes /+i/ or /+e/ are actually present, but it is opaque when the suffix /+j/ is deleted by a phonotactic rule after a [+palatal] consonant:

'fug+j
 → 'fudʒ+j (palatalization)
 → 'fudʒ (deletion of /j/ after a [+palatal] consonant)

Palatalization feeds the deletion of /j/; note that the suffix /+j/ is justified in the derivation of this word form, because it is attested in other paradigms, such as that of *spune* ('to say'):

spun+j
 → spu+j (deletion of /n/ before /j/)

The conclusion is that a higher principle takes priority over transparency, even if transparency plays a role in rule interaction. We already knew that this role is crucial, as the universal condition emphasizes it: a rule cannot be postulated if it is never transparent. Transparency is certainly more natural than opacity (we know that rules are allowed to be opaque in a subset of derivations), except if opacity is produced by feeding order. The functional explanation is straightforward: opaque feeding order does not prevent recoverability, as in the Rumanian example: [car] → cjar → /kjar/ (inverse algorithm: see SVI.2.3).

Let us call the principle which takes priority over transparency and is relevant in this example the principle of *free application*. This principle is subordinate to self-preservation, but takes priority over transparency. It is relevant only when a rule potentially feeds another rule, and not when the structural descriptions of the two rules are satisfied simultaneously. We are now in a position to state the hierarchy of principles of rule ordering:

- (i) Self-preservation
- (ii) Free application
- (iii) Transparency

Blockage statements are then necessary when the principle of free application, which maximizes feeding, is violated; in Finnish, we find an instance of this in the word-formation component. Consider the formation of the adessive plural of *kuningas* ('king'), *kuninkaille* /kuniŋka⁺+lla/ (-i-

being the plural marker, which actually forms a diphthong with the preceding vowel):

$kuniŋk\alpha\alpha^{+1}ll\alpha$

→ $kuniŋk\alpha^{+1}ll\alpha$ (shortening)

Although the third syllable has a long nucleus, the diphthong / α^{+1} /, the structural description of gradation is satisfied: normally, this rule weakens consonants in checked syllables with a short nucleus, but also in checked syllables with a long nucleus, provided this long nucleus is a diphthong with a second element -i-, and provided this -i- is the plural marker; it is clear that analogy between singular and plural has played a role (see Sauvageot (1949: 58)). In Finnish, a trimoric vowel is not possible (79-80), and this motivates the shortening rule which simplifies the long vowel - $\alpha\alpha$ - when -i- follows it: - $\alpha\alpha^{+1}$ - → - α^{+1} -. This shortening rule potentially feeds gradation, but in fact the latter does not apply, because it is blocked after shortening (that the structural description of gradation is met is proved by forms such as *kaduilla* / $k\alpha du^{+1} ll\alpha$ /, the adessive plural of *katu* ('street'), since the basic stem allomorph is / $k\alpha tu^{-}$ /). We therefore need an explicit blockage statement, because the principle of free application is violated.

We should now ask what motivates such counterfeeding interactions. Counterfeeding increases the recoverability of inputs (in this case, I mean the recoverability of inputs to the rules, that is, of a stage which may be intermediate, and which is not necessarily the initial stage of a derivation; this issue must not be confused with the recoverability of

underlying representations in the phonological component, in upside down derivations). I have thus isolated the functional principle which explains why marked orders are possible: maximizing feeding increases the distortion between the initial and the final stages of derivations; a blockage constraint can act as a moderator, which decreases the length of derivations, and counterfeeding makes forms easier to learn: this simple fact is often neglected by advocates of intrinsic ordering.

VII.3.8. Precedence and transparency

We have just seen that opacity can be natural when it is caused by the principle of free application (cf. the Rumanian example in the preceding section); this principle maximizes feeding, and takes priority over transparency. I shall now examine this third principle: transparency, and especially in what kinds of situations it is relevant. It can be operative only in the relation 'precedes', since when a rule A potentially feeds a rule B, the other two (higher) principles perform their functions.

When the structural descriptions of two rules A and B are satisfied simultaneously, at the same stage, the order of these two rules can be completely immaterial, and the two rules can be left unordered (with respect to each other). Yet, quite often, rules interact significantly, and their order is crucial because different orders would yield different outputs. In these situations, the principle of transparency states that the order which maximizes transparency is the natural one. If this natural order is effective, it is clear that we do not need any language-specific

ordering statement, but if the other order, which results in opacity, is effective, a precedence statement is required ('A precedes B'). However, it seems that the principle of transparency can be violated only if this violation increases the recoverability of inputs. This is why we can expect rules of epenthesis (inserting vowels) to bleed rules of assimilation between adjacent consonants when they precisely break consonant clusters: in such cases, bleeding is unmarked and natural, but also obligatory, because counterbleeding would not increase the degree of recoverability of inputs to rules. Consider the allomorphs of the plural marker in English in the following items:

bags /bæg#z/, *cats* /kæt#s/, *gases* /gæs#ɪz/

The allomorphs of the suffix are /z/, /s/, and /ɪz/. The basic allomorph is certainly /z/ (see Anderson (1974: 54-61)); it is subject to two rules:

- (i) voice assimilation
- (ii) epenthesis.

Epenthesis applies after a [+sibilant] consonant. In the initial stage of the formation of /gæs#ɪz/ (</gæs#z/), the structural descriptions of the two rules are satisfied, and yet only epenthesis applies; this means that epenthesis takes precedence over assimilation, and bleeds it. In the output, the principle of transparency is respected. The other rule order is automatically disallowed, and the principle of transparency, in this particular case, cannot be violated, because a violation would not entail a

greater degree of recoverability (note that the two rules are phonotactic processes which apply in word formation).

There are two kinds of situations in which the principle of transparency cannot be operative, because it cannot decide which order is natural:

(i) Whatever the order, the two rules are transparent, but the order is crucial; this is known as *mutual bleeding* (see Kenstowicz & Kisseberth & (1977: 225-226) for examples).

(ii) Whatever the order, one of the two rules is opaque, and none of our principles is operative; we can call this *mutual contradiction*.

Explicit precedence statements will naturally be necessary in these two situations: ordering statements are therefore required either when natural principles are violated, or when they are unable to indicate which order is marked or unmarked. Anderson (1974: 216) mentions a case of mutual contradiction in Turkish. In this language, two rules interact:

(i) Labial vowel harmony, which labializes a [+high] vowel if the preceding syllabic nucleus is [+rounded].

(ii) Palatal umlaut, which makes a vowel [+high & -rounded] before [+palatal] consonants.

The form /oku+mwʃ+t+wɯn+wz/ ('you had read', past perfect narrative; stem = oku-, 'read') reveals that palatal umlaut takes precedence, since the structural descriptions of the two processes are satisfied, but only umlaut applies. In fact, palatal umlaut affects only the vowel of the second morpheme -- /+mwʃ+/ -- and backness harmony makes it [+back], because the preceding vowel, /u/, is itself [+back] (for details on vowel harmony in Turkish, see Deny (1955: 61, 71) and Bazin (1968: 935-936)). Then vowel-harmony processes condition the proper feature values of the other vowels. It appears that labial harmony is violated only by the first occurrence of /u/: according to this phonotactic rule, we would expect /u/. Note that labial harmony cannot apply after palatal umlaut; a blockage statement is required in order to prevent its application in other forms: in the word form /yʃy+mi+jiʃ/ ('the fact of being cold', noun derived from the stem yʃy- ('be cold')), the vowel /e/ of the affix /+me+/ is raised by palatal umlaut, which potentially feeds labial harmony; yet labial harmony is blocked after umlaut. So the interaction between the two rules is twofold:

(i) Palatal umlaut takes precedence

(ii) Labial harmony is blocked after palatal umlaut.

In fact, we can add a logical principle:

When two rules have contradictory effects (and both can potentially apply), the application of one precludes the further application of the other to the same point of the string.

This means that labial harmony will be automatically blocked after palatal umlaut, but only at a specific point of the string: the segment which is affected by umlaut; otherwise, labial harmony is free to apply at any other points of the string, insofar as it is not potentially fed by palatal umlaut.

The Turkish example also contradicts a hypothesis which is put forward by Kenstowicz & Kisseberth (1977: 176): 'when two rules are contradictory, the natural interaction is the one that leads to the appearance of the unmarked sound in the phonetic representation'. This principle cannot be valid: in /oku+muɣ+t+um+uz/, palatal umlaut makes the vowel [+high & -rounded], while labial harmony would have made it [+rounded]. However, we can decide on the marked value of the feature [rounded] only after the application of the rule of backness harmony: [-rounded] is equivalent to [U rounded] only if associated with the feature value [-back]; unfortunately, backness harmony makes the vowel [+back], which makes it [N rounded].

The blockage constraint preventing the application of labial harmony after palatal umlaut in forms like /yɣy+mi+jɨɣ/ also contradicts another hypothesis, which is put forward by Donegan & Stampe (1979: 150-151). According to them, when a process is counterfed by one other process, this implies that it is counterfed by any process of the language. This does not work in Turkish: labial harmony is counterfed by palatal umlaut, but not by epenthesis, which inserts /i/ in certain conditions: /dede+m/ 'my grandfather', /baba+m/ ('my father'), but: ev+m → /ev+im/ ('my house': stem + possessive suffix). In the following derivation, epenthesis feeds labial harmony:

- g'øz+m (= 'my eye')
- g'øz+im (epenthesis)
- g'øz+ym (labial harmony)

VII.4. Conclusion

In this chapter, I have put forward a set of constraints on rules, representations, phonemic systems, derivations, and rule interactions. These constraints are assumed to be universal, and this is why they have been illustrated by examples borrowed from several different languages.

There is a logical relationship between the form and the nature of constraints, and the general organization of the model (Chapter VI). Formal criteria restrict the set of possible natural rules and representations, and limit their degree of abstractness.

VIII

A CONSTRAINED THEORY OF FRENCH PHONOLOGY

VIII.1. Introduction

In this chapter, I shall provide a description of French within the framework of constrained phonology developed in Chapters VI & VII. I shall deal only with the most interesting aspects of the language, and especially with the data which were presented in Chapter IV.

I shall examine the main consequences of the form of the model, and of the constraints which I put forward, in the field of French phonology. The interesting issues are the existence of underlying nasal vowels, the treatment of schwa, *H aspiré*, and liaison, as well as the constraints imposed on rules, rule interaction, and underlying representations. The problem of consonants alternating with 'zero' leads me to discuss post-lexical rules, such as liaison, but also lexical rules (cf. stem allomorphy in verb inflection).

VIII.2. System, rules, and representations

VIII.2.1. The phonemic system

In French, there are several grounds for admitting the existence of phonemic nasal vowels:

- (i) Surface contrasts between nasal and oral vowels, which motivate the following contrastive rule:

(R.1) [+vocalic] → [±nasal]

- (ii) The rejection of a nasalization rule, because, as we saw in Chapter VII, such a rule would violate the universal condition on rules.

As nasal vowels exist in phonetic representations, if they were not underlying, we would need a post-lexical process of nasalization: the impossibility of this process entails that nasal vowels are underlying.

When a nasal vowel precedes a nasal consonant, there are two possible situations; in one, the two segments belong to the same word form, and the [+nasal] vowel contrasts with a [-nasal] vowel in the same context: *emmener* [ãmne] ('to take away'), *amener* [amne] ('to bring'), or the nasal consonant is a connective element which is preceded and followed by a word boundary: *mon enfant* [mõ n äfã] ('my child') (see Chapter V). In both cases, the nasality of the vowel is not conditioned, but is rather underlying.

Naturally, there are alternations between nasal vowels and sequences of oral vowel plus nasal consonant, as in the pair *plein/pleine* ('full'), but the rules relating the alternants are clearly lexical processes, and will be examined later (but connective [n] is inserted by a post-lexical rule (liaison)).

As for *H aspiré*, it cannot be a phoneme, for several reasons:

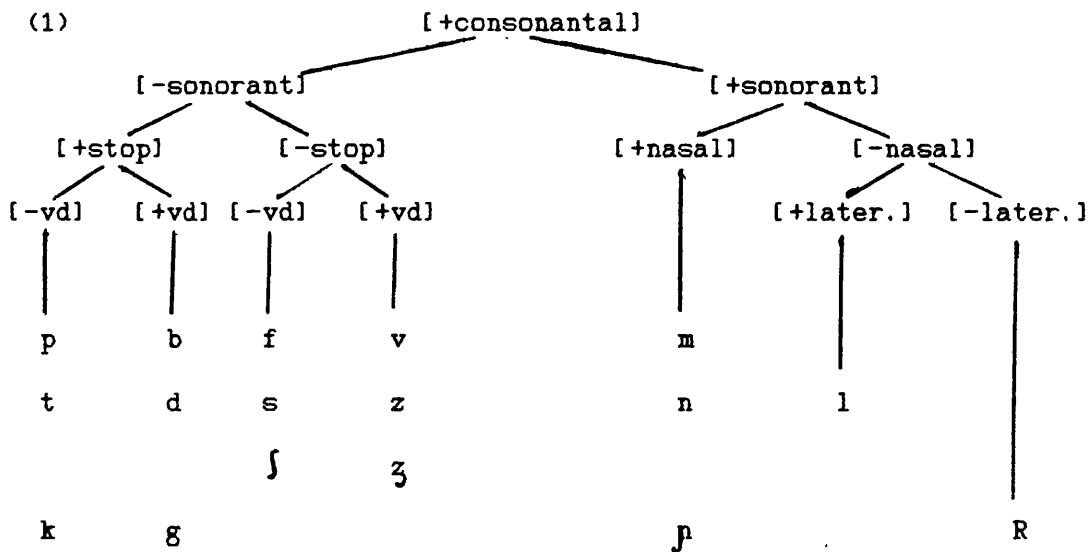
- (i) /h/ would be systematically deleted, but a rule /h/ → ∅ would violate the condition on structure-preserving rules.
- (ii) A rule /h/ → ∅ would be context-free and obligatory: it would violate the universal condition on rules.
- (iii) Pairs of words like *être, hêtre*; *auteur, hauteur* ('being', 'beech'; 'author', 'height' respectively) are strictly homophonous; if the underlying representations of *hêtre, hauteur* were /hɛtR/, /hot+œR/, the recoverability condition would be violated.

For these three reasons, the diacritic-feature approach for *H aspiré* words is therefore more appropriate (see SVIII.3.1).

As contrastive rules must respect the universal condition on rules, the phonemic system of French in the constrained theory is quite similar to traditional interpretations; the following rules generate the consonantal system of French (for the features, see Chapter III):

- (R.2) [+consonantal] → [±sonorant]
- (R.3) [-sonorant] → [±stop]
- (R.4) (i) [-sonorant & +stop] → [±labial], [±coronal], [±dorsal]
- (ii) [-sonorant & -stop] → [±labial], [±coronal]
- (R.5) [-sonorant & -stop & +coronal] → [±hissing]
- (R.6) [-sonorant] → [±voiced]
- (R.7) [+sonorant] → [±nasal]
- (R.8) [-nasal] → [±lateral]
- (R.9) [+nasal] → [±labial], [±coronal], [±dorsal]

The distinctions generated by the above rules may be represented by the following diagram:



The phonemes on the first line (/p/, /b/ etc...) are [+labial]; the phonemes on the second and the third lines (/t/, /d/ etc...) are [+coronal]; the phonemes on the fourth line are [+dorsal]. It should be added that there is also an opposition between the [+hissing] sibilants,

/s/ and /z/, and the [-hissing] sibilants, /ʃ/ and /ʒ/, all sibilants being [+coronal] (this is expressed by (R.5)). As regards [+dorsal] consonants, /k/, /g/ are [+velar], /p/ is [+palatal], and /R/ is [+uvular] (redundancy rules will express this).

