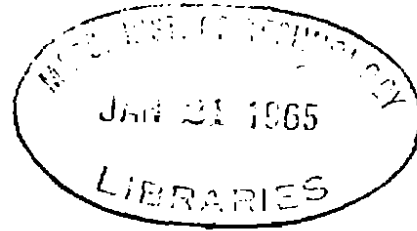


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THE ACCENTUAL SYSTEM OF
STANDARD JAPANESE

by

JAMES D. McCAWLEY

M.S., University of Chicago (1958)

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Signature of Author.....
Department of Modern Languages,
September 16, 1964

Certified by.....
Thesis supervisor

Accepted by.....
Chairman, Departmental Committee on
Graduate Students

The accentual system of standard Japanese

James D. McCawley

Submitted to the Department of Modern Languages on Sept. 16, 1964 in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

The theory of generative phonology has been applied to the study of the accentual systems of English, Russian, and German, languages which have a "stress accent", in which a phrase will generally contain a primary stress and several secondary, tertiary, etc. stresses. In making a generative-phonological analysis of Japanese, whose accentual system is one of "pitch accent, in which a phrase can be characterized accentually simply in terms of the location of a fall in pitch and in which there is nothing comparable to the several degrees of stress which can be found in a word in English, it is my intention not only to make an accurate analysis of the facts of Japanese but also to shed some light on the formal nature of such concepts as "stress accent", "pitch accent", and "tone language".

Chapter I is a sketch of generative phonological theory. Chapter II is a description of the rules relating to segmental phonology in a transformational grammar of Japanese; it includes a detailed study of verb and adjective inflection and a discussion of the differences in behavior of items from different strata of vocabulary. Chapter III is a treatment of the accentual system of standard Japanese; it contains a thorough discussion of the accentual alternations in Noun + Enclitic combinations and in verb and adjective inflection, and the accentuation of noun compounds; it is shown that to predict the accentuation of Japanese utterances it is necessary for the grammar to contain a transformational cycle of rules. Furthermore, the rules which assign accent turn out to have the same formal nature as the stress assignment rules of "stress-accent" languages such as English. Appendix I is a list of "pre-accenting" and "de-accenting" morphemes in Japanese. Appendix II is a brief survey of the accentual systems of Japanese dialects.

Thesis supervisor: Noam Chomsky
Title: Professor of Linguistics.

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Preface

My primary purpose in undertaking the investigation reported below is to give a generative-phonological analysis of already known data about standard Japanese rather than to accumulate new data. As a result, the "informants" which I have used have to a large extent been dictionaries and textbooks rather than live persons.

My principal informant has been Hirayama's "Zenkoku Akusento Jiten" (All-Japan Accent Dictionary), a most valuable work which contains a staggering wealth of information; in addition to an 888 page dictionary which gives the Tookyoo, Kyooto, and Kagoshima accents for all the words listed plus the Tookyoo accent for the principal inflected forms of verbs and adjectives and phrases and short sentences containing the relevant words, the "Zenkoku Akusento Jiten" also contains a sketch of the accentual systems of the dialects (which includes a 40 page word list giving pronunciations in 12 different dialects) and a comprehensive treatise on the accentual system of standard Japanese.

My one live informant was Sige-Yuki Kuroda, at present a graduate student in linguistics at M.I.T., who I consulted when Hirayama provided insufficient data for my purposes. In cases where his idiolect differs from that reported by Hirayama, I have accepted Mr.

Kuroda's forms, except in the cases where he felt that the forms he uses are non standard.

Two other sources from which I have drawn a fair amount of data are Tashiro's "Hyoojungo Akusento no Kyoohon" (Textbook of Standard Japanese) and Eleanor Harz Jordan's "Beginning Japanese". The former is a book intended for Japanese who wish to acquire standard pronunciation; while Tashiro wrote it in the capacity of a speech teacher rather than a linguist, it is of considerable interest to the linguist in that it contains a huge corpus of utterances with accents marked, as well as some most perceptive observations regarding the regularities which underly the data. Mrs. Jordan's textbook also contains a huge corpus of data about accent and, like Tashiro's book, it enables the reader to get the feel of Japanese accentuation by going through a series of graded examples which illustrate the various accentual phenomena of Japanese. I did not become aware of the existence of Kindaichi's "Meikai Akusento Jiten" until I had written the bulk of this dissertation; if I had had a chance to consult it earlier, I am sure that my section on noun compounds would have been more comprehensive, since Kindaichi gives the most thorough account I have ever seen of the accentuation of Japanese noun compounds.

I will transcribe most of my examples using the Bloch-Jordan romanization, deviating only to the extent

of not distinguishing between their symbols g and g̃ nor between n and N. When it becomes necessary for me to indicate more phonetic detail than such an orthography would allow, I will simply introduce extra symbols ad hoc at the places where the need arises. When Japanese place names, etc. occur in glosses or in the text, I will use the Hepburn system of romanization, modified only to the extent of using double letters instead of macrons; thus I will write kyuusyuusiki 'Kyuushuu style'. Instead of [ŋ] I will write [ŋ̃], which is more amenable to typewriting.

Since I am an adherent of a school of linguistic thought which does not believe in phonemes, my use of slashes // and square brackets [] may not be readily comprehensible to adherents of other schools. The source of the problem is that when one is operating in terms of a system of ordered rules, the intermediate stages through which an item passes are neither underlying forms nor phonetic representations; nevertheless, one still needs some kind of brackets within which to enclose these intermediate representations. The practise which I have followed is to use // and [] as relative rather than absolute symbols, so that when I write "/p/ becomes [h] intervocalically" and give examples like "/kepai/ = [kehai]", the slashes and brackets will simply mean the input and

output (respectively) of whatever rule is under discussion at the moment. Thus a form which appears in square brackets on one page may appear in slashes on the next page.

I would like to express my most sincere gratitude to my advisor, Noam Chomsky, who has had a profound influence on my thinking and has been a continuous source of intellectual stimulation such as I had never encountered before coming to M.I.T. I am equally grateful to Morris Halle, whose ideas can be found on every page of this dissertation and with whom I have had countless hours of stimulating and pleasurable discussion. It is to him and Prof. Chomsky that I credit my rapid transformation from the intellectual counterpart of a 97-pound weakling into a productive scholar in my chosen field.

I wish to thank Sige-Yuki Kuroda, without whose assistance it would have taken me twice as long to get half the results which I present here; I have always been able to turn to him for stimulating insights into the structure of Japanese, and I must report that in what follows I have plagiarized from him unmercifully. I am grateful to Theodore M. Lightner for having greatly enriched my understanding of generative phonology in many hours of discussion; I also wish to thank Mr. Lightner's wife Lee for so graciously putting up with the marathon linguistic bull sessions which she so often has had to

endure. I also wish to express gratitude to G. Hubert Matthews and Akira Komai for useful comments on and criticisms of dissections of this dissertation, to Rev. Willem A. Grootaers for introducing me to Japanese dialectology and assisting my study in that area while I was at Seton Hall University in summer, 1963, to Arnold Satterthwait and Erica Garcia, who by acting as devil's advocate have helped me to see more clearly just where I stand on phonological theory, and to Phyllis Hershfang, who proofread this manuscript and made many valuable suggestions for its improvement.

CHAPTER I

GENERATIVE PHONOLOGICAL THEORY

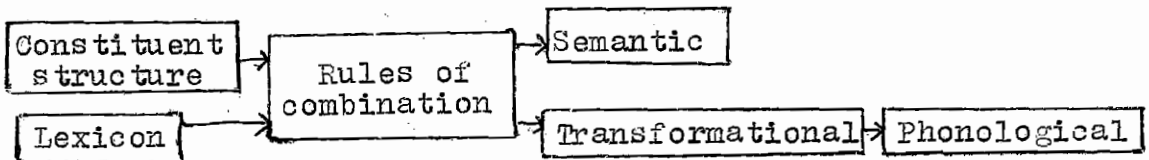
Акцентуация является самым трудным, или — вернее сказать — единственным трудным вопросом японской фонетики.

--- E. D. Polivanov

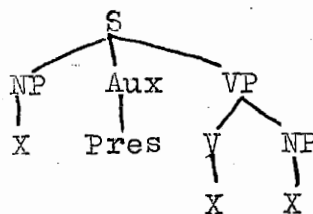
1.1 The notion of a grammar

"Accentuation is the most difficult, or more correctly, the only difficult problem of Japanese phonology". Thus in 1924 Polivanov characterized the contrast between the complexity of the Japanese accentual system and the relative simplicity of everything else in Japanese phonology. Accordingly, in the following generative-phonological treatment of Japanese phonology, I will devote particular attention to the accentual system.

Following Chomsky [3], I assume that the grammar of any language has the following components:

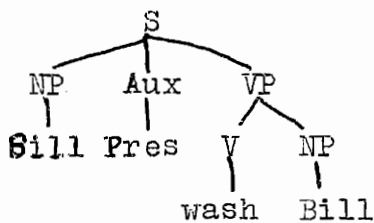


1. A constituent structure component, which generates the basic sentence shapes of the language. A basic sentence shape is a string of "dummy symbols" with a labeled immediate constituent (IC) structure, for example,

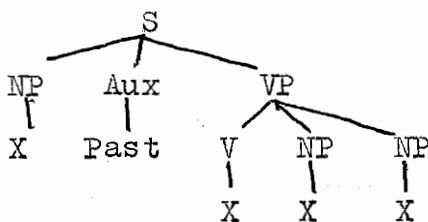


2. A lexicon, which consists of a list of the morphemes of the language, together with full idiosyncratic information about each morpheme: all information needed to characterize its morphophonemic, syntactic, and semantic behavior.