The main redundancy rules for consonants are:

(R.10) [-sonorant] → [-nasal & -lateral]

(R.11) [+sonorant & α nasal] → [α stop] (this rule means that nasal consonants are [+stop], but /l/, /R/ are [-stop]).

(R.12) [+sonorant] → [+voiced] (there is a voicing contrast only among obstruents; this rule is valid for semivowels and vowels).

(R.13) [α voiced] → [-α fortis]

The next rule accounts for the fact that labial stops are bilabial, and that labial continuants are labio-dental:

(R.14) [+labial & α stop] → [-α dental]

Note that, as regards markedness, all labial consonants are [U dental], because of the following universal rule:

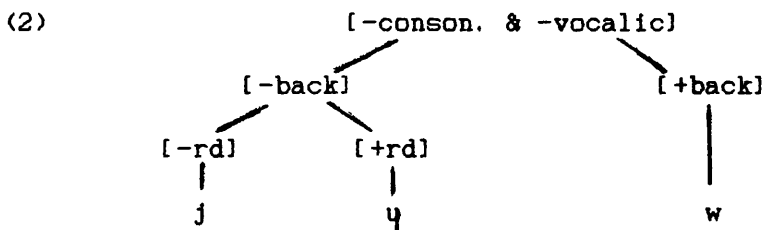
(R.15) [U dental & α stop & +labial] → [-α dental]

The places of articulation of liquids are fully redundant; we can also add that there are no [+dorsal] fricatives. The shape of strictures of fricatives is predictable:

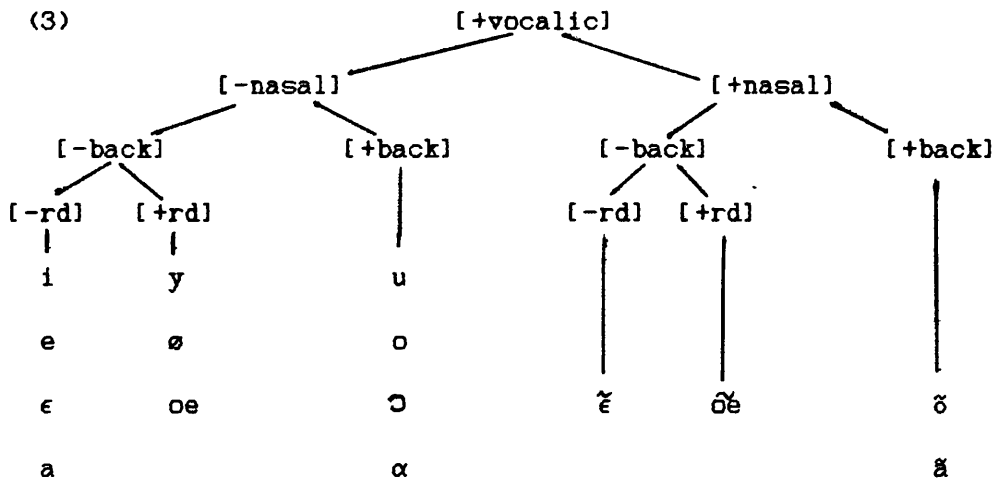
(R.16) [α coronal & -sonorant & -stop] \rightarrow [α sibilant]

Palato-alveolars are also [+palatal], which reinforces the contrast between hissing and hushing sibilants. Other rules will assign the exact places of articulation of [+coronal] consonants: sibilants are [-apical] and [+alveolar], /t/, /d/ /n/ are [+dental] and [+apical], and /l/ is [+apical] and [+alveolar].

The next diagram expresses the contrasts among semivowels:



Naturally, semivowels are automatically [+sonorant] and [+voiced], like all [-consonantal] segments. They are also redundantly [+high]. Here is now the diagram for vowels:



The vowels on the first line are [+high]; the vowels on the second line are [+mid-high]; the vowels on the third line are [+mid-low]; the vowels on the fourth line are [+low]. [+back] vowels are redundantly either [+rounded] or [-rounded], and the rounding contrast characterizes only [-back & -low] vowels or semivowels. As for [+nasal] vowels, they are necessarily [+mid-low] or [+low]. /i/, /y/ and /u/ share all their feature values with their semivocalic counterparts, that is, /j/, /y/ and /w/ respectively: the only difference is that vowels are [+vocalic], and semivowels [-vocalic].

The diagrams and structure-building rules express a hierarchy of features: details concerning the exact place of articulation of a consonant, for example, are clearly conditioned by its manner of articulation. The feature [+lateral] for /l/ is superior in the hierarchy to its place of articulation, [+coronal & +apical & +alveolar]. The absence of such a hierarchy in structuralist theories is rather unfortunate. Martinet (1970: 73) accepts the idea of a correlation between stops and continuants among obstruents only if a subset of the two series share exactly the same place of articulation. In Greek, for example, /x/ and /k/ are both dorso-velar;

this would allow us to regard bilabial stops (/p/, /b/) and labio-dental fricatives (/f/, /v/) as belonging to the same locational class. The same line of reasoning is not applicable to French, according to the functionalist tradition, because in this language stops and fricatives are never articulated in exactly the same place. For Martinet, the subsystem of obstruents should be represented as:

p b f v t d s z ∫ʒ k g (see §III.1.3)

This means that, in the functionalist framework, we are forced to distinguish phonetic features from phonological features; phonological features would be mere conventional labels (see Martinet (1974: 130-146)). In this functionalist description, place of articulation and manner of articulation are not treated as distinct phonological entities. The above presentation of stops and fricatives seems to indicate that what is relevant is the place of articulation, and indeed, the labels which are adopted by Martinet refer to topological categories: *bilabial*, *labio-dental*, etc... Yet, in François (1968: 204) -- another work in the functionalist tradition -- we can read that the manner of articulation conditions the exact location: 'Si, en première approximation, il semble ici y avoir deux traits, il n'y en a en fait qu'un seul, le mode d'articulation conditionnant le point d'articulation'. The problem is that if manner features condition location, they should be mentioned in the inputs to redundancy rules, which presupposes that they are contrastive. Martinet's presentation (see above), on the contrary, implies that manner features are redundant, and it also hides the strong affinities between the pairs /p/, /b/ and /f/, /v/, which are all labial. Similarly, the fact that /t/, /d/ and all sibilants form a natural class of [+coronal] obstruents

cannot be expressed in the functionalist analysis. We also know that a correlation with the two series /p/, /b/ and /f/, /v/ is less marked and more expected than a correlation where the series of labial fricatives is bilabial: /ɸ/, /β/ (labio-dental fricatives being more firmly articulated than bilabial fricatives, which are subject to lenition: see Martinet (1970: 46-48)).

Realization rules will specify the contextual values of phonemes; as most theories agree on these rules, which are allophonic, I shall not deal with them in detail. Stressed vowels, for example, are lengthened in certain conditions, and consonants undergo various assimilatory processes (see Fouché (1959) and Léon (1978) for details).

As regards markedness values, it is easy to formulate them, and I shall give only a few illustrative examples:

(R.17) [*N* nasal] → [+nasal]

(R.18) [α sonorant & *N* voiced] → [-voiced]

(R.19) [-sonorant & *N* stop] → [-stop]

(R.20) [+sibilant & *N* hissing] → [-hissing]

(R.21) [-conson. & α back & *N* rounded] → [-α rounded]

(R.22) [+low & *N* rounded] → [+rounded]

These rules express various universal generalizations, which are of course valid in French.

Finally, it should be added that several tendencies exist: a lot of speakers have replaced the phoneme /ɲ/ (the [+palatal] nasal consonant) by a sequence /-nj-/; similarly /œ/, the [+rounded & +nasal & -back] vowel, often merges with /ɛ/, and /ɑ/ with /a/ (see Chapter III).

VIII.2.2. Underlying representations

The underlying representations of word forms will be based on careful speech variants, but not on hypercorrect or artificial speech; this implies that schwas in most internal syllables, and in all final syllables of polysyllabic items, will be disallowed in underlying representations by various phonotactic rules: the underlying representations of *samedi*, *médecin*, *amener*, *petite*, *grosse*, *grande* ('saturday', 'doctor', 'to bring', 'small', feminine, 'big', feminine, 'large', feminine), for instance, will be /sandi/, /medsɛ̃/, /amne/, /pɛtit/, /gRɔs/ and /gRɑ̃d/ (but the underlying representations of *le*, *me*, *ne*, or *fenêtre*, *pelouse* etc... ('the', 'me', negative particle, 'window', 'lawn') will be /lə/, /mø/, /nø/, /fɛnɛtR/, /pøluz/, because in these examples, schwa is normally pronounced in careful speech). As I reject the pandialectal approach, Southern French will not be invoked to justify abstract forms in Standard French, since the two varieties are quite distinct.

As schwa does not play a protective role, preventing final consonants from being truncated, the feminine marker in items such as /pɛtit/, /gRɔs/ etc... which are the underlying representations of *petite*, *grosse*, is clearly the final consonant.

As connective consonants are preceded by a word boundary (cf. for instance [pøti#t#amil]), the underlying representations of masculine forms will necessarily be based on the pre-pausal variants of adjectives, or of any word form: the underlying representation of *très* ('very'), for example, will be /tRɛ/, and not */tRɛz/. More generally, connective consonants are never word-final, as they are supposed to be in most versions of abstract phonology (from Schane (1968) to recent syllabic versions, such as Noske (1982) and Clements & Keyser (1983)).

The recoverability condition excludes underlying representations with final consonants which would be justified only by alternations between different word forms; so the underlying form of *escroc*, *talent* ('swindler', 'talent'), for instance, will be /ɛskRo/, /talã/, in spite of the related items *escroquer*, *talentueux* ('to con', 'talented'), with the consonants /k/ and /t/ respectively, which appear before a vowel-initial suffix or in the verb paradigm (see SVIII.5.4).

VIII.2.3. Rules

Fromkin (1975: 47) writes that 'A rule of phonology [...] is psychologically real if it is permitted by the general theory which places constraints on the kinds of rules and the form of rules which can occur in any language'. In constrained phonology, a rule is psychologically real only if its effects are observable on the surface, a fact which the universal condition on rules expresses neatly. One of the main differences between my theory and the standard model rests on the notion of rule plausibility. This traditional criterion of rule naturalness

is based on the presumably universal character of rules: yet the constraints which I impose on them restrict the set of possible rules in any language; the fact that a process is recurrent in space and time does not prove that it takes place in a specific language. Rules can also be *apparently* natural, while in fact they are no longer productive, or general and phonetically motivated; in the same way, minor rules can appear to be exceptionless if we postulate highly marked interactions.

As regards rules in French phonology, the consequences of what precedes are very important:

- (i) There is no nasalization rule in French, for vowels.
- (ii) There is no major process of truncation for word-final consonants.

The underlying representation of *caneton* ('duckling'), for instance, is /kantø/ -- here, the structural description of the putative rule of nasalization is satisfied, but this process does not apply, which constitutes another piece of evidence against the existence of such a realization rule in French phonology. The underlying representations of *petite*, *grosse*, *grande*, *très* ('small', feminine, 'big', feminine, 'large', feminine, 'very'), etc... are /pøtit/, /gRøst/, /gRäd/, /tRø/; these forms have a final consonant, which is not subject to any deletion process. A phonotactic rule, which filters underlying representations, disallows final schwas in polysyllabic items:

(R.23) *VC₁ {ø or øe}#
[-stress]

Unstressed [ə] in *petite hache*, *verte campagne* ('small axe', 'green countryside'), for instance, will thus be epenthetic (see SVIII.4.3).

I shall postulate several rules which are quite different from those of abstract phonology; among them, let us mention:

- Liaison: connective consonants will be inserted by post-lexical rules.
- Allomorphy rules will insert final consonants in feminine forms of adjectives: *petite*, *grosse* ('small', feminine, 'big', feminine), or the plural of verbs: *mettent*, *servent* ('to put', 'to serve', present indicative third person plural), or convert a nasal vowel into a sequence of oral vowel plus nasal consonant: *bonne*, *viennent* ('good', feminine, 'to come', present indicative third person plural).

VIII.2.4. Rule order

In the standard model of generative phonology, rule order is often quite marked; in the following derivations of *caneton* ('duckling') and *grosse* ('big', feminine), nasalization and truncation are counterfered by the deletion of schwa, which necessitates blockage statements (see SVII.3):

<i>kanətɔn</i>	<i>gRos+ə</i>	
→ <i>kanɔtõ</i>	"	(nasalization)
→ <i>kantõ</i>	→ <i>gRos</i>	(schwa deletion)

Elision is also counterfed by the deletion of /h/, in the derivation of, for instance, *le hêtre* ('the beech tree');

$l_0\#hetR$

$\rightarrow l_0\#etR$

However, the abstract analyses are not rejected on the pretence that they would violate principles of rule ordering, since these counterfeeding interactions are quite possible in constrained phonology. The marked interactions which are generally postulated in the standard model are actually allowed by the general principles which I presented in Chapter VII, but they certainly contribute to the complexity of the grammar. In a more constrained framework, rule interaction is much simpler, and processing more direct, but this is the consequence of the applications of other constraints: the standard analyses are disallowed because they violate conditions on rules, representations, and the phonemic system. It is certain that French phonology is more 'concrete' than was assumed in the standard theory, because across-the-board denaturalization took place, concomitantly with the historical restructuring of underlying representations.

VIII.3. The problem of disjunctive items

VIII.3.1. Exceptional environments

The rules of elision and liaison in French can take place in the following contexts:

(i) Before vowels: *l'avion, l'ami, l'hélice; les avions, les amis, les hélices* ('the plane', 'the friend', 'the propeller'; 'the planes', 'the friends', 'the propellers').

(ii) Before semivowels: *l'oiseau, l'oie; les oiseaux, les oies; l'huile, l'huissier; les huiles, les huissiers* ('the bird', 'the goose'; 'the birds', 'the geese'; 'the oil', 'the usher'; 'the oils', 'the ushers') etc...

The proper environment of these processes is therefore: $_ \#[-\text{conson.}]$. However, some disjunctive items inhibit the application of the above-mentioned external-sandhi rules, despite the fact that their structural descriptions are apparently satisfied:

le watt, le huit, le whisky, le héros ('the watt', 'the eight', 'the whisky', 'the hero'); *les watts, les huit, les whiskies, les héros* (< = same items in the plural), etc...

These sequences are pronounced: [lɔ wat], [lɔ ɥit], [lɔ wiskil], [lɔ eʁɔ], for the singular, and [le wat], [le ɥit], [le wiskil], [le eʁɔ], for the plural.

Disjunctive items fall into two subclasses:

(i) Words with an initial vowel, called *H-aspiré* words: *héros, hasard, hache, hanneton, hangar* ('hero', 'chance', 'axe', 'cockchafer', 'shed'). This subclass can also include *un, onze* ('one', 'eleven'), that is,

numerals which traditional grammars do not regard as *H-aspiré* words, but which behave exactly like other disjunctive items.

- (11) Words with an initial semivowel: *whisky, watt, huit, hiérarchie, ouistiti* ('whisky', 'watt', 'eight', 'hierarchy', 'marmoset')...

Within the constrained framework, as I defined it in Chapters VI and VII, abstract analyses with a phoneme /h/ (or /ʔ/, or /x/) are not permitted by various constraints on rules, representations, and underlying segments.

VIII.3.2. The status of *H aspiré*

H-aspiré words proper are vowel-initial disjunctive words. We know that *H aspiré* cannot be a phoneme for several reasons (see SVIII.2.1). The following data must be accounted for: *cette hausse* [set^h o:s] ('that rise'), *sept héros* [set eRo] or [set ʔeRo] ('seven heroes'). In the second of these examples, a glottal stop is optional; note that schwa may be pronounced at the end of the word *cette*, but not at the end of the word *sept*. We might ask if the presence of the glottal stop after a final consonant should not induce us to revise our positions: *H aspiré* might be a glottal stop in underlying representations. Suppose that this glottal stop is optionally preserved after a consonant: then the rule deleting it would be an external-sandhi process, and would not violate any constraint:

- (R.24) ? → Ø / [-conson.]#_, or: §_ (i.e., after a pause or a vowel or a semivowel).