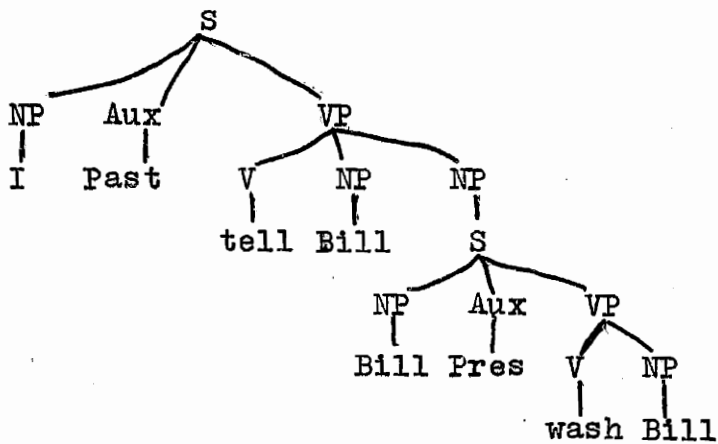
3. Rules of combination, which fill out basic sentence shapes by inserting morphemes or other basic sentence shapes in place of the dummy symbols. For example, the rules of combination allow one to substitute morphemes into the structure given above and obtain the structure



underlying "Bill washes himself", and to substitute that and various morphemes into the structure



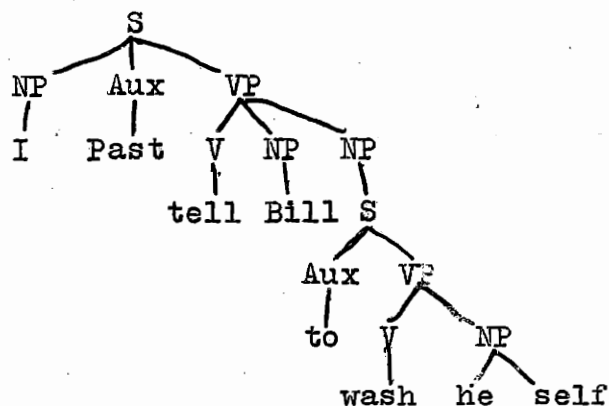
and obtain the structure



The output of the rules of combination is the "deep (syntactic) structure" of an utterance. The above tree diagram is thus the "deep structure" of the utterance "I told Bill to wash himself".

4. A semantic component, which assigns interpretations to the deep syntactic structures of sentences.

5. A transformational component, which carries out order changes, deletions, and other operations on the deep structure of a sentence, thereby converting it into the "surface (syntactic) structure" of the sentence. For example, the transformational component converts the last tree diagram into



which is the surface structure of "I told Bill to wash himself".

6. Finally, a phonological component, which associates the phonetic representation of an utterance to its surface syntactic structure.

1.2 The function of the phonological component

What I will say below will be confined to a discussion of the lexical and phonological components of a transformational grammar of Japanese. My task is to find appropriate ways of representing the morphemes of Japanese in the dictionary and to give a set of rules for converting surface syntactic structures involving those dictionary representations into the correct phonetic form.

1.2.1 Phonetic representation.

Before going on, it will be necessary for me to make precise what I mean by the "phonetic form" of an utterance. By "phonetic form" I mean a representation in which all phonetic characteristics subject to linguistic regularity are represented. Any actual speech act will, of course, exhibit many characteristics which will not be included in the phonetic representation, namely those which are the result of extra-linguistic factors such as the size of the speaker's vocal organs, his state of mental alertness, the possible presence of chewing gum in his mouth, etc. In the

phonetic representation, only those characteristics are marked whose presence or absence is determined by the language itself.

A phonetic representation in this sense is a rather tall order, since very fine details of pronunciation may still correspond to linguistic regularities in a language. One might attempt to simplify the problem by separating those phonetic characteristics which play a role within the language from those which, while a part of the language, are a superficial part of it, where by "superficial" features I mean those which play little or no role in conditioning variants of other segments. If such a notion makes sense, then it would be possible to divide the phonological component of the grammar of a language into two parts: the phonological rules, which involve only a limited set of phonetic features, and the feature interpretation rules, which convert "systematic phonetic representations" in terms of that small set of features into detailed phonetic representations. The most ambitious and valuable attempt in this direction has been Morris Halle's use of Jakobson's theory of distinctive features¹. Jakobson's goal was actually quite different,

¹) R. Jakobson, C. G. M. Fant, and M. Halle, "Preliminaries to Speech Analysis", MIT Press, Cambridge, Mass., 1951.

namely to set up a minimal set of acoustic/physiological oppositions in terms of which all distinctive (i.e., phonemic) oppositions between segments could be expressed. However, Halle and his disciples have used the Jakobsonian system of features with considerable success as a system of "systematic phonetic representation" of utterances. Since the topics which I will discuss in this dissertation can be treated without going into really fine phonetic details, it will be sufficient for my purposes if I accept the Jakobsonian system of features as providing a system of systematic phonetic representation. I will thus assume that the phonological component of a grammar of any language splits into the two components indicated above: phonological rules, which involve only the Jakobsonian features, and feature interpretation rules, which convert the Jakobsonian feature specifications into ranges of physical variables. Let me clarify the roles of these two parts with an example²: Hindi has a binary opposition of aspiration; the phonological rules will yield systematic phonetic representations in which the aspirated members of this opposition are marked [+ tense] and the unaspirated members [- tense]. However, phonetically there are not two but three degrees of aspiration in Hindi: voiceless "unaspirates" have a perceptible amount of aspiration,

²) I am grateful to Arnold Satterthwait for calling this example to my attention.

although not so great an amount as do the true "aspirates". The relevant "feature interpretation rules" assign segments three degrees of aspiration (none, small, full) according to their Jakobsonian feature composition.

1.2.2 Underlying representations

The part of the phonological component which I will concern myself with will thus have as its output matrices of binary feature specifications: an utterance will be represented as a sequence of segments and each segment will be represented as a set of values for the Jakobsonian features. I must now consider in greater detail what the input to these rules will be. I have already said that the rules operate on the surface syntactic structure of an utterance, that is on a representation which indicates a sequence of morphemes with a labeled immediate constituent structure.

The representation of a morpheme must in some way be a specification of all its idiosyncratic properties. Not all English verbs can take an animate object; therefore the representation of the verb "surprise" must contain either the information that it can take an animate object or some other information from which that information can be deduced. Not all English morphemes correspond to a stretch of sound beginning with a voiceless bilabial stop; therefore the representation of the prefix "pre-" must contain information from which it can be deduced that a bilabial stop occurs at the beginning of the

corresponding stretch of sound. Not all English verbs form the past tense by ablaut; therefore the representation of the verb "sing" must contain information from which it can be deduced that the past tense form is "sang" and not "*singed".

It will be noted that much of the idiosyncratic information about morphemes relates to the phonetic form of utterances involving those morphemes. One way of representing this information is the so-called item-and-arrangement representation, in which a list of the phonetic and phonemic shapes a morpheme can take is given, together with a list of the environments in which the different shapes occur. Thus the English morpheme "spit" would be represented by a list of four alternants /spit, spɪD, spɪt, spɪD/ (D denotes the voiced alveolar flap) together with the statements

/spit/ occurs except when PAST or PP (the past participle morpheme) or an unstressed vowel follows,
 /spɪD/ occurs when an unstressed vowel follows,
 /spɪt/ occurs when PAST or PP follows but is not in turn followed by an unstressed vowel,
 /spɪD/ occurs when followed by PAST or PP plus an unstressed vowel.

However, an item-and-arrangement representation fails to meet the important requirement (which I will assume to be imposed on all linguistic description) that dictionary

entries contain no redundant information. Note that in the above example many pieces of information are stated four times. For example, the morpheme "spit" always corresponds to a stretch of sound which begins with /sp/; but instead of this information being stated just once, it is included in the representation of each of the four alternants³. Furthermore, much of the information which the item-and-arrangement representation includes does not have to be marked in the dictionary entry at all, since it does not correspond to idiosyncrasies of the particular morpheme but is a consequence of general principles about the language. For example, since initial consonant⁴ clusters in English can only begin with /s/, it is unnecessary to say that the first segment of "spit" is /s/: it is sufficient just to give the information that it is a consonant, and all other information about it (that it is voiceless, that it is a fricative, that it is dental, that it is strident) will be predictable.

³) In a grammar of my own idiolect, where there are six alternants (the above plus /spɪ?/ and /spʰɪ?/), it would be represented six times.

⁴) I use the term "consonant" here to exclude liquids.

Similarly, it is unnecessary to say that "spit" has alternants /spɪD/ and /spɛD/ before an unstressed vowel, since morphemes which end in /t/ in other environments always have an alternant in /D/ when followed by an unstressed vowel. Moreover, if the fact that a verb forms its past tense by ablaut is considered to be a feature of the entire morpheme (just like, say, the feature of taking an inanimate subject), then it is unnecessary to say that "spit" has an alternant /spɛt/ before the past tense morpheme, since the fact that the vowel is /ɛ/ will be predictable from the fact that the morpheme is ablauting and that the present-tense vowel is /ɪ/.

If all of this redundant information is omitted from the item-and-arrangement representation, all that remains is the following: "spit" is an ablauting verb stem whose phonetic form consists of a consonant followed by a bilabial stop, followed by a lax front vowel which is high except in the past tense and past participle, followed by a dental stop which is voiceless except when an unstressed vowel follows. However, note that even this representation still contains redundant information, since the clauses "except in the past tense and past participle" and "except when an unstressed vowel follows" merely point out facts which are completely predictable from the rules of the language and the other information in the representation of the morpheme: these already imply that the vowel in

the past tense will be low and that the final consonant will be voiced before an unstressed vowel.

But here a difficulty arises. So far, I have been treating the information contained in the representation as if it were a set of statements about the morpheme. If I omit the clause "except when an unstressed vowel follows" from the statement in question, I end up with the statement that the final segment is "a dental stop which is voiceless"; however, that statement is false. since the segment in question is often voiced. But any qualification which might be added so as to yield a true statement would be equivalent to the redundant clause which, by the criterion of non-redundant dictionary entries given above, must be omitted from the representation. The simplest way out of this dilemma is to consider the information in the representation not as a set of statements but rather as a set of abstract marks. Instead of making a statement about the voicelessness of the final segment of "spit", I will simply represent the morpheme as having a final segment with the abstract mark [- voiced]. When a dental stop is followed by an unstressed vowel, the phonetic realization will be voiced regardless of whether the syntactic representation contained the abstract mark [- voiced].

The abstract marks which I have just introduced are known as "classificatory feature specifications". They

indicate not that the corresponding Jakobsonian feature must be present phonetically, but merely that it will be present unless some other condition causes it not to be present. The resulting representation of "spit" thus contains some items of information which relate to the morpheme as a whole (that it is an intransitive verb, that it may take a directional complement, that it forms the past tense by ablaut) and other items which refer to individual segments of the phonetic realization of the morpheme; these latter items can be displayed as a matrix of values (+ or -) for the classificatory features, say,

	(s)	(p)	(i)	(t)
consonantal	+	+	-	+
obstruent		+		+
grave		+	-	-
compact		-		
diffuse			+	
tense			-	

1.2.3 The rules of the phonological component

Suppose for the moment that all morphemes are indeed represented according to the above scheme: a classificatory matrix of feature specifications plus some information relating to the morpheme as a whole. The rules which convert the syntactic representations of utterances into phonetic representations then must be stateable solely in

terms of these two kinds of features ("segment features" and "morpheme features") and syntactic categories and junctures, of which more will be said later. The effect of the individual rules must thus be to add or change feature specifications and possibly also to add, delete, or rearrange entire segments. Note that for a rule which performs operations of any of these types, the output is an object of the same type as the input, namely a matrix of feature specifications.

To appreciate the consequences of this fact, it is worthwhile to consider the implications of the contrary situation, namely that of a description which does not use features but rather treats the items involved (phones, phonemes, morphophonemes) as indivisible alphabetic symbols; this latter position is, of course, shared by a great many American linguists. A description in such terms involves several levels of representation and sets of rules for converting from one level of representation into another (say, for converting a phonemic representation into a phonetic representation or a morphophonemic representation into a phonemic representation). The input and output of these rules will then be objects of different types, say, strings of phonemes as input and strings of phones as output.

Note now that there are basically two ways in which rules can apply: sequential or simultaneous. In sequential

application, an input string Φ (say, a string of phonemes) will be converted into an output string Ψ (say, a string of phones) through several intermediate stages: first some rule will replace some element of Φ by something, thus yielding a new string Φ_1 ; then some rule will replace some element of Φ_1 by something, thus yielding a new string Φ_2 , etc., until some condition is reached which is stipulated to terminate the process (one possible convention is that the process terminates whenever there are no more rules which would be applicable to the string, in which case the rules are said to be random sequential; another possible convention is that the rules are assigned a fixed order, that they apply in precisely that order, and that the process terminates when the end of the list of rules is reached, in which case the rules are said to be ordered). In simultaneous application, there are no intermediate stages; the rules involve only items present in the input string (rather than also items created by other rules, as is possible in the sequential case) and simultaneously replace each item in the input string by the corresponding piece of the output string.

In the work of most American linguists, sequential application of rules, whether random or ordered, is excluded, since it violates the prohibition against one

type of "mixing levels" by allowing representations which are, say, part morphophonemic and part phonemic, or part phonemic and part phonetic.⁵ They thus require their rules to apply simultaneously.⁶

However, in a description where a segment is treated as a set of features rather than as an indivisible alphabetic item, the rules could perfectly well apply sequentially, since (as pointed out above) in this case the input and output of any rule are objects of the same type. Let me at the outset exclude the possibility of rules in terms of phonological features being random sequential. While there are parts of a grammar which it is natural to describe with a set of random sequential rules (e.g., the "combination rules" of p. 10, where one

⁵) There is another quite unrelated meaning to the term "mixing of levels", which relates not to the form of a grammar but to the "discovery procedure" used in arriving at it, namely the use of "higher level" information in deciding how to analyse things on a "lower level".

⁶) Many linguists speak not of "rules" but of "statements". However, since a statement of, say, "/p/ has the allophone [p^h] before vowels" is clearly equivalent to a rule "/p/ → [p^h] in env. _____ Vowel", I can just as well speak of rules.

simply imbeds sentences and lexical items into suitable vacant slots until there are no more slots left to fill), it is unreasonable to expect the rules of the phonological component to be random sequential, since the underlying representation of an utterance determines its phonetic form almost uniquely (the correspondence is non-unique only in cases of phonological free variation), so that the only freedom which can be expected in the application of the rules is the option of either applying or not applying a certain small number of rules. I thus conclude that the rules of the phonological component must apply either simultaneously or in a fixed order.

A great saving in the complexity of the rules and a great increase in the insight which they provide into the workings of the language is obtained if the rules are assumed to be ordered rather than simultaneous.⁷ One reason why this is the case is provided by a consideration of any morphophonemic process which applies to items which can undergo any of a variety of other processes. Unless the rules are ordered, the rules in question will have to be complicated by the addition of side clauses which cover all cases where more than one of the rules applies. A grammar of Russian with ordered rules would,

⁷) Halle [2], Chomsky [2].

for example, contain the two rules:

1. Final /l/ is deleted after a velar consonant.
2. Final obstruents become voiceless.

which would apply in precisely that order (note the past tense forms $\check{z}ok = \check{z}eg \ \& \ l$ 'he burned', $\check{z}gla = \check{z}eg \ \& \ l \ \& \ a$ 'she burned'). In a grammar with simultaneous rules, rule 2 would have to be modified to read:

2'. An obstruent becomes voiceless if it is final or is followed by final /l/.

There is also a regressive assimilation of voicing of obstruents which operates even across word boundaries:

$\check{z}og \ bi$ 'were he to burn' (but $\check{z}ok \ l, i$ 'whether he burned').

The grammar with ordered rules would simply have rules 1 and 2 followed by the rule

3. An obstruent assumes the voicing of an immediately following obstruent.

(rule 2 converts $\check{z}og\#bi$ and $\check{z}og\#l, i$ into $\check{z}ok\#bi$ and $\check{z}ok\#l, i$; rule 3 then converts the former into $\check{z}og\#bi$

but leaves the latter unchanged since /l/ is not an obstruent). However, to take care of this phenomenon, a grammar with simultaneous rules would have to modify rules 2 and 3 to read:

2". An obstruent becomes voiceless if it is either final or followed by final /l/, provided in addition that it is not followed immediately by a voiced obstruent.

3". An obstruent assumes the voicing of an obstruent which either follows it immediately or is separated from it by word-final /l/.

As more and more rules are added, the qualifications which would have to be added to the rules already present would continue to grow in this fashion, and the grammar would contain some rules which would contain pieces of virtually every other rule in the grammar. I will thus assume henceforth that the rules of the phonological component will apply sequentially and in a fixed order.

1.2.4 The relation between feature specifications in the lexicon and those in phonetic representations.

I arrived at the underlying representation which I assigned to "spit" through the "discovery procedure" of first writing an item-and-arrangement description and then omitting predictable information about alternants. Consequently, the feature specifications which appear in the dictionary representation are physically manifested in one or more of the alternant phonetic shapes of the morpheme; indeed, I in effect picked one particular alternant as basic and showed that all the other alternants can be predicted from it. However, it was purely fortuitous that the above discovery procedure yielded a useful underlying form. It is often the case that the appropriate underlying form for a morpheme not only does not correspond to one of its alternants but indeed involves feature

specifications which are never manifested phonetically, as, for example, in the ~~example~~ cited in Halle [2] of a Russian dialect in which certain vowels which are always manifested phonetically as low must be represented in dictionary entries as mid. In classical phonemics, this ~~dialect~~ has a 5-vowel system: /i, ε, a, o, u/. There is a process of vowel reduction which affects the pretonic vowel as follows: if the stressed vowel is /a/, then the pretonic vowel is /i/; if the stressed vowel is /i/ or /u/, then the pretonic vowel is /a/; words in which the stressed vowel is /ε/ or /o/ fall into two classes: in one class the ~~pretonic~~ vowel is /a/ and in the other it is /i/. Halle's solution is to represent the /ε/ and /o/ for which the pretonic vowel is /a/ not as /ε/ and /o/ but as /e/ and /o/, so that the underlying forms will have a 7-vowel system. The vowel reduction rule is then simply a dissimilation of vowel height: the pretonic vowel becomes /i/ before a low vowel (/ε, a, o/) and /a/ before a non-low vowel (/i, e, o, u/). A later rule coalesces /e/ with /ε/ and /o/ with /o/. This solution could not have been obtained by the discovery procedure given earlier of writing an item-and-arrangement description and then omitting all redundant information, since in the item-and-arrangement description, accented /ε/'s and /o/'s would be represented the same way regardless of what the ~~upretonic~~ vowel was.