Unfortunately, this analysis is highly questionable for the following reasons:

(i) [ʔ] does not characterize *H aspiré* exclusively; it can appear before any initial vowel when speakers avoid enchaînement, in order to make a word stand out against the rest of the utterance (see Carton (1977: 117-123), Cornulier (1978: 50), Tranel (1981: 310-311), Lucci (1983), and Encrevé (1983). Enchaînement is the reassociation of a final consonant with the initial vowel of the next word; it is a kind of syllabic restructuring: see SVIII.6.3).

(ii) [ʔ] appears inconsistently before disjunctive items (see Tranel (1981: chapter 9)).

It is therefore much more reasonable to postulate an inverse process inserting [ʔ]; this process is a variable rule, whose application will be contingent upon several factors, which are essentially sociolinguistic or stylistic. The last argument in favour of the phonemic status of *H aspiré* collapses. We are thus left with the diacritic-feature approach.

The initial vowel of disjunctive items (*H-aspiré* words) will be marked [+H], and the precise environment of liaison and elision must therefore be modified:

_[#[-consonantal & -H]

The specification [+H] will prevent these processes from applying. A lexical redundancy rule will predict that foreign items with an initial semivowel are automatically disjunctive: /j/ & /w/ → [+H] if [+foreign]. Of course, native items with initial semivowels may also be disjunctive, and their initial segment will be marked [+H] (ex.: *huit*, *hyène*, 'eight', 'hyena'). The rule inserting glottal stops will also be sensitive to the feature [+H]:

(R.25) $\emptyset \rightarrow [ʔ]/[-\text{vocalic}]_{\#} [+ \text{vocalic} \ \& \ +H]$ (optional)

With the feature [+H], we avoid abstractness, the violation of constraints, complex rule order, opacity, and also the problem of the indeterminacy of the feature composition of the ghost segment (for a similar proposal, see Kaye & Lowenstamm (1984: 139-143)).

VIII.3.3. The effect of the alphabet feature

Disjunctive items, which can have initial vowels, but also semivowels, are characterized by the alphabet feature [+H], which is assigned to their initial segment (for the treatment of exceptions in generative phonology, see Zonneveld (1978: 213), for whom 'alphabet features are part of the underlying representations of the irregular forms', and 'phonological rules can be triggered by them'); the scope of this alphabet feature, in my view, must be the first phoneme of disjunctive words. It inhibits rules, such as liaison and elision, but it can also condition rules, which will apply in exceptional contexts (the truncation of the final consonant of *six*, *huit* ('six', 'eight'), for instance, which is a minor process, applies normally before a consonant: it also

applies before any segment marked [+H]: *six héros* [si eRo] ('six heroes'), while the underlying form of *six* is /sis/).

An optional rule deletes *E caduc* (that is, unstable schwa) before consonants or semivowels: *prends le train* [pRã lø tRÊ] or [pRã l tRÊ] ('take the train'). This rule is not operative before non-disjunctive semivowels, which are marked [-H]; these semivowels condition the obligatory rule of elision. However, it applies before disjunctive semivowels, marked [+H]. So in (a), it is elision which deletes schwa, but in (b), it is the optional rule deleting schwa before a consonant or a semivowel marked [+H]:

(a) lø#wazo (b) lø#wiski
 → l#wazo → l#wiski

(the initial /w/ of *oiseau* ('bird') is [-H], but the initial /w/ of *whisky* is [+H])

Before disjunctive vowels, marked [+H], the optional rule deleting schwa before a consonant or disjunctive semivowels does not apply: *le héros* [lø eRo] ('the hero'), never *[l eRo]; therefore, the context of the rule is: _(ℓ)[-vocalic] (we must remember that the context of elision, which is obligatory, is: _(ℓ[-consonantal & -H]).

In SVIII.4, we shall see that disjunctive vowels trigger a lexically restricted rule inserting a final schwa, as in *tristø héros* ('sad hero').

VIII.4. The problem of schwa

VIII.4.1. Schwa in underlying representations

The data were presented in SIV.2, and I shall not repeat them here; I shall simply summarize my observations. The quality of schwa is generally that of the phoneme /ə/, which leads me to the conclusion that schwa and /ə/ are not distinct phonemes (for the quality of schwa, see Walter (1977: 50)). In SIV.2, I noted that schwa is in fact the phoneme /ə/ in most varieties, but that this term is reserved for the occurrences of this phoneme which are spelt *E*. These *E* can be stable, unstable, or mute; here are examples:

(i) Stable schwa: *crever, premier, appellions, fonderions* ('to puncture, 'first', '(we) called', '(we would) found').

(ii) Unstable schwa: *fenêtre, pelouse, geler* ('window', 'lawn', 'to freeze') (= *E caduc*).

(iii) Mute schwa: *jolie, grosse, grande* ('pretty', 'big', 'large'), but also: *samedi, médecin, appeler, pèlerin* ('saturday', 'doctor', 'to call', 'pilgrim') etc... (= *E muet*).

As I stated in SVIII.2.2, all mute schwas are excluded from underlying representations (in Standard French), even if they can be pronounced in artificial styles, poetic diction, hypercorrect speech, or regional varieties, because underlying representations are based on variants which are used in

natural careful speech in conversational French. So in non-standard varieties -- in Southern French, for instance -- or in poetic diction I shall assume that there are alternative underlying representations; a speaker of Standard French will generally be aware of these alternative forms, and his competence is certainly polydialectal (but not pandialectal: in the pandialectal approach, one -- incorrectly -- assumes that all surface forms in all varieties are derived from the same underlying representations).

Stable schwas and mute schwas (= *E muet*) do not pose any particular problem; the former behave exactly like any other occurrence of the phoneme /ø/, and will be present underlyingly: *premier* /pʁømjɛ/ ('first'), and the latter will be absent from underlying forms. The main theoretical problem will thus be the treatment of unstable schwas (= *E caduc*). Before proceeding further, let us repeat, for convenience, the contexts where these unstable schwas can occur:

- (i) Initial syllables of polysyllabic items: *fenêtre* ('window')
- (ii) Monosyllabic items: *le*, *me*, *te* ('it', 'me', 'you') etc...
- (iii) Internal syllables: *restera*, *parlera*, *recevoir*, *devenir* ('(he will) stay', '(he will) speak', 'to receive', 'to become')

Schwa in word-final position, in polysyllabic items, must not be considered as unstable, but rather as mute. It is true that it can occur in connected speech, in this context, but, as we shall see in SVIII.4.3, in such cases it

is not underlying but inserted by rules of external sandhi. Note that in internal syllables, in case (iii), unstable schwa generally occurs after more than one consonant, or after one consonant provided the latter is itself preceded by another unstable schwa, as in *devenir, recevoir* ('to become', 'to receive'). Otherwise, after other VC sequences, I regard schwa as excluded from underlying forms. On the other hand, I regard unstable schwas as present underlyingly, and deleted by means of various rules, rather than inserted. Deletion is more acceptable than insertion, in view of the following examples: *pli, pelouse, ski, secouer, scribe, secret* ('fold', 'lawn', 'ski', 'to shake', 'scribe', 'secret'); it is clear that in the same context we can find a contrast between schwa and 'zero'; the presence of schwa is therefore difficult to predict, and I prefer to follow Dell (1973a: 239-241) rather than Martinet (1969a: 24-25; 1969b: 216-217); Dell shows that the alternative in which schwa in initial syllables is underlying is superior, because its presence is often idiosyncratic (cf. the examples above), whereas for Martinet the realization of schwa in initial syllables does not imply that it is phonemic: facts contradict this view. As to Grammont (1966: 115), his analysis is obviously grapho-phonological, and not strictly phonological: 'il est commode, pour étudier le sort de cette voyelle inaccentuée, de prendre pour point de départ l'orthographe usuelle'.

It is not sufficient to state that unstable schwas are present underlyingly, and deleted by rules, because some occurrences of /ø/ are stable, and others are unstable: so some are subject to post-lexical deletion, and others are immune from it. The only solution is a diacritic feature; unstable schwas will be marked [+F] (for 'fleeting'), and stable schwas, or more generally all stable occurrences of the phoneme /ø/, will be

marked [-F]. Note that the scope of the feature is the segment itself, and not the morpheme, or the entire word form, in view of examples like *semelle, ressemeler, il ressemelle* ('sole', 'to resole', 'he resoless'), whose underlying representations will be /sɔmɛl/, /Rɔ+sɔml+e/, /Rɔ+sɔmɛl/. In the first syllable of the stem, /ɔ/ is [+F] in the first and the third items, but is [-F] in the second item (infinitive). As we find the same morpheme in the three word forms, it cannot be this morpheme which is marked [+F] or [-F]; there is a second argument, this time against the idea that it is the entire word form which is marked for the feature [F]: in the infinitive, the first /ɔ/ is [+F], and the second /ɔ/ is [-F].

VIII.4.2. Schwa: lexical rules

In this section, I shall deal with the main lexical rules involving schwa. Some phonotactic rules are the natural consequences of the analysis which precedes. Two such rules delete schwa in specific contexts, which means that they play the role of well-formedness conditions and filter underlying representations. They apply in the word-formation component:

(R.26) /ɔ/ [+F] → Ø/[+vocalic & -F][-vocalic]_[-vocalic]

(R.27) /ɔ/ [+F] → Ø/ (1) VC₁_#

(11) V_

These two rules account for the deletion of schwa, or its exclusion, in certain forms: in *appeler, samedi, pèlerin* ('to call', 'Saturday', 'pilgrim') etc... that is, in internal syllables. (R.27) disallows schwa in word-final

position in polysyllabic items, or after a vowel: *petite, jolie, bleue* ('small', 'pretty', 'blue') etc... Of course, these processes exclude only 'fleeting' schwas, that is, unstable schwas (*E caduc*), marked [+F], and therefore subject to deletion. However, in certain cases, we find an unstable schwa in two successive syllables, as in *devenir, recevoir* ('to become', 'to receive'): in such items, I shall assume that the two schwas are underlying, because either is preserved in connected speech: [døvniR] or [dvøniR]; the underlying representation is therefore /dø+vøn+iR/.

Two other phonotactic rules disallow unstable schwas in certain contexts, but do not delete them: this time, schwas become stable:

(R.28) /ø/ → [-F]/[-sonorant]{R, l}_[-vocalic]

(R.29) /ø/ → [-F]/[-vocalic]_{R, l}[j]

The first of these rules accounts for forms like *crever, montrera* ('to puncture', '(he will) show'), and the second rule, (R.29), accounts for forms like *chapelier, appellions, chanterions, fonderions* ('hatter', '(we) called', '(we would) sing', '(we would) found'). Note that in the paradigm of *appeler* ('to call'), (R.29) makes schwa stable in *appellions* /apølj+ø/ ('(we) called'), but (R.26) deletes it in *appeler* /apl+e/ ('to call').

There are also allomorphy rules involving schwa, and I shall now provide a few examples. We must account for the underlying presence of schwa in *restera, parlera, chanterions* ('(he will) stay', '(he will) speak', '(we would) sing'), for instance. I shall assume that an allomorphy rule inserts a schwa marked [+F] in stem-final position, in verb paradigms, if

the stem is followed by the affix /+R/; only verbs of the first conjugation, that is, verbs with the infinitive in /+e/, are subject to this rule, as well as all stems with a final /j/: *cueillir*, *asseoir*: *j'asseyerai* ('to pick', 'to sit', 'I shall sit') etc... The rule will have the following form:

(R.30) $\emptyset \rightarrow /ø/ [+F]/ (1)_+R+$ (if first conjugation)

(11) j_+R+

This allomorphy rule feeds phonotactic rules; in *chanterions* ('(we would) sing'), (R.29) makes schwa stable; in *jouerons*, *chanterons* ('(we shall) play', '(we shall) sing'), (R.27) and (R.26) delete it; in *parlerons*, *resterons* ('(we shall) speak', '(we shall) stay'), schwa remains present underlyingly, but also remains unstable, and subject to post-lexical deletion. This analysis accounts for the different behaviours of *resterons*, *chanterons*, *chanterions*, for instance: the first item has two possible phonetic realizations: [Rɛst*ɾø], [RɛstRø]; the second item has only one variant, without schwa, and this variant is [ʃätRø]; finally, the third item has only one variant, with schwa: [ʃät*Rjø] (all my informants agreed on these pronunciations). Schwa can also be inserted in derivational morphology, in the formation of adverbs, for instance; a schwa is inserted in stem-final position, before the affix +ment: *vertement*, *justement* /vɛRt*+mä/, /zyst*+mä/ ('sharply', 'rightly'), but: *bêtement*, *joliment* /bet+mä/, /zɔli+mä/ ('stupidly', 'prettily'); in these last two forms, (R.26) deletes the schwa which is inserted by the allomorphy rule, because only one consonant, or a vowel, precedes schwa. Schwa remains unstable after two consonants, as in *restera*, *parlera* ('(he will) stay', '(he will) speak'), but only in verb forms; in adverbs, like *vertement*, or in any other class of words, schwa tends to be stable after

two consonants, but this is subject to idiolectal variation: the schwa of *appartement* ('flat') is normally stable in Standard French, but for some speakers it is unstable.

Compounds behave in a specific way, with respect to the problem of schwa; consider the following items:

(a) *lave-glaces, garde-malade, porte-bouteilles* ('windscreen washer', 'nurse', 'wine rack')

(b) *garde-fou, ouvre-boîtes* ('parapet', 'tin opener')

Their underlying representations are:

(a) /lav#glas/, /gaRd#malad/, /pɔRt#butej/

(b) /gaRd*#fu/, /uvR*#bwat/

In (b), the first member of the compound ends in a consonant cluster, and the second member is monosyllabic: if these two conditions are satisfied, a stable schwa is inserted at the end of the first member. This rule suffers no exception for some speakers, and schwa will be inserted even when it is not orthographic, as in *ours blanc* /uRs*#bl&/ ('polar bear'); however, for other speakers, the rule affects only a subset of items: those which have a final orthographic schwa, and to which I shall assign a diacritic feature, [+E]; so, /gaRd/ will be marked [+E], but /uRs/ will be marked [-E]; in SVIII.4.3, we shall see that the assignment of the value [+E] is predictable

to a large extent. In (a), as the two conditions are not both satisfied, the rule will not apply: in *garde-malade* ('nurse'), for instance, there is a final cluster, but the second member of the compound is not monosyllabic. The word *ouvre-bouteilles* ('bottle opener') illustrates a different problem: its underlying representation, for many speakers, will be /uvR[#]#butɛj/, with a stable or an unstable schwa, because the cluster is a sequence of obstruent plus liquid: so schwa is underlying even when the second member is not monosyllabic. Note that in the examples in (b), the schwa which is inserted by a lexical rule is stable, and marked [-F], for the majority of speakers (but not all of them).