However, there is no reason to restrict linguistic descriptions to those which are yielded by a fixed discovery procedure. I follow Chomsky⁸ in holding that the proper goal for a linguistic theory is not to provide a procedure for converting data into the grammar of the language, but rather to provide a formal characterization of the notion of a grammar of the language plus a way of evaluating grammars which allows one to choose between the possible solutions. For the moment I will accept as a grammar of the language, i.e., as a candidate for the grammar of the language, any set of representations of morphemes and system of rules for converting underlying representations into phonetic form which is of the same formal nature as the systems discussed so far, namely in

⁻⁸⁻ Syntactic Structures, ch. 6. Note also Hockett's remark "It is possible to be an adherent of the God's-truth doctrine in linguistics, and none the less to be convinced that the search for some one "correct" set of procedures for phonemicization, applicable to any and every language, is chimerical. This is the current position of the present writer" (C. F. Hockett, "Short and Long Syllable nuclei", Int. Journal of American Ling., vol. 19 (1953), pp. 165-171).

which each morpheme is represented as a matrix of classificatory feature specifications plus a set of morpheme features, and in which the rules apply in a fixed order and have the effect of adding or changing feature specifications or of deleting, inserting, or permuting segments. Later in this dissertation I will make various further restrictions on what will be admitted as possible grammars.

1.3 The shape of phonological rules

1.3.1 The features

The Jakobsonian features to which I will refer below are:

1. Consonantalness, which opposes liquids and true consonants ([+ cns]) to vowels and glides ([- cns]).
2. Vocalicness, which opposes vowels and liquids ([+ voc]) to glides and true consonants ([- voc]).
3. Obstruence, which opposes stops, spirants, and affricates ([+ obs]) to liquids, nasals, glides, and vowels ([- obs]).
4. Nasality, which opposes segments with an open nasal passage ([+ nas]) to segments pronounced with a closed nasal passage ([- nas]).
5. Continuance, which opposes segments with closure of the oral cavity (stops, affricates, nasals, flap or trilled [r]) ([- cnt]) to those without (spirants, [l], glides,

vowels) ([+ cnt]).

6. Gravity, which opposes dental and palatal consonants ([t] and [c̣], which are [- grv]) to velar and labial consonants ([k] and [p], which are [+ grv]) and front vowels (which are [- grv]) to back vowels ([+ grv]).

7. Compactness, which opposes velar and palatal consonants ([+ cmp]) to dental and labial consonants ([- cmp]) and low vowels ([+ cmp]) to non-low vowels ([- cmp]).

8. Diffuseness, which opposes high vowels ([+ dif]) to non-high vowels ([- dif]); for consonants, diffuse means the same as non-compact.

9. Voicing, which opposes segments pronounced with vibrating vocal cords ([+ voice]) to those pronounced without ([- voice]).

10. Sharpness, which opposes palatalized segments ([+ shp]) to non-palatalized ([- shp]).

11. Flatness, which opposes segments with a secondary constriction at the periphery of the oral cavity (i.e., either labialized or pharyngialized segments, which are [+ flt]) to those without ([- flt]).

12. Stridency, which opposes segments with high turbulence of the expiratory air to those without (e.g., [f] is [+ str] but [ɸ] is [- str]; affricates are [+ str] and the corresponding simple stops are [- str]).

It is to be noted first of all that these features are binary, i.e., that in the systematic phonetic matrix

each segment will be specified with a value of either + or - for each of these features, and secondly, that they are relative: they specify an opposition along a dimension rather than an absolute value on that dimension, so that, for example, the "front" member of one pair of vowels which differ only on the front/back dimension (gravity) could very well be as far back as the "back" member of another pair.

1.3.2 How rules operate; blanks.

Above I made the demand that the dictionary entry of a morpheme contain no redundant information; such information would be omitted from the dictionary entries of the relevant morphemes and then filled in by rules. The dictionary representations constructed according to this demand will then involve matrices of feature specifications which will contain not only pluses and minuses but also blanks. Suppose for a moment, however, that there are no blanks and consider the problem of deciding which segments a rule applies to. A typical rule might be, say,

$$\begin{bmatrix} + & \text{obs} \\ - & \text{grv} \end{bmatrix} \rightarrow [+ \text{voice}] \text{ in env. } \begin{bmatrix} + & \text{cns} \\ + & \text{voc} \end{bmatrix} \text{_____} [- \text{cns}],$$

which could be translated into words as "a non-grave obstruent becomes voiced when preceded by a consonantal vocalic segment (a liquid) and followed by a non-consonantal segment". In the body of this dissertation, phonological rules will be written in this format. However, for the

purposes of the discussion here, it will simplify things if the rule is rewritten in the form

$$\begin{array}{c} [+ \text{ cns}][+ \text{ obs}][- \text{ cns}] \\ [+ \text{ voc}][- \text{ grv}] \\ \downarrow \\ [+ \text{ voice}] \end{array}$$

The line $[+ \text{ cns}][+ \text{ obs}][- \text{ cns}]$ will be called the analysis of the rule. To determine what segments of an utterance this rule applies to, one examines all 3-segment long pieces of the utterance. If such a piece contains the analysis of the rule, in the sense that its first segment contains the feature specifications $[+ \text{ cns}][+ \text{ voc}]$, the second contains $[+ \text{ obs}][- \text{ grv}]$, and the third contains $[- \text{ cns}]$, then the rule will apply and make the second segment $[+ \text{ voiced}]$ (regardless of what other feature specifications the segments might contain). The 3-segment pieces to which the rule does not apply will be (still under the assumption that there are no blanks present) those which are distinct from the analysis in the sense of having a + somewhere where the analysis has a - or having a - somewhere where the analysis has a +. For example, if one were given the matrix

	1	2	3	4	5
cns	-	+	+	-	-
voc	+	+	-	+	-
obs	-	-	+	-	-
grv	+	-	-	-	+
.

the rule would not apply to the piece 123, since segment 1 contains $[- \text{ cns}]$ where the analysis calls for $[+ \text{ cns}]$; it

would apply to the piece 234, which contains all the feature specifications of the analysis, and segment 3 would thus become [+ voiced]; it would not apply to the piece 345, since 3 contains [- voc] where the analysis calls for [+ voc]. A 3-segment piece will either contain the analysis or be distinct from it. If the former, the rule applies; if the latter, it does not apply.

Now let us return to the real situation in which a feature matrix may involve blanks. Here the situation could arise that a piece of an utterance neither contained nor was distinct from the analysis. For example, in the matrix

	1	2	3	4	5
cns	-			-	
voc	+	+	-	+	-
obs		-	+	-	-
grv	+		-		+

the piece 234 neither contains nor is distinct from the analysis, since 2 is unmarked for consonantalness while all the other feature specifications named in the analysis are present. What happens in this case? Should the rule apply on the grounds that the piece 234 is non-distinct from the analysis or should it fail to apply on the grounds that the piece does not contain the analysis? One could, of course, introduce a convention that a rule applies to all pieces which are non-distinct from its analysis or that a rule only applies to those pieces which contain its

analysis; however, either convention can lead to undesirable results, as is shown by the following example constructed by T. M. Lightner. Suppose that there are three segments I, II, and III and three features A, B, and C, for which I is marked [+ A], II is marked [- A], III is unmarked for A, and all three segments are unmarked for B and C, and that there is a set of rules

1. [] \rightarrow [+ B],⁹
 + C
2. [+ A] \rightarrow [- B],
3. [- A] \rightarrow [- C].

These rules would convert the initial matrix

	I	II	III
A	+	-	
B			
C			

into

	I	II	III
A	+	-	
B	-	+	-
C	+	-	-

if the convention were adopted that

a rule applies to all pieces non-distinct from its analysis and into

	I	II	III
A	+	-	
B	-	+	+
C	+	-	+

if the convention were adopted that a

rule only applies to those pieces which contain the analysis of the rule. In either case, the resulting feature specifications for I, II, and III are now mutually distinct, i.e., for any two of them there will be a feature for which one is marked + and the other -. But this means that the single "binary" feature A would have been used to represent a 3-way contrast, i.e., the blank for feature A

⁹) I.e., all segments become [+ B, + C].

would not correspond to redundant information but would actually carry the information that segment III is distinct from segments I and II, so that what was ostensibly a binary feature would be functioning as a ternary feature. In order to preserve the notion that the information carried by a binary feature should be a 2-way contrast and that a blank should bear no information, it will be necessary to impose constraints to prevent situations such as that just discussed. This can be done in two ways. One is to accept one of the above applicability criteria but impose constraints on the rules which would preclude the possibility of a binary feature functioning as ternary; the other is to restrict the dictionary forms and rules in such a way that it becomes unnecessary to have any such applicability criterion at all. Chomsky and Halle currently take the former position; I take the latter, as did Chomsky and Halle until 1963, although in a slightly different version from that which I take.

The position which I will take throughout this dissertation is that information in a dictionary entry is redundant whenever the behavior of the morpheme in question is independent of that information. I interpret this as meaning that the feature specifications which it is proper to leave blank in dictionary entries are those which play no role in the operation of the rules, in the sense that the rules would yield exactly the same results no matter what information was entered in those feature specifica-

tions. I thus formulate the following constraint on grammars:

The dictionary and rules must be such that if the blanks in dictionary entries are filled in with pluses and minuses in a random fashion, the rules will generate the same output regardless of how the blanks are filled in.

What this means is that a "blank" is not to be interpreted as "a feature specification slot which contains neither a plus nor a minus" but rather as "a feature specification slot which contains either a plus or a minus, but it doesn't matter which". Since any piece of ^afeature specification matrix containing no blanks will either contain or be distinct from the analysis of any rule, no applicability criterion is needed. Moreover, with this restriction on grammars, an extremely simple characterization can be given of the notion "phonologically well-formed utterance" in a language: a phonologically well-formed utterance is anything which can be generated by taking a well-formed syntactic representation, replacing the lexical items in it by random matrices of pluses and minuses (no blanks!), and applying the rules of the phonological component.¹⁰

¹⁰) The present position of Chomsky and Halle is hard to describe, since it is to some extent still in a programmatic stage. It involves allowing a rule to apply to any piece which is non-distinct from the analysis

I now turn to the matter of brackets, parentheses, etc., which is generally known under the misleading term of "notational conventions". The term is misleading because the use of a "notational convention" actually implies a substantive claim about language¹¹ if it is used in connection with an evaluation measure which chooses as optimal that grammar which is in some sense "shorter"

of the rule and excluding grammars in which a blank is filled in on the basis of information which is "derived from" that blank, as would be the case in whatever rule fills in the A-specification for segment III in the above example: unless that rule makes the three segments all have the same specification for feature A, it would have to refer to some feature for which they are marked differently, i.e., B or C; but those feature specifications were put in by a rule which referred to the A-specification now to be put in. However, Chomsky and Halle have not yet found a formal property of grammars which would characterize that set of grammars to be excluded, and it is not at all clear just how that would be done.

¹¹) See Noam Chomsky, "Aspects of the Theory of Syntax", sec. 1.7 (M.I.T. Press, to appear 1965).

than all others. Thus the fact that a pair of rules

(1) $A \rightarrow B$ in env. $W \text{ --- } X$

$A \rightarrow B$ in env. $Y \text{ --- } Z$

can be abbreviated to a single rule

$A \rightarrow B$ in env. $\left\{ \begin{array}{l} W \text{ --- } X \\ Y \text{ --- } Z \end{array} \right\}$

which "counts as 6 symbols" rather than as 8, whereas

a pair of rules such as

(2) $A \rightarrow B$ in env. $W \text{ --- } X$

$B \rightarrow A$ in env. $Y \text{ --- } Z$

can not be abbreviated by any "convention"; corresponds not merely to the fact that linguists have just happened to introduce a notational device in the one case and not in the other but rather to an assertion that language utilizes configurations such as (1) but not those such as (2) in a significant way.

The following conventions are used in the rules:

1. Curly brackets are used to indicate a logical disjunction. For example, $\left[\begin{array}{l} \text{cns} \\ \{ + \text{ grv} \\ - \text{ flt} \} \end{array} \right]$ means a non-consonantal segment which is either grave or non-flat. More precisely, a rule involving $\left[\begin{array}{l} \text{cns} \\ \{ + \text{ grv} \\ - \text{ flt} \} \end{array} \right]$ operates as a sequence of two rules, the first of which refers to $\left[\begin{array}{l} \text{cns} \\ + \text{ grv} \end{array} \right]$ segments and the second to $\left[\begin{array}{l} \text{cns} \\ - \text{ flt} \end{array} \right]$ segments; these two rules apply in precisely that order. When a rule contains more than one pair of curly brackets, it will sometimes make a difference which pair is expanded first. In such cases brackets will

be numbered, the lower numbers going to the brackets which are to be expanded first. Thus a rule

$$A \rightarrow B \text{ in env. } \left\{ \begin{array}{c} C \\ D \end{array} \right\}_1 \text{ --- } \left\{ \begin{array}{c} E \\ F \end{array} \right\}_2$$

is equivalent to the pair of rules

$$\begin{array}{l} A \rightarrow B \text{ in env. } C \text{ --- } \left\{ \begin{array}{c} E \\ F \end{array} \right\} \\ A \rightarrow B \text{ in env. } D \text{ --- } \left\{ \begin{array}{c} E \\ F \end{array} \right\} \end{array}$$

and is thus equivalent to the ordered set of rules

1. $A \rightarrow B \text{ in env. } C \text{ --- } E$
2. $A \rightarrow B \text{ in env. } C \text{ --- } F$
3. $A \rightarrow B \text{ in env. } D \text{ --- } E$
4. $A \rightarrow B \text{ in env. } D \text{ --- } F$

If the subscripts on the brackets were interchanged, the effect would be to change the order of the sub-rules to 1, 3, 2, 4. There will be many cases in which the ordering of the subrules is immaterial; in those cases I will omit the numerical subscripts from the brackets. If two pairs of curly brackets have the same subscript, they are expanded simultaneously and corresponding items within them are to go together. For example, a rule

$$\left[\begin{array}{c} - \text{ cns} \\ + \text{ voc} \end{array} \right] \rightarrow \left[\left\{ \begin{array}{c} + \text{ flt} \\ + \text{ cmp} \end{array} \right\}_1 \right] \text{ in env. } \text{ --- } \left[\begin{array}{c} + \text{ cns} \\ + \text{ voc} \\ \left\{ \begin{array}{c} + \text{ cnt} \\ - \text{ cnt} \end{array} \right\}_1 \end{array} \right]$$

would make a vowel rounded before [l] and low before [r].

2. Parentheses denote an optionally present element.

Thus a rule with the environment $\text{---}([+ \text{ nas}])\#$ applies to any segment which is either word-final or separated from

a following word-boundary only by a nasal segment.

Parentheses thus appear to be a special case of disjunction, namely disjunction in which one of the terms is null, so that a rule $A(B)C$ could be written as either $A\left\{\begin{matrix} B \\ \emptyset \end{matrix}\right\}C$ or as $A\left\{\begin{matrix} \emptyset \\ B \end{matrix}\right\}C$. It makes a difference whether the B or the \emptyset comes first, since a rule containing curly brackets is equivalent to an ordered set of rules. One might then suspect that a need would arise for two kinds of "parentheses": one corresponding to a situation in which a rule applies first when an optional element is present and then when it is absent, and the other corresponding to the opposite order of application. However, I have yet to find an instance in which the latter type of parentheses was needed; all cases known to me in which the order of the subrules mattered are of the former type: first the rule applies to items containing the optional element, then to items lacking it. For example, the English "auxiliary attraction rule", which moves a constituent of the form Tense & $\left\{\begin{matrix} \text{Modal} \\ \text{be} \\ \text{have} \end{matrix}\right\}$ to the beginning of an interrogative sentence, is equivalent to a sequence of two rules:

- a. prepose Tense & $\left\{\begin{matrix} \text{Modal} \\ \text{be} \\ \text{have} \end{matrix}\right\}$
- b. prepose Tense

which must apply in the order ab, since if (b) were to apply before (a), then (a) would never apply ((b) would separate Tense from a following Modal, be, or have), and

such ungrammatical items as

- *Does John be here?
- *Do you have been feeling well lately?
- *Did he can do it?

would result.

Now consider the following rule in the Nagasaki dialect of Japanese: in a phrase of a certain type, the 2nd syllable becomes high-pitched if there are more than two syllables, but if there are only two syllables, the first syllable becomes high-pitched. Using S to denote "syllable", one would be tempted to write the simple rule

- (1) $S \rightarrow [+ \text{high pitch}]$ in env. $\#(S)___S$.

The subrule

- (a) $S \rightarrow [+ \text{high pitch}]$ in env. $\# S ___ S$

would make the second syllable high-pitched if there are at least three syllables, and the subrule

- (b) $S \rightarrow [+ \text{high pitch}]$ in env. $\# ___ S$

would make the first syllable high-pitched in 2-syllable phrases. The trouble arises, however, that 2-syllable phrases are not the only ones whose first syllable would become high-pitched if (1) is interpreted as meaning the ordered sequence (a, b): (b) would apply even if there were more than two syllables, so that incorrect forms with ~~both the first and second syllables high-pitched would arise.~~ Situations such as this are found in all sorts of languages, for example, situations in which an accentuation rule

basically involves an environment of 2 or 3 syllables but also applies even when less than that number of syllables are present. In all these cases, the relevant rule could be stated very simply if the use of parentheses were interpreted as meaning that where the parenthesized element is present, only the "long" option of the rule applies. Such a convention would allow one to say that the stress goes on the antepenultimate syllable of a word of 3 syllables or more and on the first syllable of a 1 or 2 syllable word through the single rule

(2) $S \rightarrow [+ \text{stress}]$ in env. $\underline{\quad} (S)(S)\#$

instead of the 3-part rule

(3) $S \rightarrow [+ \text{stress}]$ in env. $\left\{ \begin{array}{l} \underline{\quad} S S \# \\ \# \underline{\quad} S \# \\ \# \underline{\quad} \# \end{array} \right\}$

which would otherwise be needed. Since there are virtually no cases in which a convention that interpreted P(Q)R as merely an ordered sequence of rules

PQR

PR

(which in principle could both apply to the same item) would allow any simplification of rules which could not be got with the above convention, I will adopt the latter.

The convention which I am adopting is really a special case of the well-known principle in syntax that a rule

applies only to the "largest" items which satisfy its analysis, in the sense that if a transformation were to apply to structures analyzable as, say, X-NP-VP-D_{man} and a given sentence were of the form NP-VP-D_{man}, with the noun-phrase itself containing a noun-phrase, only the outermost noun-phrase (the one containing the smaller noun-phrase) would be interpreted as meeting the analysis of the rule.

3. Greek letters are used to denote variables which range over values of phonological features. The device of variables is essential for stating rules of assimilation and dissimilation. For example,

$$[+ \text{cns}] \rightarrow [\alpha \text{shp}] \text{ in env. } \text{---} [\bar{\alpha} \text{cns}]$$

says that consonants become palatalized before front vowels and plain before back vowels, and

$$\begin{bmatrix} + \text{obs} \\ - \text{grv} \end{bmatrix} \rightarrow [-\alpha \text{cnt}] \text{ in env. } \begin{bmatrix} + \text{obs} \\ \alpha \text{cnt} \end{bmatrix} \text{---}$$

is a dissimilation rule by which a dental obstruent becomes a continuant ([s] or [z]) after a stop and becomes a stop ([t] or [d]) after a spirant. A rule

$$\begin{bmatrix} + \text{voc} \\ - \text{cns} \\ \alpha \text{grv} \end{bmatrix} \rightarrow [+ \text{dif}] \text{ in env. } \text{---} \begin{bmatrix} - \text{voc} \\ - \text{cns} \\ \alpha \text{flt} \end{bmatrix}$$

raises the first member of a back-vowel-plus-[w] or front-vowel-plus-[y] diphthong but leaves other diphthongs unaffected (i.e., it only applies when the graveness value of the vowel agrees with the flatness value of the glide).