VIII.4.3. Schwa: post-lexical rules

Post-lexical rules either delete or insert schwa, but in connected speech, and not in the lexicon. The following four rules will serve to exemplify this process:

(R.31) /ø/ [+F] → Ø/#C_(#)[-consonantal & -H] (= elision; domain: phonological phrase (see SVIII.6.6))

(R.32) /ø/ [+F] → Ø/_(#)[-vocalic]

(R.33) Ø → [ø]/C_#[+vocalic & +H] (condition: the item undergoing the rule is marked [+E])

(R.34) Ø → [ø]/CC_#C

Elision, (R.31), is obligatory, and is a well-known phenomenon; the derivations of *l'avion* and *l'oiseau* ('the bird', 'the plane') illustrate its application:

$l\emptyset\#avj\emptyset$	$l\emptyset\#wazo$
$\rightarrow l\#avj\emptyset$	$\rightarrow l\#wazo$

Elision does not affect stressed schwas, because its domain is the phonological phrase (in connected speech, only phrase-final items are stressed):

fais-l\emptyset entrer ('show him in')

(R.32) applies quite often in connected speech, and is style-dependent; in very careful speech, the application of this process tends to be less frequent; there are also complex phonetic factors, such as the number and the nature of consonants preceding and following schwa, which play a crucial role (see Malmberg (1971b: 319-321)). In some complex situations, several schwas, in successive syllables, are subject to potential deletion: *je ne me le demande pas* ('I do not ask myself'); in such cases, it seems that the rule applies iteratively from left-to-right, and that an application of the process can bleed its application in the next syllable: $[z\emptyset n m\emptyset l d\emptyset m\check{a}d pa]$ or $[z n\emptyset m l\emptyset d\check{a}d pa]$, but not $*[z n m l d\check{a}d pa]$ (see Dell (1973a: 244-250) and Anderson (1974: 221-230)). (R.33) is also style-dependent, and applies preferentially if the second word is monosyllabic, as in *quelle honte, légère hausse* ('what a disgrace', 'slight

rise'), for instance; it does not seem to be applicable when the two items are separated by a phrase boundary, as in:

ma femme hait les carottes ('my wife hates carrots')

In this example, the subject, *ma femme* ('my wife'), is followed by a phrase boundary (%):

%ma#femme%hait%les#carottes%

This rule of epenthesis applies before *H-aspiré* words, but affects normally only items which are marked [+E]: in sum, the rule is lexically restricted; it affects *cette* ('this' or 'that'), but not *sept* ('seven'); *cette hache*, *sept haches* ('this axe', 'seven axes') are pronounced [set^h aʃ] and [set (?)aʃ] respectively. The assignment of the feature [+E] is largely predictable: noun modifiers and adjectives which are [+feminine] are generally [+E], if their underlying representation is different from that of their masculine counterpart: *petit*, *petite* ('small'); verbs of the first conjugation (infinitive in *-er*), and all verb forms ending in /j/ are also [+E]; verb forms of the second and third conjugations (non-productive types) are [+E] if they are [+plural] or [+subjunctive]; all items with a final obstruent plus liquid cluster are [+E]. These generalizations are illustrated by the following examples:

chante, *cueille*, *mette*, *ouvre* ('sing', 'pick', 'put', 'open', in the subjunctive)

(R.34) is also a complex process of epenthesis, which is purely phonetic, and can insert schwa even when it is not orthographic, in order to break certain consonant clusters, but the nature of the consonants which are involved is an important factor (see Dell (1973a: 187, 212-214, 236)): epenthesis applies preferentially after a obstruent plus liquid cluster: *ouvre la porte* ('open the door'), and more often when the next syllable is stressed; so epenthesis will be still more expected in *ouvre-la* ('open it').

Note also the difference between (i) and (ii):

(i) *dis-le (à ton ami)* ('say it (to your friend)')

(ii) *qui suis-je, qui est-ce* ('who am I', 'who is it')

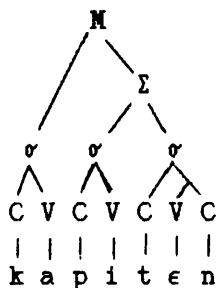
The phonetic representations are: [di lə a tɔ̃ n ami], [ki sɥi ʒ], [ki ɛ s]. In (i), schwa is not elided, because it is stressed (it is also preserved before a pause or a consonant). However, in (ii), schwa is never pronounced; we therefore need a special rule deleting schwa in two post-verbal monosyllabic items:

$s\emptyset \rightarrow s$, $ʒ\emptyset \rightarrow z$

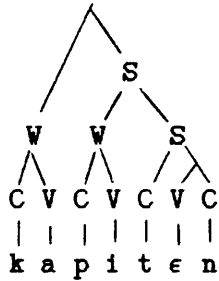
This has nothing to do with the processes that I have examined in this section. Finally, I tend to think that the stability or the instability of schwa, (that is, the value of the feature [F]) is hardly predictable, in spite of several attempts to find generalizations (see Delattre (1951), Malécot (1955), Grammont (1966: 115-128), and Léon (1971)).

VIII.4.4. Schwa and syllable structure

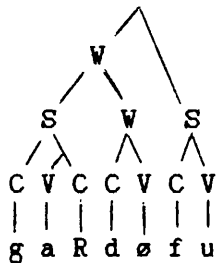
In this work, as I said in Chapter V, I adopt the framework of metrical phonology for the study of syllable structure (S-structure). For details concerning this theory, see Van der Hulst & Smith (1982) (eds.), Harris (1983), Dell, Hirst, & Vergnaud (1984) (eds.) and Giegerich (1985). I shall use the following symbols: σ for the *syllable* node, Σ for *hypersyllables*, M for the *word*, S for *strong*, V for *weak*, C for *margins*, and V for *nuclei*. In French, true vowels are attached to V-nodes, and semivowels and consonants are attached to C-nodes, because in this language only true vowels can constitute syllabic nuclei (or peaks). In metrical phonology, it is assumed that syllables are internally structured, just as words can be analyzed into syllables. I shall hypothesize that syllables are grouped into hypersyllables, and that, in French, the rightmost syllable of a hypersyllable is strong, and that the leftmost syllable is weak (see Dell (1984: 97-101) for a similar observation). It is a well-known fact that in French, the last member of a prosodic unit is generally prominent: 'Dans un plurisyllabe français, c'est toujours la dernière voyelle "ferme" qui est accentuée' (Fouché 1959: XLIX), even if 'l'accent français est faible' (Fouché 1959: L). The word *capitaine* ('captain'), for instance, will be analyzed in the following manner:



This can also be expressed in a different manner, with the symbols S and W:



It is clear that in this kind of analysis, branching is binary, and that the prominent element in a tree is the rightmost unit. So in the underlying representation of *capitaine*, /kapiten/, the most prominent syllable is -ten-, but the hypersyllable -piten- is also stronger than the first syllable -ka-. However, there are exceptions to this principle of prominence, and in some cases, the leftmost element of a tree is prominent; I shall regard these less frequent situations as marked, and the cases where the general principle of prominence is respected will be regarded as unmarked. The word /kapiten/ is fully unmarked from this point of view. Consider now the compound *garde-fou* ('parapet'), whose underlying representation is /gaRd#fu/ (see §VIII.4.3):

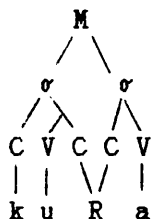


In the hypersyllable *-gaRd^h-*, the *leftmost* syllable (*-gaR-*) is prominent, and is dominated by a S-node; this means that the hypersyllable is marked.

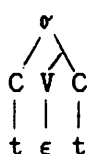
I shall now attempt to demonstrate that the interaction between schwa and S-structure is best explained if we assume that some consonants are ambisyllabic, and that this corresponds to slight phonetic differences. In the preceding representations, it can be observed that phonemes are linked to C- or V-elements; the CV-tier represents the prosodic skeleton of the word. An ambisyllabic consonant can be represented as a case of double motherhood, that is, as a C-element which is attached to two adjacent syllables:



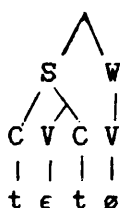
There are several examples of ambisyllabicity in SVIII.6.3. Ambisyllabicity is thus formally distinct from gemination: a geminate consonant is a segment which is attached to two adjacent C-elements; the verb form *courra* /kuR+R+a/ ('(he will) run'), with a geminate /R/, will have the following representation:



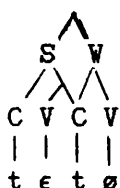
Just like other (segmental) rules, syllabification rules are lexical or post-lexical; in connected speech, resyllabification will take place at word boundaries, and segmental rules will cause resyllabification. It can be noted that the insertion of a final unstressed schwa, before a disjunctive vowel, for instance, or in order to break a consonant cluster, does not modify the quality of mid vowels: the sequence *tête haute* ('high head'), pronounced [tɛt^h o:t], keeps a mid-low [ɛ], even in varieties of French where [e] and [ɛ] are in complementary distribution ([e] in free syllables, and [ɛ] in checked syllables). It seems that in all varieties of French, mid-vowels in final syllables and mid-vowels in pre-final stressed syllables (or more exactly: in pre-final syllables which are stronger than final syllables) behave in exactly the same way (see Walter (1977: 136)). In other terms, [ɛ] in *tête haute* behaves exactly as if it stood in a checked syllable. In fact, if we assume that the [t] which follows [ɛ] is ambisyllabic, [ɛ] does stand in a checked syllable. In Standard French, lexical syllabification will yield the following structure for /tɛt/:



In connected speech, schwa is inserted before the disjunctive vowel of the adjective *haute*; this insertion will cause the creation of a second syllable, which is weaker than the initial one:



The presence of schwa in the weak syllable causes the attachment of the [t] which precedes it to the first σ -node:



So [t] becomes ambisyllabic, and [ε] stands in a checked syllable, which explains that in all dialects, it remains mid-low, even in Southern French, when there is a final schwa: in this variety, [ε] is disallowed in a free syllable. If [t] in our example is ambisyllabic, the general law of position (see Léon (1978: 43-44)) accounts for the quality of [ε] in both variants of the word *tête*, with and without a final schwa. I shall now formulate the general principle which is responsible for ambisyllabicity:

If an S-node is followed by a W-node, and if S is free, it attracts the initial consonant of the W-node, which thus becomes ambisyllabic (domain = N).

If S is checked, there will be no resyllabification, as in the item *reste* /Rest/ ('stay'). If a final schwa is inserted, the new S-structure is \$Res\$t*\$, and there is no ambisyllabic consonant. Ambisyllabicity accounts for the quality of mid vowels in connected speech, when epenthesis rules

insert a final schwa. It can also account for the quality of unstressed mid vowels, in the lexicon. Consider, for example, the partial paradigm of *céder* ('to yield'):

/sed+e/, /sed+ø/, /sed/ (infinitive, present indicative first person plural, and imperative)

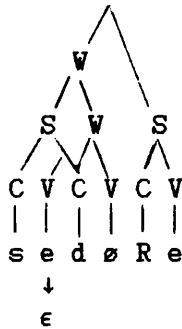
It is very easy to explain the alternation between /e/ and /ɛ/: the basic alternant is /e/, and the law of position lowers it in checked syllables:

/sed-/+ /sed/

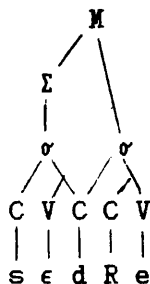
It is less easy to account for the mid-low quality of the vowel in the future: /sed+R+e/, as normal syllabification rules should presumably yield the following structure: \$se\$R\$e\$; the vowel /ɛ/ apparently stands in a free syllable, and it is unclear why it has been lowered. In segmental abstract analyses, it is assumed that the underlying representation of the form is /sed+ə+R+e/, and that schwa in the second syllable is responsible for the lowering of /e/ (see Dell (1973a: 210)). /e/ would be lowered when followed by one or more consonants and schwa. Schwa would then be deleted, and the first rule, lowering, would thus become opaque. My analysis will be quite different, and will not entail opacity. An allomorphy rule, (R.30), inserts schwa in stem-final position:

/sed+R+e/+ /sed*+R+e/

The second syllable is weaker than the first one, which entails ambisyllabicity for /d/:

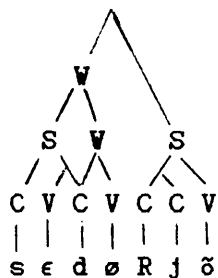


After the attachment of /d/ to the first S-node, this consonant belongs to two adjacent syllables, and the first syllable is now checked, which causes the lowering of /e/ to /ε/, by virtue of the law of position (see §VIII.5.1). (R.30) will then feed (R.26), a phonotactic rule which deletes schwa in this context (for (R.26) and (R.30), see §VIII.4.2). After this deletion, the new segmental structure is /sed+R+e/. Normal (re)syllabification rules will attach /d/ to the second syllable, and it will remain ambisyllabic; I shall also assume that -sed- keeps its status of hypersyllable (Σ):

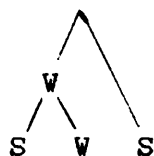


In the final structure, the law of position is transparent. In the derivation of /sed+R+e/, the allomorphy rule, (R.30), inserts a schwa which is marked [+F], and belongs to a weak syllable. In some specific contexts,

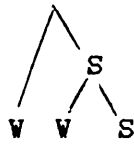
this schwa becomes stable, and the value of the feature [F] becomes positive: this is due to the application of certain phonotactic rules (see SVIII.4.2). In the derivation of *céderions* ('(we would) yield'), for instance, this happens, and schwa is stable because it precedes a sequence of liquid plus /j/: /sed+*+R+j+ø/, but at the stage when (R.30) inserts it, it is [+F]. This detail is crucial, because it is the value [+F] which accounts for the W-node. After the change [+F]→ [-F], the syllable whose nucleus is /ø/ remains weak:



The hypersyllable -sed*- being marked (SW), /d/ is ambisyllabic, and the law of position, once again, explains the mid-low quality of the vowel /ε/. In all these examples, the marked structure, SW, is predictable. In some cases, however, it is not: in Southern French, the structure of *pèlerin* /pe1*Rẽ/ ('pilgrim') is:



while that of *médecin* /medøse~/ ('doctor') is:



And yet both items have an unstable schwa. The quality of the vowel in the initial syllable reveals the difference. In Southern French, / ϵ / occurs only in checked syllables (see Walter (1982: 189-194)). This entails that /l/ is ambisyllabic in *pèlerin*, and therefore that the first two syllables of this item constitute a marked hypersyllable (SW). It seems that a syllable with schwa is weaker than the preceding syllable, and forms with it a marked tree (SW) if schwa precedes a boundary (+ or #). When an unstable schwa is morpheme-internal, its syllable is unpredictably weaker or stronger than the preceding syllable, as in our examples drawn from Southern French (in Standard French, the underlying representations of *pèlerin* and *médecin* are /p ϵ lR ϵ / and /m ϵ ds ϵ /).

Fouché's (1959: 67) view is analogous: in *afféterie* ('preciosity'), *Séderon*, *Séderac*, *Séverin* etc..., the groups -tR-, -vR-, -dR-, for Fouché, 'sont précédés d'un léger appendice consonantique appartenant à la syllabe précédente; *afféterie* est en réalité [afe^t-tRil]. This assertion clearly means that [t] is ambisyllabic.

The present analysis predicts that speakers may be aware of a slight difference in the pronunciations of the conditional *monterait* ('(he) would go up') and of the imperfect *montrait* ('(he) showed'), although they are segmentally identical: /m ö tR ϵ /. My work with informants confirms this prediction. The conditional (*monterait*) is derived in exactly the same way as /s ϵ d+R+ ϵ /: the S-structure of *montrait* is $\$m\text{ö}\$tR\epsilon\$,$ but the /t/ of *monterait* is ambisyllabic.

VIII.5. Lexical rules

VIII.5.1. Phonotactic rules

The most well-known phonotactic rules in French phonology affect mid vowels, and cause alternations in final syllables. The law of position disallows /e/ in checked syllables; its domain is therefore the syllable:

(R.35) [+vocalic & -rounded & +mid] → [+mid-low]/_C (domain = syllable)

Another rule raises rounded vowels in word-final position:

(R.36) [+vocalic & +rounded & +mid] → [+mid-high]/_#

Examples of this type of alternation are:

céder /sed+e/, (*je*) *cède* /sɛd/ ('to yield', 'I yield')

(*un*) *œuf* /œf/, (*des*) *œufs* /ø/ ('an egg', 'eggs')

There is also an interesting process denasalizing vowels which precede /n/ and a grammatical boundary (see my discussion in Chapter V):

(R.37) V → [-nasal]/_[n]{# or +}

This rule is always transparent in Standard French; it is motivated by surface generalizations: *bonne*, *pleine*, (*ils*) *tiennent* ('good', 'full', '(they) hold'), for instance, are pronounced /bɔ̃n/, /plɛ̃n/, /tjɛ̃n/. Such a general

phonotactic condition cannot coexist with a nasalization rule. (R.37) and other phonotactic rules can be conceived as well-formedness conditions on underlying representations.