4. \emptyset is used to denote the absence of a segment. It appears in rules of insertion and deletion:

$\emptyset \rightarrow \begin{bmatrix} - & \text{cns} \\ - & \text{grv} \\ + & \text{dif} \end{bmatrix}$ in env. $\begin{bmatrix} + & \text{obs} \\ + & \text{cnt} \end{bmatrix}$ ___ & [+ cns]
 inserts [i] at the end of a morpheme (& means morpheme boundary) ending in a spirant which is followed by a morpheme beginning with a consonant. The rule as given (which is an actual rule of Japanese) makes the inserted vowel part of the first morpheme. If I had written the environment as $\begin{bmatrix} + & \text{obs} \\ + & \text{cnt} \end{bmatrix}$ & ___ [+ cns], it would have become part of the second morpheme, and if I had written $\begin{bmatrix} + & \text{obs} \\ + & \text{cnt} \end{bmatrix}$ & ___ & [+ cnt], it would function as a separate morpheme. A rule

$\begin{bmatrix} - & \text{cns} \\ + & \text{dif} \end{bmatrix} \rightarrow \emptyset$ in env. $\begin{bmatrix} + & \text{obs} \\ - & \text{voice} \end{bmatrix}$ ___ #
 would delete final high vowels which are preceded by a voiceless obstruent.

5. In addition to referring to phonological information, (the feature composition of segments, boundary markers), phonological rules may refer to information carried by a morpheme as a whole or by some larger syntactic unit. This information may be of two types: categorial and classificatory; categorial information is the information that an item is analyzable as some node in an immediate constituent structure, say, that the item is a noun-phrase; classificatory information relates to the subclassification of certain items according to features which may relate to

grammatical co-occurrence relations (e.g., the information that a verb is transitive) or lexical co-occurrence relations (e.g., the information that a verb takes an animate object) or phonological behavior (e.g., the information that a verb forms its past tense by ablaut or that a morpheme belongs to the "native" stratum of vocabulary). Every node in an IC structure will carry exactly one item of categorial information. Classificatory information is carried only by those nodes which either directly dominate a lexical item or are filled by an item created by a "derivational" process such as compounding; thus the only case in which a node carrying classificatory information dominates another node carrying classificatory information is that in which the former node corresponds to an item derived or compounded from the item under the latter node. The classificatory information carried by a node is in the form of a set of features (generally binary), to which all the conventions relating to phonological features (e.g., the use of Greek letters as variables) will apply; note that unlike categorial information, a node can carry an arbitrary amount of classificatory information.¹²

The following are some examples of the format of rules involving syntactic information:

¹²) These questions are discussed in detail in sec.

2.2.3 and 4.2 of Chomsky [3].

[] \rightarrow [- shp] in env. _____)Adj-stem ,
 which makes the final segment of an adjective stem non-
 sharp. The symbol)Adj-stem means "end of a constituent
 corresponding to the node Adj-stem"; similarly, Adj-stem(
 denotes the beginning of such a constituent. A rule

[^{+ cns}_{- nas}] \rightarrow [+ obs] in env. + Native (_____
 would make a non-nasal consonant an obstruent (i.e.,
 exclude a liquid) at the beginning of "native" morphemes.
 Such a rule could occur in a language where it made sense
 to divide morphemes into two or more strata which behave
 differently; such a division may agree in gross outlines
 with the historical origin of the morphemes, but generally
 will not coincide with it, so that for synchronic purposes
 many loan words may function as "native vocabulary" .

I will make the convention of writing rules which have
 classificatory syntactic features written as if they were
 part of a phonological segment, e.g., [^{+ cns}_{- voc}^{+ native}]. Such a
 symbol is to be interpreted as meaning a

[^{+ cns}_{- voc}] segment which is contained in a morpheme marked
 [+ native]. Thus one piece of syntactic information may be
 referred to in 3 ways: by referring to a left parenthesis
 or to a right parenthesis or to a segment of the item:

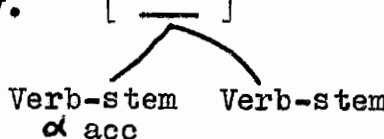
+ native ([+ cns] _____
 [+ nas] _____)+ foreign

[
 - cns
 + voc
 + onomatopoeia
]

The information in question is, of course, neither "part of the parenthesis" nor "part of the segment", but belongs to the entire syntactic node of which the parenthesis marks the boundary.

I will also allow rules which alter classificatory syntactic features, for example, the following rule of Japanese:

Verb-stem \rightarrow [- α acc] in env. $[\text{---}]$



This rule states that if a verb stem is composed of a sequence of two verb stems, it acquires the opposite accentuation to its first component (assuming that verb stems are marked as either accented or unaccented, as will be the case in Japanese). This rule will convert the Japanese item

	Verb-stem		Verb-stem		Verb-stem		Verb-stem
							
	Verb-stem	Verb-stem	into	Verb-stem	Verb-stem	Verb-stem	Verb-stem
	- acc	+ acc		- acc	+ acc	- acc	+ acc
	nozok	mi		nozok	mi	nozok	mi

corresponding to the fact that the compound verb nozokimi'ru is accented. In view of the remarks above concerning which nodes may carry syntactic inflexional features, such rules will only occur in instances of derivational morphology (including compounding). Rules of this type are a natural device to handle the fact that

derived words can be classified in exactly the same way as can simple words, and that the features relating to the behavior of a derived word are generally predictable from the corresponding features of the items from which it is derived.

1.3.3 Junctural elements

Most American linguists recognize phonetic and/or phonemic elements of "juncture" which are "segmental" in the sense that an utterance is represented as a sequence of items of which some are ordinary segments and others are "junctures" (e.g., /buk+šap#/ , where the + and # are junctures), in contrast to the true supra-segmental items of stress and pitch, which generally are not regarded as entering into linear sequences with ordinary segments (so that there are few linguists who would be willing to represent an utterance as a sequence of items of which the first is /p/, the second high pitch, the third primary stress, the fourth /o/, etc.).

There are two aspects of this viewpoint which could be contested: the notion of juncture as a phonetic/phonemic (rather than morphophonemic) entity and the segmentalness of juncture. Chomsky, Halle, and Lukoff's paper, "Stress and Juncture in English"¹³ and Halle's "Sound Pattern of

¹³) For Roman Jakobson, the Hague, 1956, pp. 65-80.

Russian" contest the first of these positions by treating junctures as merely markers of syntactic boundaries which have phonetic correlates only to the extent that some phonological rules will apply and others not apply at or across such boundaries. This position is also implicit in Jakobson's "Russian Conjugation" of 1948. In particular, Chomsky and Halle do not admit junctures in the phonetic representation of an utterance: the acoustic correlates of juncture such as length, tenseness, etc. of surrounding segments are simply marked in the feature representations of those segments in the phonetic representation, and no reference to juncture appears. Thus Chomsky and Halle's conception of the place of juncture in a grammar is as follows:

1. Junctures are introduced at various syntactic boundaries by rules (this implies that a juncture can not occur within a morpheme but only at a morpheme boundary).
2. Phonological rules may refer to these junctures.
3. At the end of the grammar, all junctures are erased.

However, Chomsky and Halle retain the position that juncture is segmental in that when a rule ^{has} an analysis of, say, [+ nas][+ cns], they interpret it as not applying to a sequence in which a juncture intervenes between the [+ nas] segment and the [+ cns] segment. They thus claim

that a juncture will inhibit the action of a rule unless specific provision is made to allow the rule to apply, so that if a rule is to apply regardless of the presence or absence of juncture, then it must be written with a parenthesized junctural element at the place where the juncture may be either present or absent; for example, a rule which assimilates nasals to the point of articulation of the following consonant even when a #-juncture intervenes would have to be written

A. $[+ \text{nas}] \rightarrow \left[\begin{array}{l} \alpha \text{ grv} \\ \beta \text{ cmp} \end{array} \right]$ in env. $\text{---} (\#) \left[\begin{array}{l} + \text{cns} \\ \alpha \text{ grv} \\ \beta \text{ cmp} \end{array} \right]$

If the assimilation did not take place when the # intervened, Chomsky and Halle would then simply write

B. $[+ \text{nas}] \rightarrow \left[\begin{array}{l} \alpha \text{ grv} \\ \beta \text{ cmp} \end{array} \right]$ in env. $\text{---} \left[\begin{array}{l} + \text{cns} \\ \alpha \text{ grv} \\ \beta \text{ cmp} \end{array} \right]$

Note that the more general rule (A) is more complicated than the less general rule (B). Chomsky and Halle are thus implicitly claiming that in this situation greater generality does not correspond to greater simplicity. While such a claim could conceivably be justified, perhaps by showing that languages have a ^{greater} tendency to replace a rule of type (A) by one of type (B) than vice versa, no such justification has yet been given. In the absence of such justification, serious consideration should be given to the possibility that this ~~claim~~ of Chomsky and Halle's may be wrong, in which case the theory would have to be revised so that the situation of (A) would correspond to a shorter rule than that of (B) would. In the remainder of this ~~dissertation~~, I will develop such an alternative approach to juncture, which

I will then apply in the body of this dissertation to the description of Japanese.

My alternative approach, like Chomsky and Halle's approach, is based on the fact that the phonetic difference between those utterances traditionally transcribed with "internal open juncture" and those without it is that in the former the segments adjacent to the "juncture" exhibit phonetic similarities to initial and final segments which medial segments without juncture do not; this has been demonstrated quite thoroughly by Ilse Lehiste.¹⁴ This means that certain rules which affect initial (final) segments will also affect post-junctural (pre-junctural) segments and certain rules which affect medial segments will not affect segments adjacent to a juncture. I choose to explain this simply by saying that the juncture gives the limits of

14) "An Acoustic-Phonetic Study of Internal Open Juncture" (suppl. to *Phonetica*, vol. 5). In view of the fact that in many cases final segments in English are longer than the corresponding medial segments, it is understandable how Joos could come to the conclusion that juncture corresponds acoustically to a delay within the utterance ("The Definition of Juncture and Terminals", 2nd Texas Conference); however, Lehiste demonstrates quite conclusively that such is not the case in general and, indeed, that there is no constant acoustic property which can be correlated with all instances of "internal open juncture".

the stretches of utterance to which certain rules apply. Thus, suppose that there is a rule in some language that intervocalic /t/ becomes a voiced flap but not when a juncture # intervenes, and that there is an utterance #pat#atak#. In that utterance, of course, the first /t/ will remain /t/ but the second will become [D]. For me, this corresponds to the rule applying separately to the two chunks #pat# and #atak#: in the second chunk the /t/ is intervocalic, but not in the first. For Chomsky and Halle, the utterance is treated as a whole rather than as two chunks, and the inapplicability of the rule to the first /t/ is explained by saying that /at#a/ does not satisfy the analysis $[- \text{cns}][\text{ }_{-}^{+} \text{obs}][\text{ }_{-}^{\text{grv}} \text{cns}]$ (say) of the rule.

So far I have been acting as if a language could only contain one junctural element. However, a language may indeed have several junctural elements. For example, in Japanese I will show the necessity of assuming the existence of distinct junctural elements # and ; , corresponding to the fact that such rules as the p → h rule and the h-deletion rule apply to different-sized stretches of utterance. The p → h rule operates on chunks bounded by #-juncture and the h-deletion rule on chunks bounded by :-juncture, so that in an utterance #ze:pi#, the /p/ will be subject to the p → h rule but the /h/ created by that rule will not be subject

to the h-deletion rule, since that rule operates separately on the two chunks #ze: and :hi#, and the /h/ is not intervocalic -- as the rule requires -- within the chunk ;hi#.

In the few languages whose junctural phenomena I have considered, the junctures form a hierarchy in the sense that there is an order relationship among them under which any occurrence of a juncture also counts as an occurrence of all weaker junctures, so that in the above example, any occurrence of # also counts as an occurrence of : . If the term rank of a rule is used to indicate the juncture defining the stretches over which the rule operates, then an utterance of the form #A:B#C#D:E# would be split into the chunks AB, C, and DE by a rule of rank #, and into the chunks A, B, C, D, and E by a rule of rank : (since the #'s between B and C and between C and D also count as : 's). Similarly, a rule which inserts an [i] after a consonant which is followed by : will also apply when the consonant is followed by # (precisely this rule is given in the section on verb inflection).

Since all junctures are assumed to occur at a morpheme boundary, morpheme boundary & will be the lowest member of the junctural hierarchy; the highest member of the junctural hierarchy will be pause, written §. A rule will be taken to be of rank § unless it is specifically assigned a lower

rank. The rank of a urule will be interpreted as adding to the complexity of the rule only when it has to be marked (i.e., only when it is lower than #), so that of the two nasal assimilation rules given earlier, (A) will now be "shorter than" (B):

$$\begin{array}{l}
 \text{A.} \quad [+ \text{ nas}] \rightarrow \begin{bmatrix} \alpha \text{ grv} \\ \beta \text{ cmp} \end{bmatrix} \text{ in env. } \text{---} \begin{bmatrix} + \text{ cns} \\ \alpha \text{ grv} \\ \beta \text{ cmp} \end{bmatrix} \\
 \text{B. rank \#} \quad [+ \text{ nas}] \rightarrow \begin{bmatrix} \alpha \text{ grv} \\ \beta \text{ cmp} \end{bmatrix} \text{ in env. } \text{---} \begin{bmatrix} + \text{ cns} \\ \alpha \text{ grv} \\ \beta \text{ cmp} \end{bmatrix}
 \end{array}$$

Since a juncture-J is now interpreted as merely a place where rules of rank J or higher divide the utterance into pieces, the presence of a lower juncture in one of the pieces will not inhibit the operation of the rule. Thus the rule that intervocalic /p/ becomes /h/, which is of rank #, will apply to the /p/ of #ze:pi# even though there is a : before the /p/. Thus the analysis of a rule cannot require the absence of a juncture. However, it may require the presence of a juncture, as in the case of the rule quoted above which inserts an [i] at a morpheme boundary which is preceded by a spirant and followed by a consonant. My position thus generalizes the convention of Chomsky and Halle that a rule may not require the absence of morpheme boundary but may require its presence; moreover, that principle is now a consequence of the formal nature of juncture rather than being a seemingly ad-hoc extra condition on grammars, as it is in Chomsky and Halle's

---treatment of juncture.

1.3.4 Syllable and mora

Japanese utterances are traditionally analyzed as consisting of morae (onsetsu, ^h ~~h~~ ~~h~~), each mora consisting of either consonant plus vowel, or vowel alone, or "syllabic nasal", or "syllabic obstruent", so that hoo, hon, and ippon are respectively 2, 2, and 4 morae (ho-o, ho-n, i-p-po-n). The notion of "syllable" in the sense of a division which would take in both morae of a long vowel or a vowel plus "syllabic nasal" sequence is rarely used among Japanese linguists in describing standard Japanese.¹⁵

There are many reasons for considering morae as basic in standard Japanese. First of all, the meters of Japanese poetry are based on the number of morae per line; for example, several common meters involve alternating lines of 5 and 7 morae.¹⁶ Secondly, the two morae of a "long syllable" are each at least as long as a "short syllable". Thirdly, there are phonological rules which depend on the number of morae (for example, in a certain class of loan words, the accent is put 3 morae from the end), but none to my knowledge which depend on the number of syllables.

Japanese thus deserves to be called a "morenzählende

¹⁵) ~~Although it often appears in descriptions of Japanese~~
dialects. See, for example, Shibata.

¹⁶) Han, p. 81.

Sprache" (mora-counting language), to use Trubetzkoy's term. However, the matter does not stop there, since, contrary to popular misconception, the fact that a language counts morae does not prevent syllables from playing an essential role in the language as well. While Japanese is certainly "morenzählend", it is not a "Morensprache" but rather a "morenzählende Silbensprache" (mora-counting syllable-language).¹⁷ While the rules of Japanese require one to count morae rather than syllables, the rules for assigning accent never put accent on the syllabic nasal or on the second mora of a long vowel. In cases where one might expect the accent to go on that mora, it actually appears on the preceding mora. Thus the rule to which I referred above only puts accent on the 3rd-from-last mora when that mora is neither the "syllabic nasal" nor the second mora of a diphthong or long vowel; if it is, the accent goes on the 4th-from-last mora. This statement could be simplified somewhat by using the notions of both syllable and mora together: accent is placed on the syllable containing the 3rd-from-last mora. Likewise, there are certain rules which affect "final-accented" words (for example, the rule that final-accented nouns lose their accent before the particle no); these rules

¹⁷) This felicitous designation and some of the following remarks were suggested to me by S.-Y. Kuroda.

apply to all words in which the next-to-last syllable is accented, even if the accent is then on the next-to-last mora.

Furthermore, in the classes of Japanese morphemes in which the location of accent is "free", the number of places where the accent could in principle occur equals the number of syllables, not the number of morae. The formal characterization of free accentuation in a language is that the dictionary entries for at least some classes of morphemes must be marked with the value of a feature which specifies the location of accent and whose possible values are the integers from 1 to n, where n is the length of the word, expressed in number of syllables or morae.¹⁸ In Japanese, n is the number of syllables, not the number of morae and when the accent location feature has the value i, the accent is on the i-th syllable, not the i-th mora.

Since the notion of syllable will be involved in any comprehensive treatment of Japanese accentology, it would be well at this point to take up the question of how the notion of syllable fits into generative phonology. The notion of syllable has been completely neglected in generative-phonological descriptions so far. In the places where one might expect the notion "syllable" to appear in a rule, Chomsky and Halle have instead just used formulas

¹⁸) I will modify this statement somewhat in chapter III.

like $C_1 V_1 C_0$, for example, writing $V \rightarrow [+acc]$ in env. $\text{--- } C_1 V_1 C_0 \#$ to mean that the next-to-last syllable of a word gets accented.¹⁹ However, there are two objections which may be raised against such a practise. First of all, it is inefficient, since it forces one to restate the definition of syllable in every rule which involves the notion. Secondly, it is not clear that it will always work, at least not without considerably complicating the rules, since while early in the rules syllable divisions may be definable by a simple formula like $C_1 V_1$ (which would imply that consecutive vowels always belong to the same syllable), later rules may increase the number of possible syllable shapes and complicate the expression needed to specify the location of syllable boundaries; if a consonant deletion rule creates consecutive vowels belonging to separate syllables which contrast with monosyllabic diphthongs, no formula whatever will work if it is necessary to refer to syllables after that rule has applied.

I thus conclude that the fact that in some cases one can get along with writing $\text{--- } C_1 V_1 C_0 \#$ to mean "in the penultimate syllable" is fortuitous and that in the general situation one will have to be able to write rules which

¹⁹) Subscripted numerals mean "at least so-and-so many"; thus $C_0 V_2 C_1$ would mean any number of consonants (possibly none) followed by at least two vowels and at least one consonant.

refer directly to syllables.