Some rules involve /i/ and its semivocalic counterpart, /j/. The following pair of verb forms has been studied by Martinet (1969b: 217):

(*nous*) *fonderions*, (*nous*) *fondrions* ('(we would) found', '(we would) melt')

Their underlying representations are: /föd*+R+j+ö/ and /föd+R+ij+ö/ respectively. I shall assume that the basic allomorph of the infix is /+j+/. It can undergo two phonotactic rules: vocalization, and yod insertion. The former converts /j/ into /i/ when it follows a cluster of obstruent plus liquid; the latter inserts a transitional /j/ after /i/, when a vowel follows. The two processes apply in the derivation of /föd+R+ij+ö/:

föd+R+j+ö
 → föd+R+i+ö (vocalization)
 → föd+R+ij+ö (yod insertion)

Yod insertion causes alternations in verb inflection; *crier* ('to shout'), for instance, has a basic stem allomorph /kRi-/, but yod insertion can affect it, in the infinitive, or before any vocalic suffix: /kRij+e/.

VIII.5.2. Allomorphy rules: nouns and adjectives

In this section, I shall deal with the question of alternations between a consonant and 'zero' in the paradigms of adjectives. Some nouns undergo the same processes: compare *petit, petite; avocat, avocate* ('small'; 'lawyer', both in the masculine and in the feminine). For the description of data, see Chapter IV, and for a review of previous accounts, see Chapter V. In the standard model of generative phonology, it is assumed that the feminine marker in French is schwa. This allows advocates of this theory to postulate that the stem of adjectives is invariant in underlying representations, whatever the gender. The masculine form of *gros* ('big'), although it is pronounced [gRo], will have the underlying representation /gRos/, in the standard analysis, because the feminine form is [gRo:s] (the underlying representation of the feminine form will have a final schwa). Liaison is also invoked, in this abstract framework, to justify the form /gRos/ for the masculine: *gros avion* [gRo z avjɔ̃] ('big plane'). However, in Chapter V, I showed that a word boundary separates the adjective from the connective consonant, which is therefore not part of the adjective, and is necessarily inserted by a post-lexical rule. This means that the basic form of the masculine is /gRo/ in constrained phonology. Whilst abstract phonologists posit a rule truncating the final consonant of /gRos/, in constrained phonology I shall posit a rule inserting /s/ when the item is [+feminine]. The allomorphs of the adjective are /gRo/ (masculine) and /gRos/ (feminine). I shall also posit the following rules for markedness:

[-feminine] = [*U* feminine] and [+feminine] = [*M* feminine]

These equivalences exclude a rule deriving the masculine form from the feminine form, by means of a truncation rule (see §V.2.4). The truncation rule is acceptable only when the truncated form is marked, as in *œufs*, *os*, *boeufs*, *aïeux* ('eggs', 'bones', 'oxen', 'ancestors'); these plural forms are clearly the truncated variants of the (unmarked) singular (and basic) forms:

<i>singular:</i>	<i>plural:</i>	
/œf/	/ø/	('egg')
/ɔs/	/o/	('bone')
/boef/	/bø/	('ox')
/ajoel/	/ajø/	('ancestor')

These plural formations are obviously irregular; more generally, plural forms of regular nouns and adjectives in French are identical to singular forms. We shall need special rules for irregular formations, as in *cheval*, *chevaux* ('horse', 'horses'), whose underlying representations are /ʃøval/ and /ʃøvo/ respectively. These rules will convert /al/ and /aj/ (cf. *travail*, 'work') into /o/. In abstract phonology, it is sometimes assumed that these forms are regular, and can be derived by means of natural processes, as in the following example (*journaux*, 'papers'):

$\mathfrak{z}uRnal+z$	
→ $\mathfrak{z}uRnau+z$	(vocalization of /l/)
→ $\mathfrak{z}uRno+z$	(monophthongization)
→ $\mathfrak{z}uRno$	(truncation)

External evidence (speech errors) reveals that this analysis is incorrect, and these forms are felt as irregular by children and even adults: as most French nouns and adjectives have no plural marker, analogy leads speakers to use the same form (/ʒuʁnal/) in the singular and in the plural (sometimes, it is the plural form which will be used in the singular). I have personally quite often heard this kind of error. If we except these irregular forms, the plural in French, as far as nouns and adjectives are concerned, is a matter of liaison rather than of inflection, since the plural marker is often the connective /z/, which is not part of the item which precedes it, as a word boundary separates the noun or the adjective from the plural marker, in *petits enfants* [pøti#z#ãfã] ('little children'), for instance.

As regards gender inflection, we may note the following types of alternations:

	<i>masculine</i>	<i>feminine</i>	
<i>gros</i>	/gʁo/	/gʁos/	('big')
<i>plein</i>	/plɛ̃/	/plɛn/	('full')
<i>vif</i>	/vif/	/viv/	('quick')
<i>sot</i>	/so/	/sɔt/	('stupid')
<i>distinct</i>	/distɛ̃/	/distɛ̃kt/	('distinct')

We can observe the following structural changes:

(i) $\emptyset \rightarrow C$

(ii) nasal V \rightarrow oral V + nasal C

(iii) f \rightarrow v

(iv) o \rightarrow ɔt

(v) $\emptyset \rightarrow$ kt.

In type (i), several different consonants can be inserted (see Dubois (1965: 69-72) for a detailed account of the various changes). In type (ii), there are several possibilities for adjectives:

$\tilde{o} \rightarrow$ ɔn

$\tilde{o}\tilde{e} \rightarrow$ yn

$\tilde{e} \rightarrow$ in, en

$\tilde{a} \rightarrow$ an

and for many speakers, if $\tilde{o}\tilde{e}$ has merged with \tilde{e} , we can add $\tilde{e} \rightarrow$ yn. The change $\tilde{e} \rightarrow$ in is certainly more productive (see Martinet (1983: 11-12)). Note that in type (i), the inserted consonant is always [-nasal], but that this [-nasal] consonant can be inserted after a [+nasal] vowel, as in *grand*, *grande* /gRã/, /gRãd/ ('large').

We can now posit the following rules:

(R.38) $\emptyset \rightarrow [-\text{vocalic} \ \& \ -\text{nasal}]$ if $[+\text{feminine}]$

(R.39) $[+\text{vocalic} \ \& \ +\text{nasal}] \rightarrow [+\text{vocalic} \ \& \ -\text{nasal}][+\text{conson.} \ \& \ +\text{nasal}]$ if
 $[+\text{feminine}]$

(R.40) $f \rightarrow v$ if $[+\text{feminine}]$

(R.41) $o \rightarrow \text{ot}$ " "

(R.42) $\emptyset \rightarrow kt$ " "

As we cannot predict which rule will affect a given adjective, the two forms, masculine and feminine, will have to be listed in the lexical entry, and the rules above simply relate the two allomorphs; they are also generative in the case of new formations. In a similar way, we cannot infer which consonant will be inserted by (R.38), or which structural changes will be operated by (R.39). Listing forms in lexical entries solves these problems. There is a slight difference between, for example, *sot* and *haut* ('stupid', 'high'): the former is subject to (R.41), while the latter is subject to (R.38), which inserts /t/. (R.41) is more expected for items whose masculine forms ends in /-o/. This rule causes two changes: it inserts /t/, and it also lowers /o/. In the paradigm of *haut*, the quality of the vowel is invariant: /o/, /ot/. In other cases, the change in the quality of the vowel is caused by a phonotactic rule, as in the following derivation, of *première* ('first', feminine):

pRømjε

→ pRømjεR (R.38)

→ pRømjεR (R.35: see SVIII.5.1)

Generalizations concerning the nature of the structural changes in gender inflection, and the nature of connective consonants will be studied in §VIII.6.1.

VIII.5.3. Allomorphy rules: verbs

I shall now deal with the question of alternations between a consonant and 'zero' in verb inflection. Some of these alternations are caused by phonotactic rules; yod insertion, for instance, is responsible for the following changes:

cri, (il) *crie*, *crier* /kRi/, /kRij+e/ ('shout', '(he) shouts', 'to shout'),
or *rire*, (nous) *riions* /Ri+R/, /Rij+ø/ ('to laugh', '(we) laugh')

/j/ may also be inserted before a vowel or a semivowel by a fairly general allomorphy rule:

(il) *croit*, (nous) *croions* /kRwa/, /kRwaj+ø/ ('(he) believes', '(we) believe')

This rule affects verbs belonging to any conjugation type (*croire*, *voir*, *employer*, 'to believe' 'to see', 'to employ' etc...). Other frequent allomorphy rules apply in more general contexts, which are phonological or morphological, and affect only verbs belonging to non-productive types:

- (i) verbs whose infinitive affix is in +iR: /fin+iR/ ('to finish')
- (ii) verbs in +R: /bɔti+R/ ('to build')
- (iii) verbs in +waR: /dɔv+waR/ ('to owe')
- (iv) verbs in +iR: /dɔRm+iR/ ('to sleep').

Verbs whose infinitive is in +e, which constitute the productive type, are not affected. Rules insert a consonant, or transform a nasal vowel into a sequence of oral vowel plus nasal consonant:

- (i) *lit*, (*ils*) *lisent* /li/, /liz/, (i) *tient*, (*ils*) *tiennent* /tjẽ/, /tjen/
- ('he) reads', '(they) read', '(he) holds', '(they) hold'

Some verbs have two stem allomorphs, and others have three; we can call these variants allomorph A, allomorph B, and allomorph C; for the verbs with only two allomorphs, B and C are identical. Here are the contexts where A, B, and C appear:

- Allomorph A: present indicative singular, and imperative singular.
- Allomorph B: (i) before a vowel or a semivowel.
 - (ii) present indicative plural, present subjunctive (when no affix follows the stem).
- Allomorph C: before the affix +R.

The following list illustrates the various possibilities:

	<i>allomorph A</i>	<i>allomorph B</i>	<i>allomorph C</i>	
<i>lire</i>	/li/	/liz-/	/li-/	('to read')
<i>coudre</i>	/ku/	/kuz-/	/kud-/	('to sew')
<i>bâtir</i>	/bati/	/batis-/	/bati-/	('to build')
<i>connaître</i>	/kɔnɛ/	/kɔnes-/	/kɔnɛt-/	('to know')
<i>écrire</i>	/ekRi/	/ekRiv-/	/ekRiv-/	('to write')
<i>vivre</i>	/vi/	/viv-/	/viv-/	('to live')
<i>mettre</i>	/mɛ/	/mɛt-/	/mɛt-/	('to put')
<i>moudre</i>	/mu/	/mul-/	/mud-/	('to grind')
<i>craindre</i>	/kRɛ̃/	/kRɛ̃p-/	/kRɛ̃d-/	('to fear')
<i>conclure</i>	/kɔ̃kly/	/kɔ̃kly-/	/kɔ̃kly-/	('to end')

The last verb of the list, *conclure*, has an invariant stem, although it belongs to a non-productive conjugation type. Here are now a few examples with affixes: /liz+ø/, /li+R/, /ekRiv+e/, /batis+ɛ/. Note that allomorph B occurs before a vowel or a semivowel, but also in morphological contexts (see above) whilst in the paradigm of *croire* ('to believe') and similar verbs, /j/ is inserted only in a phonological context, before a vowel or a semivowel. Compare, in the present indicative:

/li/ (singular), /liz+ø/ (before a vowel), /liz/ (plural), and /kRwa/ (singular), /kRwaj+ø/ (before a vowel), /kRwa/ (plural).

Allomorph A will be regarded as basic, for the following reason: the plural is marked whilst the singular is unmarked, and the subjunctive is

marked whilst the indicative is unmarked. Allomorph A appears exclusively in unmarked contexts, and will be the input to allomorphy rules inserting consonants, or modifying nasal vowels. We can now formulate the two main allomorphy rules for verbs of non-productive conjugation types:

(R.43) $\emptyset \rightarrow [-\text{vocalic}] / (i) _+[-\text{consonantal}]$

(ii) $_ \#$ if $\{ [+plural] \text{ or } [+subjunctive] \}$ &
 $[-1^{\text{st}} \text{ conjugation}]$

(R.44) $[+\text{vocalic} \ \& \ +\text{nasal}] \rightarrow [\epsilon] [+consonant \ \& \ +\text{nasal}] /$ in the same contexts as (R.43). The sequence $/w\check{\epsilon}/$ becomes $/wap/$ in the same context (cf. *joindre, je joins, nous joignons*, ('to join', 'I join' 'we join')).

(R.45) $\emptyset \rightarrow [-\text{vocalic}] / _+[R]$

In some paradigms, it is more reasonable to consider some allomorphs as suppletive, and particularly in the paradigms of very irregular verbs (*savoir, être, avoir, faire* etc... 'to know', 'to be', 'to have', 'to do').

Although the allomorphy rules which affect verbs of non-productive conjugation types produce structural changes which are similar to those produced by the allomorphy rules which affect adjectives and nouns, a unified treatment is not possible, because they take place in different contexts. In the standard model of generative phonology, the treatment of all alternations tended to be unified, but the degree of abstractness of the analysis was greater, and many rules and representations violated constraints. Moreover, simplicity in some aspects of the analysis may imply complexity in other aspects: in abstract phonology, the treatment was more

unified, but processing was much more complex, and derivations much longer, because the difference between underlying and phonetic forms was greater.

VIII.5.4. Derivational morphology

There is no fundamental difference between allomorphy rules in inflectional morphology and allomorphy rules in derivational morphology. In fact, some of the structural changes that we have observed in verb morphology and in adjective and noun morphology are quite analogous to those that we can observe in the formation of derived items. In the paradigm of *vivre* ('to live'), for instance, we insert the consonant /v/ before a vowel: /viv+ø/; we insert the same consonant before the derivational affix *-ot*: *vivoter* /viv+ɔt+e/ ('to get along'). There are many similar examples:

(il) *dort*, (nous) *dormons*, *dormeur*; (il) *plaît*, (nous) *plaisons*, *plaisir*
 '(he) sleeps', '(we) sleep', 'sleeper'; '(he) pleases', '(we) please',
 'pleasure')

The underlying representations of these forms are:

/dɔR/, /dɔRm+ø/, /dɔRm+œR/, /plɛ/, /plɛz+ø/, /plɛz+iR/

Each time, the same consonant is inserted in the same context, which means that the rules which we have formulated for inflectional morphology also apply in derivational morphology. Examples with adjectives are:

sot, sotté, sottise ('stupid', 'stupidity')

The underlying representations of these forms are:

/sɔ/, /sɔt/, /sɔt+iz/

The same consonant is inserted in the formation of the feminine, and before a vowel in derivational morphology. In the formation of nouns or adverbs in *-ment*, the same structural changes occur:

battement, vêtement, aboutissement, finement, grandement ('beat', 'clothes', 'outcome', 'finely', 'largely')

The underlying representations are:

/bat+mã/, /vɛt+mã/, /abutis+mã/, /fin+mã/, /gRãd+mã/

In some cases, the change is not conditioned by any affix, but by the lexical category. Compare the following pairs:

hasard, hasarder ('chance', 'to venture'); *bois, déboiser* ('wood', 'to deforest'); *bouquin, bouquiner* ('book', 'to read'); *fou, affoler* ('crazy', 'to terrify'); *témoin, témoigner* ('witness', 'to witness')

In each pair, the verb is derived from the noun, and the phonological change is conditioned by the new lexical category (verb). The underlying representations of these items are:

/azaR/, /azaRd+e/, /bwa/, /de+bwaz+e/, /bukʒ/, /bukin+e/, /fu/, /a+fɔl+e/,
/temwɛ/, /temwap+e/

Note that the changes affecting stems (for example: /azaR/ → /azaRd-/) are not conditioned by the infinitive affix, +e, which is an inflectional affix, and not a derivational affix. The changes are also apparent when no affix follows the verb stem:

(je) *hasarde*, (je) *déboise*, /azaRd/, /de+bwaz/

Note also that regularity is not absolute and that a different change can affect a stem in inflectional morphology, and in derivational morphology:

long, *longue*, *allonger* /lɔ/, /lɔg/, /a+lɔʒ+e/ ('long', 'to lengthen').

The essential point is that in constrained phonology, underlying representations are phonemic word forms (see Chapters VI & VII). The underlying representations of *fleur* ('flower'), *floral* ('floral'); *sel* ('salt'), *saler* ('to salt') will be: /floeR/, /flɔR+al/; /sɛl/, /sal+e/. Special allomorphy rules will account for the vowel shifts (oe → ɔ, and ε → a). These changes are clearly conditioned by the lexical categories (noun → verb for *sel*, *saler*, for instance). These allomorphy rules relate the underlying representations, and the phonemic form of the stem of *saler*, for instance, can only be /sal-/, and not */sɛl-/. My analysis is therefore radically different from that of Dell & Selkirk (1978: 35ff), who postulate abstract invariant underlying representations for the base forms and the items which are derived from them.

VIII.6. Post-lexical rules

VIII.6.1. Liaison

In Chapter V, I presented evidence for the following structure:

petit ami, mon ami, [pɛti#t#ami], [mɔ̃#n#ami] ('boy friend', 'my friend')

True connective consonants are preceded and followed by a word boundary, which means that they are inserted; this post-lexical insertion depends crucially on the phonological context following the word which is subject to liaison, and this context appears only when word forms are chained together in connected speech.

In SV.6.3, I also showed that two distinct phenomena are traditionally called liaison: the structure in the examples above, but also the different structure:

bon ami, fol amour, [bɔn#ami], [fɔl#amuR] ('good friend', 'crazy love')

I suggest that we should call this second structure *pseudo-liaison*, because there is no true connective consonant.

It must be observed that if liaison is most often a post-lexical rule, it can in certain cases be a lexical rule, because some compounds have a connective consonant:

bien aimé, bonshommes, /bjɛ̃#n#eme/, /bɔ̃#z#ɔ̃m/ ('beloved', 'chaps')

and also:

Etats-Unis, jeux olympiques, /eta#z#yni/, /zø#z#ɔlɛ̃pik/ ('United States', 'Olympic Games')

There are in fact several rules of liaison:

- (i) Liaison after invariable items, such as prepositions, adverbs and conjunctions. These items will be marked [+liaison], and in the lexical entry, we must also specify which consonant should be inserted: we can use such features as [+T], [+N] etc...
- (ii) Liaison after adjectives or noun modifiers: this rule of liaison applies when these items are [-plural] and [-feminine]; it can be called singular liaison. It is partly grammatically conditioned, since its application depends on the value of morpho-syntactic features. Once more, the items which are subject to liaison will be marked [+liaison]: *joli* ('pretty'), for instance, is [-liaison], whilst *petit* ('small') is [+liaison] and [+T], and *gros* ('big') is [+liaison] and [+Z]. In SIV.1.3, we saw that the nature of the connective consonant can be predicted once we know the nature of the consonant which is inserted in the formation of the feminine forms. As these forms are listed in lexical entries, lexical redundancy rules will express the correspondances between the two processes, and the features [+T], [+Z] etc... are therefore redundant

for adjectives and noun modifiers. Consider the following examples: *petit, grand, gros, heureux, premier, commun* ('small', 'large', 'big', 'happy', 'first', 'common'); their underlying representations are /pɛti/, /gRã/, /gRo/, /œRø/, /pRømje/, /kɔ̃mœ/. Their feminine forms are /pɛtit/, /gRãd/, /gRos/, /œRøz/, /pRømjeR/, /kɔ̃myn/. So the consonants which are inserted are respectively: /t/, /d/, /s/, /z/, /R/, and /n/. As the possible connective consonants in Modern French are /t/, /z/, /R/ and /n/ (connective /p/ or /k/ are very rare), we can explain why the consonants which are inserted in gender inflection are also inserted in liaison if they are possible connective consonants, and that /d/ and /s/ in the feminine forms will correspond to connective /t/ and /z/ respectively. /t/ is the [-voiced] counterpart of /d/, whereas /z/ is the [+voiced] counterpart of /s/; the lexical redundancy rule expressing the regularity will have the following form:

[+consonantal & -sonorant & α stop] in inflection ⇒
[-α voiced] in liaison

The values of [stop] and [voiced] are opposite for the connective consonants /t/ and /z/. Note that if an adjective or a noun modifier has two homophonous forms in the masculine and in the feminine, it is necessarily [-liaison] (cf. *rapide*, 'fast').

- (iii) Plural liaison, after adjectives and noun modifiers; this time, a connective /z/ is inserted, whether the item is [-feminine] or [+feminine], but only if it is [+plural]. Normally, all adjectives

and noun modifiers are [+plural liaison], but there are a few exceptions: the numerals *quatre, cinq, sept, huit, neuf, vingt, cent, mille* ('four', 'five', 'seven', 'eight', 'nine', 'twenty', 'one hundred', 'one thousand'); however, *vingt, cent* undergo plural liaison in *quatre-vingt, deux-cent* etc... ('eighty', 'two hundred'). Popular speech tends to regularize these exceptions: *huit œufs* *[qi#z#ø] ('eight eggs'). Plural liaison also applies after personal pronouns: *ils, elles, nous, vous* ('they', masculine and feminine, 'we', 'you'). It is clear that plural liaison is grammatically conditioned by the feature [+plural]. No lexical marking is required for the connective consonant which is always /z/.

- (iv) Liaison is also grammatically conditioned after verbs, when a clitic follows them: *prend-il, joue-t-il, prennent-ils, donnez-en, donnez-en, vas-y* ('does he take', 'does he play', 'do they take', 'give some', singular and plural, 'go there'); the connective consonant is /t/ before a subject clitic, and /z/ after an imperative. Such liaisons suffer no exception, and lexical marking is not necessary.

All the cases of liaison that I have just mentioned are obligatory, with the following restriction: after invariable items, it may be optional; it is obligatory after *très* ('very'), but optional after *trop* ('too'). It is patent that optionality is contingent upon the first item of the string, and is not due to grammatical factors in this particular case, and it should then be specified in the lexical entry. Other liaisons are optional, and stylistically marked (see SIV.1.5, for an account). Their optionality is generally due to grammatical or prosodic factors (see SVIII.6.4).

Whatever the grammatical or lexical conditioning, all rules of liaison share the following characteristic: they all apply in the same phonological (segmental) context. This can be formalized as follows:

(R.46) (a) $\emptyset \rightarrow \#[+consonantal \ \& \ -nasal] / _ \#[-consonantal \ \& \ -H]$

(b) $\emptyset \rightarrow \#[n] / [+vocalic \ \& \ +nasal] / \quad " \quad " \quad " \quad "$

(for the feature [H], see SVIII.3. Liaison applies after non-disjunctive vowels and semivowels)

Note that a connective /n/ can only follow a [+nasal] vowel, but also that a [-nasal] connective consonant can follow a [+nasal] vowel, as in *grand ami* [gRã#t#ami] ('great friend'). Some adjectives are [-liaison] and [+plural liaison]: this is the case of *joli* ('pretty'), for instance. Finally, the contrast between [t] and [z] in the following pair is a surface implementation of the opposition [\pm plural]:

petit ami [pøti#t#ami], *petits amis* [pøti#z#ami] ('boy friend', 'boy friends').

VIII.6.2. Pseudo-liaison

Items such as *bon*, *plein*, *nouveau*, *beau* etc... ('good', 'full', 'new', 'beautiful') are subject to *pseudo-liaison*, whose context is absolutely identical to that of true liaison. The rule of pseudo-liaison can be regarded as a morphological instruction overriding the usual lexical-

insertion rules, which, after inserting whole paradigms (possibly represented by citation forms), filter the correct word forms:

If an item is marked [+pseudo-liaison], select the feminine allomorph in liaison contexts, and in the grammatical context [-plural].

So in liaison contexts, the feminine forms /bɔ̃n/, /plɛ̃n/, /nuvɛ̃l/, /bɛ̃l/ etc... will be inserted instead of the expected masculine forms /bɔ̃/, /plɛ̃/, /nuvo/, /bo/ etc... Note that the difference between masculine and feminine strings, such as *bon ami, bonne amie* ('good friend'), is purely orthographic: their phonological structures are absolutely identical. The validity of this rule is reinforced by the undeniable existence of the inverse process in *mon amie, ton arrivée* ('my friend', 'your arrival'), for instance: in liaison contexts, the masculine forms of the possessives *mon, ton, son* ('my', 'your', 'his'), are inserted instead of the expected feminine forms, when the head of the phrase is [+feminine].

In Southern French, the underlying representations of the feminine forms have a final schwa (see Walter (1982: 186-187)); this final schwa will be deleted as usual by a general elision rule: *bel ami* ('beautiful friend') will be derived as follows:

bɛl#ami

→ bɛl#ami (elision)

Items ending in a nasal vowel behave exactly like *vieux, fou, mou, ce, beau, nouveau* ('old', 'crazy', 'soft', 'this', 'beautiful', 'new') in liaison context.

It is certainly undesirable to miss this generalization. Some speakers pronounce *premier, dernier, léger* ('first', 'last', 'light' or 'slight') with a final [e] in liaison context, which means that they apply the normal rule of liaison, but for other speakers, the quality of the vowel is different, and it is the mid-low [ɛ] which precedes the consonant [R]: *léger ennui* [leʒɛR ɛnyɪ] ('slight trouble') (see Fouché (1959: 435)). For this second category of speakers, it is the rule of pseudo-liaison which is applied, and this is revealed by the usual law of position (see §VIII.5.1). In all cases, phonotactic rules are respected:

(i) The law of position, (R.35).

(ii) (R.36), which raises a mid rounded vowel before a word boundary;

this rule does not apply in pseudo-liaison, for instance in *bon ami* ('good friend'), because the vowel is not immediately followed by a word boundary.

(iii) Denasalization, (R.37) (for these three rules, see §VIII.5.1), is

respected in *bon ami*, [bɔ̃n#ami], but its structural description is not satisfied in *mon ami* [mɔ̃n#ami] ('my friend').

For items with a final nasal vowel in the masculine (like *bon*), there is a theoretical alternative; we might posit a rule inserting [n] in word-final position, and this insertion would feed the rule of denasalization, (R.37):

bõ#ami

→ bõn#ami

→ bɔ̃n#ami

However, there is a problem with this analysis: the [-nasal] vowel in the output is not always the exact counterpart of the [+nasal] vowel in the input: *divin enfant* ('divine child') is pronounced [divin#äfä], and not *[diven#äfä], while denasalization can only produce the incorrect string in this particular case. It must be added that with this alternative analysis, we miss not only the above-mentioned generalization concerning *bon*, *plein*, etc... ('good', 'full') but also that involving *beau*, *nouveau*, *ce* etc... ('beautiful', 'new', 'this'). For these two reasons, I shall prefer the rule of pseudo-liaison which is a morphological instruction, rather than a phonological process. Note that the allomorphy rule deriving the feminine allomorphs *bonne*, *pleine*, *commune* etc... ('good', 'full', 'common', feminine) must perform two simultaneous changes in some cases: it inserts the nasal consonant, and changes the quality of the vowel, and for the same reason, we must prefer this rule to a process which would merely insert /n/, and would feed denasalization, since the latter would not always yield the proper output.

It is well known that such strings as *mon ami*, *ton ami*, *son ami* ('my friend', 'your friend', 'his friend') have a second possible pronunciation, which is less frequent; in this second variant, the vowel is [-nasal]: [mɔ̃n amil], [tɔ̃n amil], [sɔ̃n amil] (see Grammont (1966: 133-134)). Such variants cannot have undergone pseudo-liaison, since *mon*, *ton*, *son*, are not feminine

forms. The [-nasal & +mid-low] quality of the vowel suggests that the structure is:

[mɔ̃n#ami], [tɔ̃n#ami], [sɔ̃n#ami].

A new rule must be posited for these idiolects, which can be called the rule of N-liaison, and inserts [n] in word-final position, in liaison context:

(R.47) $\emptyset \rightarrow [n] / [+vocalic \ \& \ +nasal] _ \# [-consonantal \ \& \ -H]$

Its application feeds denasalization, which is thus both a lexical and a post-lexical process:

mɔ̃#ami
 → mɔ̃n#ami (N-liaison)
 → mɔn#ami (denasalization)

N-liaison and pseudo-liaison are two different processes, and we cannot dispense with the latter for several reasons:

(i) N-liaison inserts only [n], whilst pseudo-liaison also affects *fou*, *beau* etc... ('crazy', 'beautiful')

(ii) In N-liaison, the vowel is denasalized, but the output is the exact counterpart of the [+nasal] vowel in the input, but, as I have noted, this is not necessarily the case in pseudo-liaison (cf. *divin enfant*).

In Southern French, N-liaison is applied more often, and may affect more items (in some idiolects, all items ending in a nasal vowel have the diacritic feature [+N-liaison], unless they are [+pseudo-liaison]). Speakers who apply N-liaison in *un ami* ('a friend'), for instance, do not pronounce *[yn ami], but denasalization yields the exact counterpart of the [+nasal] vowel in the input, and the output is [oen ami]:

œ̃#ami

→ œ̃n#ami (N-liaison)

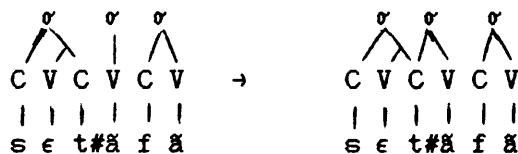
→ oen#ami (denasalization)

It is true that some strings are 'ambiguous', and both pseudo-liaison and N-liaison would yield correct outputs: *plein emploi* [plen#ãmplwa] ('full employment'). In such cases, I shall hypothesize that pseudo-liaison takes priority, when the form in liaison contexts is homophonous with the feminine allomorph, in order to treat the majority of adjectives in the same fashion, but this issue is not important, since both rules yield correct outputs when either is applicable.

VIII.6.3. Enchaînement

Enchaînement (see Fouché (1959: chapter V), and Faure (1971: 30-31)) should be regarded, in my view, as a post-lexical syllabic adjustment, occurring in connected speech. This adjustment, which can be called *rightward attachment*, creates ambisyllabicity in the following manner (for the notion of ambisyllabicity, see SVIII.4.4):

sept enfants



(= 'seven children')

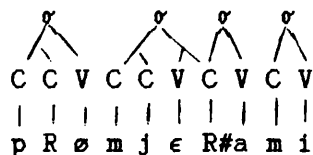
The implosive /t/ of /set/ is linked to the second σ -node, because -tæ- is a possible syllable, or more precisely because /t/ can become the onset of the second syllable, according to general syllabification rules (in French, the CV structure is unmarked, which conforms to a strong tendency: see Faure (1971: 30-31)). So /t/ becomes simultaneously syllable-final and syllable-initial. Note that post-lexical adjustments apply only across word boundaries. They account for the fact that these junctures appear to be obliterated in normal speech. They are subject to precise conditions: the rule obeys a universal principle maximizing onsets (see Noske (1982: 267) and Clements & Keyser (1983:37)). It applies only if syllable-structure conditions are respected, as in the following examples:

petite roue



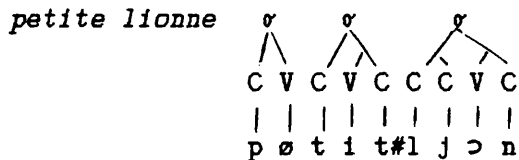
(= 'small wheel')

première amie



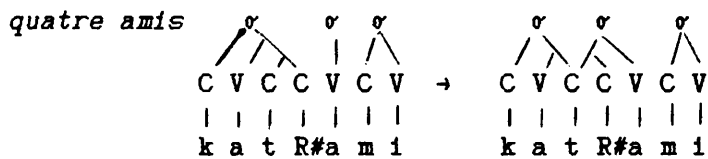
(= 'first friend', feminine)

The rule will not apply in the next example, because -tl- is not a possible onset:



(= 'little lioness')

Compare *petite lionne* with *petite roue*: -tR- is a possible onset. More generally, clusters of obstruent plus liquid are possible onsets, except for -tl-, -dl-. This fact explains the more complex adjustment below:



(= 'four friends')

This time, it is not the last consonant of the word which is ambisyllabic, but the pre-final consonant: in other words, the first member of the cluster, because the whole cluster must become the onset of the second syllable after the adjustment. As I have said, the rule is motivated: it is a well-known fact that, in French, implosive consonants, when word-final, become the onsets of the initial syllable of the next word, if the latter is vowel-initial (see Faure (1971: 30-31) and Carton (1974: 73-76)). So the validity of rightward attachment can hardly be denied. However, objections might be raised against ambisyllabicity, and it might be assumed that the word-final consonant becomes fully explosive after the adjustment. This

hypothesis is certainly incorrect, in view of the distribution of mid vowels (see SVIII.5.1): a mid-low rounded vowel should be raised after the adjustment if it became fully explosive, whilst actually it is not: *fort*, in *fort et bête* [fɔR e bet] ('strong and stupid'), for instance, is pronounced with a mid-low vowel, which proves that [R] is not fully explosive, but is rather ambisyllabic. It might also be objected that phonotactic rules do not reapply after syllabic adjustments, and that they are purely lexical processes (while resyllabification is a post-lexical process). So *sept enfants* ('seven children') might be resyllabified $sest\text{ã}f\text{ã}$, but in fact, some phonotactic rules do reapply after resyllabification: in *trois heures et demi* (half past three), [e#dømi] becomes *[ed\$mi] and finally [ed\$mi] (law of position). This proves that the [t] of *sept enfants* must be ambisyllabic, like the [R] of *fort et bête*.

We can assume that the insertion of a glottal stop (see SVIII.3) applies in the context C#_V[+H], only if the word-final consonant is fully implosive ($setseRo$ for the final structure of *sept héros* ('seven heroes'), without ambisyllabicity); enchainement will bleed this insertion. So it is not the insertion of [ʔ] which is optional, as I initially assumed (see SVIII.3), but enchainement before a disjunctive vowel marked [+H]. If enchainement does not apply in this context, the insertion of [ʔ] becomes obligatory, provided the two items belong to the same intonational phrase (see SVIII.6.3 for this notion). In the derivation of *sept héros*, the non-application of enchainement after lexical syllabification entails the insertion of [ʔ], which prevents the creation of a C\$V sequence:

$$\#set\#eRo\# \rightarrow setseRo \rightarrow set\text{ʔ}eRo$$

VIII.6.4. Liaison and syllable structure

In enchaînement, the word-final consonant is linked to the first σ -node of the following word, by the rule of rightward attachment, which applies across a word boundary. Let us now examine what happens in liaison. The underlying representations of *très* and *amis* ('very', 'friend') are /tRɛ/ and /ami/. Lexical syllabification will yield the following structures:



The rule of liaison inserts a connective [z]: #tRɛ#z#ami# (note that this consonant is extramorphological, that is, is not attached to any lexical node, since it is not part of either word: see SVIII.6.1). As the connective consonant is preceded and followed by a word boundary, it is theoretically a domain for syllabification. Yet the result is incorrect, because within this domain there is no [+vocalic] segment; the consequence is the extrasyllabicity of [z] (which means that the C-node which dominates [z] remains unattached to any σ -node):



Rightward attachment, the same rule as in enchaînement, will rescue this unacceptable structure:



The application of this rule does not add any cost to the grammar, since it already affects all C#V sequences in enchainement. From the point of view of S-structure, the only difference between enchainement and liaison is that final consonants are ambisyllabic in enchainement, whilst connective consonants are fully explosive. This difference is due to the fact that final consonants are part of the underlying representations of word forms in the lexicon, whilst connective consonants are inserted by a post-lexical rule between two word forms. It is rightward attachment which applies rather than leftward attachment; there are two reasons for this:

- (i) Rightward attachment is independently motivated, and its structural description is satisfied.
- (ii) Its application is a logical consequence of the principle maximizing onsets (see Clements & Keyser 1983: 37)). This principle conforms to universal constraints: a CV syllable is less marked than a VC syllable (29).

These principles of S-structure account for the different quality of mid vowels in, for instance, *premier ami*, *première amie* ('first friend', masculine and feminine), whose phonetic representations are, for at least some speakers, [pRømje R ami] and [pRømjeR ami] respectively. The S-structure of the masculine form, with a connective consonant, is

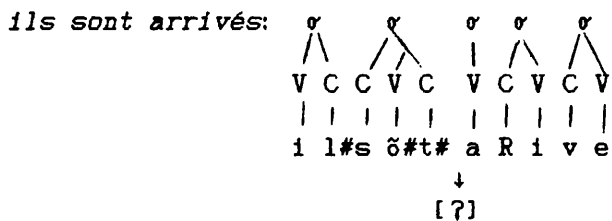
\$pRø\$mjε\$Ra\$mi\$, whilst in the feminine string, [R] is ambisyllabic, because in the lexicon, this consonant is already word-final, and causes the lowering of the basic vowel /e/: /pRømjεR/. Lexical syllabification yields: \$pRø\$mjεR\$, and /ε/, which stands in a checked syllable, undergoes the law of position.

In spite of identical sequences of segments, *petit ami* and *petite amie* ('boy friend', 'girl friend') will have different S-structures in connected speech: the structure of the masculine string will be \$pø\$ti\$ta\$mi\$, with a fully explosive connective consonant, as usual, but the final [t] of the feminine string will be ambisyllabic. The placement of word boundaries is naturally also different: #pøti#t#ami# for the masculine, and #pøtit#ami# for the feminine. This analysis is confirmed by Tranel's (1981: 268-269) observations on Canadian French, and also by Martinet (1974: 57) who notes that 'il semble que certains Français distinguent entre *petite orange* et *petit orage*, non seulement du fait de la nasalité de /ɔ/ s'opposant à l'oralité de /a/, mais aussi du fait que dans *petite orange*, le second /t/ se rattache, dans la prononciation, plutôt au /i/ qui précède qu'au /ɔ/ qui suit'. According to Martinet, a virtual pause precedes the connective [t] in the masculine string, but follows the word-final [t] in the feminine string.

After their insertion, and before the rule of rightward attachment, connective consonants are extrasyllabic; so this analysis is similar to that of Clements & Keyser (1983: 96-114), who also postulate that connective consonants are extrasyllabic. However, there is an important difference between the two analyses: for Clements & Keyser, this extrasyllabicity is an *ad hoc* lexical property, because they regard connective consonants as word-final and underlying. In the present analysis, extrasyllabicity is a natural

consequence of the post-lexical insertion of these segments, and of the word boundary which precedes them.

It seems that leftward attachment across a word boundary occurs in liaison, in a specific style: the artificial style of some politicians or radio or TV announcers. This phenomenon has sometimes been called '*liaison without enchaînement*' (see Encrevé (1983) and Lucci (1983)). A pause or a glottal stop follows the connective consonant; this insertion of [ʔ] is the automatic consequence of the absence of enchaînement:



(= 'they have arrived')

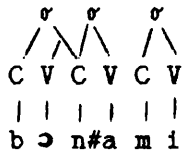
Two opposite tendencies conflict:

- (i) The tendency to apply optional liaisons in marked styles.
- (ii) The tendency to emphasize important words, which will therefore be preceded by a pause or by a protective glottal stop.

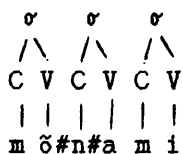
Normal liaison, with rightward attachment, is not compatible with the second tendency. Then leftward attachment becomes automatic, and the non-application of rightward attachment feeds the insertion of the glottal stop.

VIII.6.5. Pseudo-liaison, nasal vowels, and syllable structure

I have claimed that in pseudo-liaison (see SVIII.6.2), there is no connective consonant. Masculine and feminine forms become homophonous before non-disjunctive items: *bon ami*, *bonne amie* ('good friend', masculine and feminine) have identical phonetic representations, and the identity is complete, which means that the S-structure, for both strings, is:

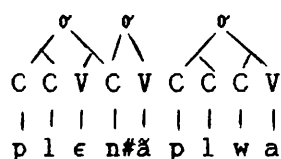


[n], in such sequences, is never extrasyllabic, because it is word-final, and is not preceded by a word boundary: on the contrary, it is subject to enchaînement, undergoes rightward attachment, and becomes ambisyllabic. Compare the structure above with that of *mon ami* ('my friend'; true liaison, with a connective [n]):



In this structure, [n] is not ambisyllabic; it is exclusively syllable-initial: S-structure is a direct consequence of a different morphological organization.

In Chapter V, I showed that nasal vowels are underlying, and I excluded the possibility of a nasalization rule, in a purely segmental approach. I shall now show that the same conclusions are confirmed in a syllabic analysis. Some linguists, working in a syllabic framework, posit a syllable-sensitive rule of nasalization: 'The rule of nasalization in French, which deletes a nasal consonant in syllable-final position and nasalizes the preceding vowel' and also: 'the rule of nasalization which crucially refers to syllable structure is ordered before the rule which deletes the schwa' (Noske 1982: 266), or: 'Nasals show the same pattern of truncation as obstruents' (Clements & Keyser 1983: 99), and: 'nasal truncation is a more general rule than obstruent truncation, applying not only word-finally, but also word-internally, as in *bon* [bɔ̃], *bonté* [bɔ̃te] (100). In syllabic phonology, nasalization is unanimously regarded as syllable-sensitive, insofar as the rule is postulated at all. This process could be formulated as follows: *a vowel is nasalized before a homosyllabic nasal consonant*. If nasalization is syllable-sensitive, advocates of the rule have to account for the difference between *plein temps* and *plein emploi*: [plɛ̃ tã] and [plɛn ɛ̃plwa] ('full time', 'full employment'). In the second form, [n] is ambisyllabic; in abstract syllabic phonology, it is assumed that the underlying representations of the adjective is /plɛn/. This form is preserved before a vowel, in the second example, but undergoes nasalization in the first example. It is necessary to specify that nasalization is applicable only if [n] is fully implosive, but not if it is ambisyllabic, as in [plɛn ɛ̃plwa]:



The order rightward attachment/nasalization would be crucial, since in this analysis the association rule must bleed nasalization. This fact makes nasalization quite implausible: rightward attachment is automatic, and applies even across phrase boundaries; insofar as no pause or no intonational boundary (see SVIII.6.6) follows the word-final consonant, enchaînement is not sensitive to the degree of prosodic relationship between contiguous words, because the domain of this process is clearly the intonational phrase, that is, a unit which ends in an intonational break (see Dell (1984)). Enchaînement will therefore apply in the following strings, even though the adjective may be followed by a phrase boundary:

bonne à rien, bonne à tout faire, bonne à jeter ('good for nothing',
'charwoman', 'fit for the dustbin')

In each of these examples, the final [n] of *bonne* is ambisyllabic:



The following data are problematic for a rule of nasalization:

il est bon à tout; ce livre est bon à jeter ('he is good at everything';
'this book is fit for the dustbin')

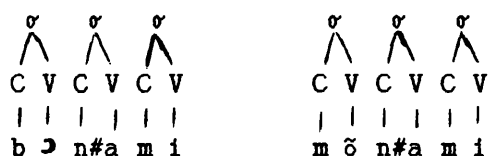
The phonetic representations of these examples are:

[il ε bõ a tul]; [sø livR ε bõ a zøte]

and the vowel of the adjective is [+nasal]. If its underlying representation were really /bɔ̃n/, enchainement should logically apply, and bleed nasalization, since the adjective is not followed by an intonational break, but this does not happen. These data provide evidence that the underlying representation of *bon* is /bõ/, and the masculine allomorph in liaison context, which is homophonous with the feminine allomorph, is the result of the rule of pseudo-liaison, which applies only within phonological phrases, but not across phrase boundaries. This explains the difference between *bon ami* [bɔ̃n ami] ('good friend'), and *bon à jeter* [bõ a zøte] ('fit for the dustbin'), the initial structures being:

%bon#ami% and %bon%à#jeter%

In Anderson (1982), we find suggestions which are analogous to those of Schane (1973b), but within a syllabic framework. Anderson assumes that the underlying representations of *mon*, *bon* ('my', 'good') are /mɔ̃n/, /bɔ̃n/, as in the standard segmental analysis. The S-structures of *mon ami*, *bon ami* ('my friend', 'good friend') are assumed to be identical:



Anderson postulates two different rules of nasalization:

(i) A process which nasalizes vowels before homosyllabic nasal consonants.

(ii) A process which nasalizes vowels before nasal consonants, but without reference to S-structure.

bon would be subject to the first rule, and *mon* to the second rule. This difference would account for the two phonetic representations: $\$b\text{õ}\$n\text{a}\$m\text{i}\$$ and $\$m\text{õ}\$n\text{a}\$m\text{i}\$$. We can note that the rule which is sensitive to S-structure violates the universal condition on rules (see Chapter VII), since it is never surface-true, and this violation invalidates Anderson's analysis, just as it invalidates Schane's (1973b), or any abstract analysis with a putative nasalization rule. It can be added that Anderson's proposal is not satisfactory for other reasons; the adjective *commun* ('common'), for instance, or the article *un* ('a'), as well as a few other items, would undergo the second rule in the masculine: *commun intérêt* [$k\text{õ}m\text{õ}n\text{#}\text{ê}t\text{e}R\text{e}$] ('common interest'), but not in the feminine. For Anderson, schwa should be represented as an empty position on the segmental tier, and the underlying representation of the feminine *commune* would therefore be $/k\text{õ}m\text{yn}./$ (the dot indicating the empty position), and the syllable structure of the item would be $\$k\text{õ}\$m\text{y}\$n.\$,$ before the deletion of the empty segment, and $\$k\text{õ}\$m\text{yn}\$$ after this deletion; in both cases (before and after the deletion of the empty segment), the structural description of the second rule of nasalization (the one which does not make reference to S-structure) is satisfied, but the rule

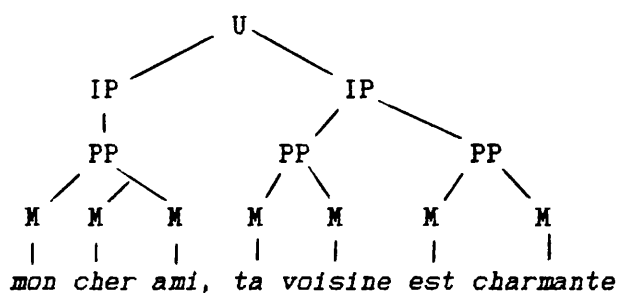
does not apply, while the morpheme /kɔmyn/ is marked as being subject to this process (note that rule order cannot be invoked).

VIII.6.6. Liaison and prosodic structure

In the metrical theory (see Wetzels & Van Lessen Kloeke (1985)), utterances are organized into:

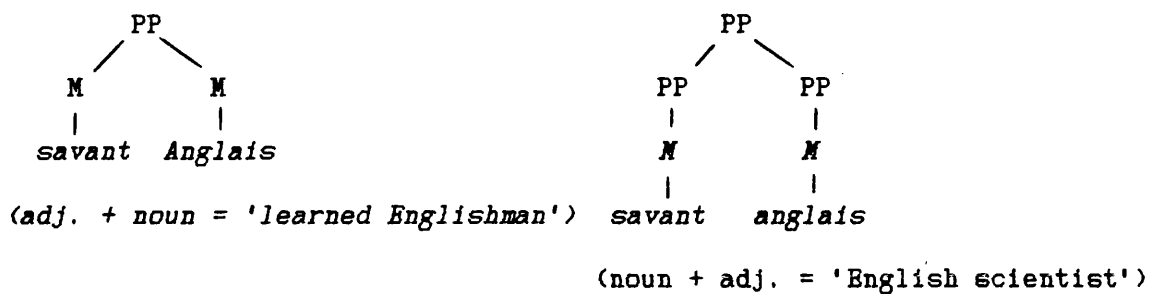
- (i) Intonational phrases (IP)
- (ii) Phonological phrases (PP)
- (iii) Words (M)

The utterance *mon cher ami, ta voisine est charmante* ('my dear friend, your neighbour is charming') would in this model have the following structure:

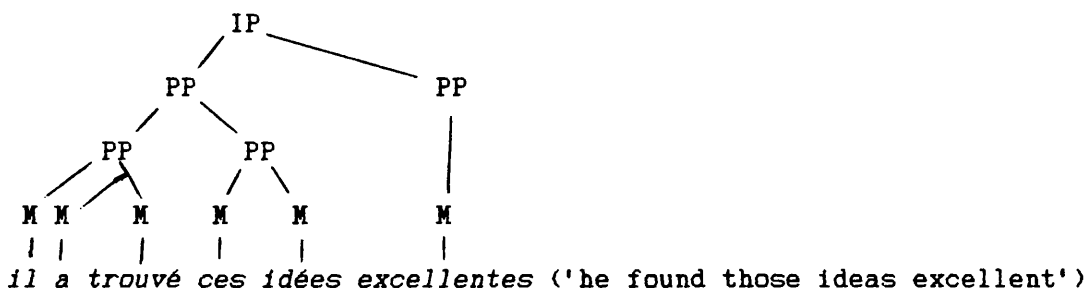
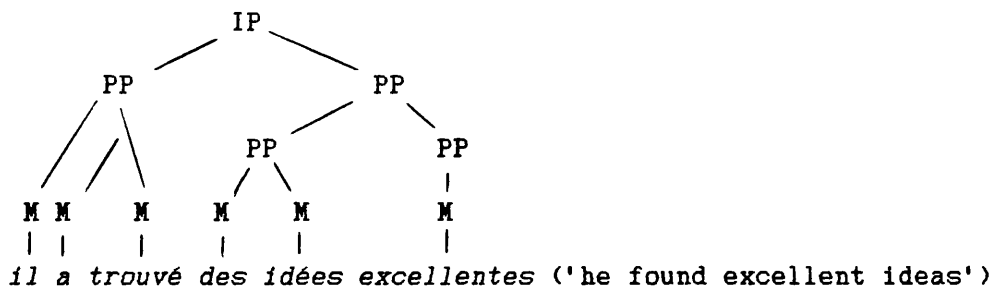
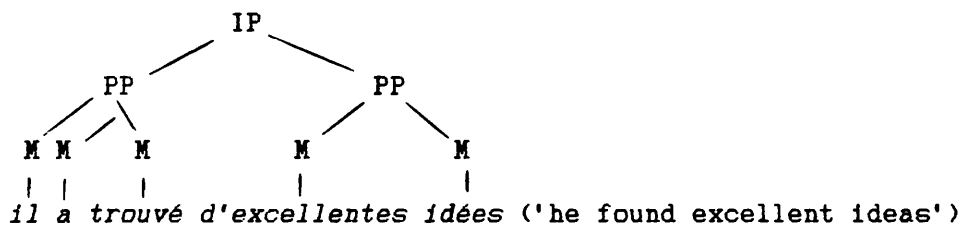


Intonational-phrase boundaries correspond to tonal breaks, as after *ami* in this example. The IP in the present work corresponds to Dell's (1984: 68) 'tronçon': 'Appelons tronçon toute portion maximale de l'énoncé qui ne contient ni silence ni rupture intonationnelle'. Liaison never takes place before or after a tonal break or a pause. My hypothesis is that the domain of obligatory liaison is the

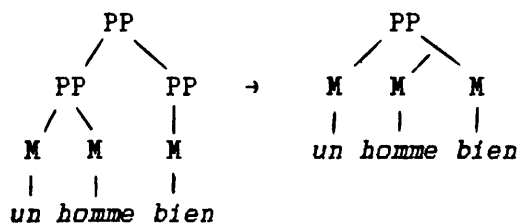
PP. For Grammont (1966: 129), 'la règle générale est fort simple; on lie dans l'intérieur d'un élément rythmique, on ne lie pas d'un élément rythmique au suivant'. Grammont's 'élément rythmique' corresponds to our PP. Grammont (132) also notes that 'on lie l'adjectif, même polysyllabique, lorsqu'il précède le substantif qu'il qualifie; il est dans ce cas très étroitement uni avec le substantif [...], mais on ne lie pas un substantif sur un adjectif qui le suit'. This yields the following possibilities: *savant Anglais* ('learned Englishman') will be pronounced [savã t ɔ̃glɛ], with liaison, if the first term is the adjective, and *savant anglais* ('English scientist') will be pronounced [savã ɔ̃glɛ], without liaison, if the first term is the noun. It must be added that plural liaison is optional in a noun plus adjective sequence: so liaison will be obligatory in *savants Anglais* (adjective + noun), and optional in *savants anglais* (noun + adjective). However, liaison in the singular, after the noun, is absolutely impossible. If the PP is the domain of obligatory liaison, as is implicit in Grammont's work, there is one PP in the adjective plus noun sequences, but two in the noun plus adjective sequences. This entails that grammatical conditions on the application of obligatory liaison are not necessary (prosodic conditions are sufficient), but that such conditions play a role for optional liaison. Moreover, if liaison is impossible after a [-plural] noun, this is certainly due to a general principle, according to which a dependent item preceding its syntactic head belongs to the same PP as this head, but a dependent item following the head belongs to a separate PP. Nouns are always phrase-final, which entails that liaison after them will never be obligatory (for the notion of syntactic head, see Jackendoff (1977)). This principle accounts for the different metrical structures which I propose for our standard examples:



Metrical structure accounts for liaison in the next examples in a similar fashion:



In the first string, the application of liaison is obligatory, because the adjective and the noun belong to the same PP: [ɛkselãt z idel]; in the second string, liaison is optional, because the phrase is [+plural], and because, although the noun and the adjective do not belong to the same PP, they are grammatically related: [ide (z) ekselã:t]; in the third string, liaison is impossible, because the noun and the adjective are not even grammatically related (the syntactic structure being: verb + direct object + object complement). Note that the general organization of PPs within the IP is directly conditioned by syntactic structure (see Malmberg (1971a: 200-203)). Configurations account for differences, but there are also, as I have already noted, extra conditions in some cases (for details concerning obligatory and optional liaison, see Fouché (1959: chapter 8)). The prosodic approach to the question of the domain of liaison is more satisfactory than traditional analyses in terms of the number of word boundaries (Selkirk 1977), or analyses with *ad hoc* syntactic structures (Rotenberg 1975), because there is no one-to-one correspondence between syntactic relations and prosodic configurations, although the former are mapped on to the latter (so syntactic relations cannot always be inferred from prosodic patterns). The domain of liaison is defined after the application of canonical prosodic rules; however, prosodic structures can be further modified by readjustment rules: *désaccentuation*, for instance (see Garde (1968: 94)). In *c'est un homme bien* ('he is a nice man'), the noun and the item which follows it belong to two separate PPs, according to canonical rules, but *bien* is monosyllabic, and *désaccentuation* is expected when two stressed syllables follow each other: prosodic restructuring erases the PP-node which dominates *bien*:



The same restructuring will affect the string *des hommes ivres* ('drunken men'), and after this readjustment there will be just one PP; yet what is relevant for liaison is the output of canonical rules: in this output, *hommes* and *ivres* belong to two separate PPs, and liaison will not be obligatory.

VIII.6.7. Truncation rules

In the framework of constrained phonology, major processes of consonant truncation are disallowed, but there are undeniably minor processes deleting final consonants. These processes are motivated by alternations in connected speech, and the basic forms of the items which undergo them have a final consonant in the phonetic representations. We know that a truncation rule deletes the final consonant of a few exceptional items in the plural (see SVIII.5.2):

boeuf, oeuf, os, aieul ('ox', 'egg', 'bone', 'ancestor')

Another truncation rule affects numerals. This process is post-lexical (whilst the rule affecting the nouns above is lexical), and the items which are subject to it will be marked [+truncation]; these items are:

cinq, six, huit, dix ('five', 'six', 'eight', 'ten')

whose underlying representations are /sɛ̃k/, /sis/, /ɥit/, /dis/. These representations, which correspond to the citation forms, are not altered before a pause (S). Consider now what happens before a consonant or a disjunctive vowel or semivowel:

six garçons [si gaʁsɔ̃] ('six boys')

dix héros [di eʁo] ('ten heroes')

huit tables [ɥi tabl] ('eight tables')

It is obvious that the final consonant is deleted in this context by an external-sandhi rule, which only applies within the domain of PP, that is, when the numeral is not phrase-final (see SVIII.6.6):

six sont là [sis sɔ̃ la] ('six of them are here')

It should be noted that many speakers no longer truncate the final /k/ of *cinq* ('five'), and that some do not truncate the final /s/ of *six, dix* ('six', 'ten'), when they bear contrastive stress. Moreover, for a subset of speakers, truncation does not take place when the numeral has the value of an ordinal number, as in *le dix décembre, dix pour cent* ('the tenth of december', 'ten per cent'). The truncation rule also affects *plus, tous*, /plys/, /tus/ ('more', 'all'):

il est plus gentil [il ɛ ply ʒɑ̃ti] ('he is kinder')

tous les gens [tu le ʒɑ̃] ('everybody')

The numerals *deux*, *trois* /dø/, /tRwa/ ('two', 'three') undergo plural liaison:

deux enfants [dø z äfã] ('two children')

trois avions [tRwa z avjõ] ('three planes')

quatre, *cinq*, *sept*, *huit*, *neuf*, *vingt*, *cent*, *mille* ('four', 'five', 'seven', 'eight', 'nine', 'twenty', 'one hundred', 'one thousand') are [-plural liaison] (see SVIII.6.1), but *vingt*, *cent* /vẽ/, /sã/, undergo liaison in [t]. As to *quatre*, *sept*, *neuf*, *mille*, they are invariant (with one exception: *neuf*, in *neuf heures*, *neuf ans* ('nine o'clock', 'nine years') is pronounced [noev]). The behaviour of *six*, *dix* ('six', 'ten'), is somewhat complex:

six, *dix* [sis], [dis]

six tables, *dix tables* [si tabl], [di tabl] ('six tables', 'ten tables')

six avions, *dix avions* [si z avjõ], [di z avjõ] ('six planes', 'ten planes')

These two numerals are subject to plural liaison, like *deux*, *trois* ('two', 'three'), but their truncated variant appears before the connective [z] (*plus* ('more') behaves in a similar fashion). These strings will be easily derived if it is assumed that plural liaison feeds truncation:

sis#avjõ

→ sis#z#avjõ (liaison)

→ si#z#avjõ (truncation)

It is clear that the minor rules of consonant truncation which have been examined have nothing to do with the major processes which are postulated in abstract phonology (Schane (1968), for instance) for the majority of French lexical items.

VIII.7. Summary

In Chapter VIII, I have applied the principles of constrained phonology (Chapters VI & VII) to French. In this language, nasal vowels are underlying, schwa is underlying only when it is really pronounced in non-artificial styles, and *H aspiré* is not a phoneme, but a diacritic feature causing rule inhibition or overapplication (it constitutes an exceptional environment). Connective consonants are inserted by post-lexical processes, and are not part of any word form: they are true linking elements, and are extramorphological. There are in fact two distinct, but related, phenomena which are traditionally called liaison: true liaison, which inserts connective consonants, and pseudo-liaison, which is rather a morphological instruction. In the field of morphology, allomorphy rules account for some frequent alternations, which are regarded as governed by natural rules in the most abstract versions of generative phonology. Segmental rules interact with syllabification rules both in the word-formation component, and in the phonological component: these syllabification rules, like segmental rules, are lexical, and integrated into the word-formation process, or post-lexical, and apply in connected speech, which alters the form of syllabified underlying representations.

IX

CONCLUSION

The constrained version of generative phonology which I have proposed can be used in the description of French, but also in that of any other language, since its principles are assumed to be universal. In all languages, we find the same rule classes, with the same properties. In every case, rules are likely to be denaturalized in time, and their status can change. Phonological criteria which help us to distinguish the various rule classes should be essentially formal, rather than substantive, and universal constraints are absolute rather than relative. They suffer no violation, and account for the learnability of structures. Criteria are formal, but this is not incompatible with the search for psycholinguistic validity, and external evidence confirming that analyses are correct.

One of the main differences between the standard or more abstract versions of generative phonology and constrained phonology is the analysis of certain alternations, which advocates of abstract models assume to be governed by natural rules, whilst I view them as governed by allomorphy rules. At many stages of the present work, it has often been clear that the

two issues of naturalness and abstractness are inseparable. Formal constraints restrict the set of natural rules in particular languages, and the degree of abstractness of underlying representations is automatically reduced. In fact, these representations are inputs to realization rules, and are filtered by phonotactic rules, which perform the function of well-formedness conditions (Chapter VI); we know that these two classes of processes constitute the set of natural rules.

Historically, substantive universals restrict the possibilities of initiation of processes, the set of universal processes being predetermined; languages borrow new processes exclusively from this universal set of natural rules. Then these universal rules are generalized (more segments are affected, in a greater number of contexts). So they are primordial from the point of view of comparative linguistics, but also of diachrony, in any language. In a new stage, rule interaction will cause denaturalization, some rules will become lexically restricted, and others will be grammaticalized. At any stage of any language, formal constraints will condition the possibility of rules; these constraints restrict the possible correlations between underlying and phonetic representations.

The respective functions of substantive and formal universals also lead me to keep the well-established distinction between synchrony and diachrony, even though linguistic variation may be both spatial and temporal. Synchronic rules cannot recapitulate the history of a language if non-productive alternations are properly regarded as linguistically peripheral, and if we acknowledge the frequency of denaturalization. This means that the conception of diachrony should be less static than is

usually assumed in generative phonology. Inversely, the existence of rules is necessary, and is conditioned by the vocal nature of speech, which is a dynamic production: this explains why phonological structures are fundamentally unstable, and liable to change, both from a paradigmatic and a syntagmatic point of view. The vocal implementation of speech also accounts for the frequent asymmetry of phonemic systems, as well as the variability of structures, because the relationship between underlying phonological structures and their phonetic implementations is natural and non-arbitrary.

Diachrony explains the apparently non-functional existence of allomorphy rules, which are not natural, and increase the complexity of languages. The preservation of these allomorphy rules conflicts with innovative tendencies. Linguistic change is responsible for the transformation of natural rules into synchronic residues in the form of allomorphy rules. So languages change, but they also keep traces of their past.

Synchronic idiolectal, dialectal, stylistic, and social variations contain the seeds of future changes, whilst non-natural rules are the archives of the past. Languages are both innovative and conservative: several centuries after the Copernican revolution, the sun still rises.

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