The general problem of defining syllable boundaries is rather complicated, in view of the existence of cases such as the English word "butter" where one could argue²⁰ that the syllable boundary (if such a thing indeed exists) would have to occur within a segment rather than between segments. In the general case, all that can be said for sure is that each utterance will be representable as a sequence of syllables and each syllable will correspond to a vowel (or "syllabic consonant") or vowel sequence of the utterance; but the syllable representation might not be a decomposition of the segment representation, since, for example, the syllables might overlap each other. However, in the case of standard Japanese such problems do not arise: there is universal agreement as to the existence and location of mora boundaries, and a syllable will be a sequence of two morae when the second mora is a vowel or "syllabic nasal", otherwise a single mora. The above statement can be translated into a ~~rule~~ statement for the insertion of syllable boundary, and a syllable will be whatever is contained between two consecutive syllable boundaries. It will be necessary to have a facility for

²⁰) As does Hockett in [2], p. 52.

referring to syllables and features of syllables. I will use a capital S to denote "syllable" and will admit rules such as

$$[\begin{smallmatrix} + \text{voc} \\ - \text{cns} \end{smallmatrix}] \rightarrow \emptyset \quad \text{in env. } \text{---} \overset{\text{S}}{+ \text{acc}}$$

(which deletes a vowel before an accented syllable)

$$\text{S} \rightarrow [\text{3 stress}] \quad \text{in env. } \text{---} \overset{\text{S}}{\text{S}} \underset{\text{1 stress}}{\text{---}}$$

(which puts stress on a syllable two before a primary stress). Syllable features will be subject to the same convention as morpheme features that a feature belonging to the morpheme (syllable) can be referred to as if it belonged to one of the segments of that morpheme (syllable).

Thus a rule

$$[\begin{smallmatrix} + \text{voc} \\ - \text{cns} \end{smallmatrix}] \rightarrow [+ \text{acc}] \quad \text{in env. } \text{---} (\text{C})\text{V}(\text{C})\text{V}\#$$

will mean "put accent on the syllable which contains the 3rd-from-last mora".

1.4 The structure of the phonological component

1.4.1 Morpheme structure rules and phonological rules.

The phonological component of a transformational grammar consists of two sets of rules: morpheme structure (MS) rules and phonological rules.²¹

Morpheme structure rules fill in feature specifications left blank in dictionary entries. For example, the constraint mentioned above that the only initial consonant clusters (more precisely, $[+ \text{cns}] [\begin{smallmatrix} + \text{cns} \\ - \text{voc} \end{smallmatrix}]$ sequences) in English have

²¹) Halle [1].

/s/ for the first segment and a stop or nasal for the second segment corresponds to a pair of rules:

$$[+ \text{cns}] \rightarrow \left[\begin{array}{l} + \text{ obs} \\ + \text{ cnt} \\ - \text{ grv} \\ - \text{ voice} \end{array} \right] \text{ in env. } \& \text{ ______ } [+ \text{cns}]$$

$$[- \text{cns}] \rightarrow [- \text{cnt}] \text{ in env. } \& [+ \text{cns}] \text{ ______ }$$

This type of MS rule may be called a sequential constraint rule. The other possible type of MS rule is a context-free redundancy rule such as the rule that all obstruents in English are non-vocalic:

$$[+ \text{ obs}] \rightarrow [- \text{ voc}].$$

Morpheme structure rules operate on a dictionary entry, phonological rules operate on an utterance. A phonological rule may involve more than one morpheme at a time; indeed, Chomsky has often made the assertion²² that phonological rules can not be restricted to applying only within a morpheme (which is to say that there are no phonological rules of rank &). Following Chomsky and Halle, I will regard the phonological rules as forming three groups: pre-cycle rules, the cycle, and post-cycle rules. The cycle (if there indeed is any: there may well be many languages which do not have cycles) consists of an ordered sequence of rules abc...f which apply in cyclic fashion: first the rules abc...f apply to the innermost syntactic constituents, then they apply to the next

²²) Lectures in various courses at M.I.T.

larger constituents, etc. For example, consider the stress rules in English:

a. in a noun, lower all stresses but the first primary stress.

b. in a noun-phrase, lower all stresses but the last primary stress.²³

When applied to the structures $((\text{small}^1 \& \text{boy}^1 \& \text{s})_{\text{NP}} \text{school}^1)_{\text{N}}$ and $(\text{small}^1 (\text{boy}^1 \& \text{s} \& \text{school}^1)_{\text{N}})_{\text{NP}}$, these rules first apply to the innermost constituents $(\text{small}^1 \& \text{boy}^1 \& \text{s})_{\text{NP}}$ and $(\text{boy}^1 \& \text{s} \& \text{school}^1)_{\text{N}}$, yielding $(\text{small}^2 \& \text{boy}^1 \& \text{s})_{\text{NP}}$ and $(\text{boy}^1 \& \text{s} \& \text{school}^2)_{\text{N}}$ respectively (N.B. the superscript numerals denote degrees of stress, not pitch). They then apply to the next larger constituents, $(\text{small}^2 \& \text{boy}^1 \& \text{s} \& \text{school}^1)_{\text{N}}$ and $(\text{small}^1 \& \text{boy}^1 \& \text{s} \& \text{school}^2)_{\text{NP}}$, yielding $(\text{small}^3 \& \text{boy}^1 \& \text{s} \& \text{school}^2)_{\text{N}}$ (= school for small boys) and $(\text{small}^2 \& \text{boy}^1 \& \text{s} \& \text{school}^3)_{\text{NP}}$ (= small school for boys) respectively.²⁴ It will be noted that these rules may be restricted to a particular syntactic category, so that a rule such as (a) above will apply only to nouns. However, the only categorial information which is ever involved in a rule of the cycle is the category to which the constituent being operated on belongs to; thus when the cycle applied to the constituent

²³) The actual cycle involves much more than these two rules. See Halle and Chomsky, "The Sound Pattern of English".

²⁴) The 3-1-2 stress on the former is changed into 3-1-3 by a post-cycle rule.

"small boys'", rule (b) could make use of the fact that ~~that~~ constituent is a noun-phrase; however, a rule could not refer to the fact that it contained a smaller constituent which is a noun or that it was part of a larger constituent which is also a noun. Furthermore, no case has ever been recorded in which there was reason for a post-cycle rule to refer to either syntactic categorial information or immediate constituent structure.²⁵ As a result of these circumstances, the cycle can be assumed to eliminate the immediate constituent structure and the labels of the syntactic categories. If immediate constituent structure is represented by parentheses, as in the "small boys' school" example, this could be formalized very simply by saying that the last rule of the cycle must always be

c. Erase the parentheses around the constituent being operated on.

Thus the derivation of the stress pattern on "small boys' school = school for small boys" could be presented in greater detail as follows:

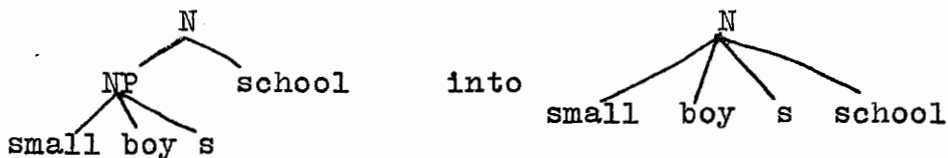
²⁵) However, they may refer to classificatory information about morphemes, such as the fact that a morpheme is "[+ native]". Thus the classificatory information about individual morphemes is not erased.

((small¹ & boy¹ & s)_{NP} school¹)_N

- a. no effect
 b. ((small² & boy¹ & s)_{NP} school¹)_N
 c. (small² & boy¹ & s & school¹)_N

- a. (small³ & boy¹ & s & school²)_N
 b. no effect
 c. small³ & boy¹ & s & school²

If one wishes to state rule (c) in terms of tree diagrams rather than parentheses, the rule would state that at the conclusion of each pass through the cycle, the node corresponding to the constituent being operated on is removed and all nodes which were connected to it become connected to the node above it, so that in the above example the first application of rule (c) would convert



Thus, at the conclusion of the final pass through the cycle, all that remains will be a string of nodes (one node per "morph") connected to a single higher node:



Thus the only information in the IC structure which will remain after the cycle is the location of morpheme boundaries.

1.4.2 The evaluation measure

The discussion on the preceding few pages has given a rough answer to the question of what a phonological component is. If the answer to that question is coupled with answers to the corresponding questions about the other components of a grammar, what results is an answer to the question "What is a grammar?". From among the set of all possible grammars, one can single out the possible grammars of some particular language, say, Japanese: these will be the grammars which are consistent with the data available about the linguistic competence of speakers of Japanese (the data include more than just a corpus of acceptable utterances and an "anti-corpus" of unacceptable utterances: they include judgements of synonymy, ambiguity, relatedness, etc.). To pick from the possible grammars of Japanese that grammar which is to be regarded as the grammar of Japanese requires an evaluation measure.

An evaluation measure is a relation between grammars which asserts that one grammar G_1 is "more highly valued" than another grammar G_2 . I will restrict my attention to those evaluation measures in which a numerical "measure of complexity" is associated to each grammar by some procedure in which the symbols in a formalized representa*

tion of the grammar are counted and one grammar is said to be more highly valued than another if it has a smaller "measure of complexity". Moreover, I will assume the syntactic component of the language to be given in advance and merely apply the notion of "evaluation measure" to the phonological component.

The evaluation measure given in Halle's "Sound Pattern of Russian" measures the complexity of the phonological component of a grammar as the total number of feature specifications used in writing it out; since Halle at that time regarded the lexicon of the language as part of the phonological component, the measure of complexity would then be the total number of feature specifications which appear in either rules or dictionary entries. It must be kept in mind that this count of symbols refers to a grammar written out in a fixed format, in this case, a grammar whose dictionary entries are matrices of pluses, minuses, and blanks for the Jakobsonian features, and whose rules are of the form discussed above, in which the conventions discussed for brackets, parentheses, etc. are observed but no other notational conventions or abbreviations are admitted.

One highly interesting idea contained in this evaluation procedure is that "accidental gaps" in the

lexicon can be distinguished from "systematic non-occurrence" by a completely formal criterion. To cite Halle's celebrated example, there is an English word /brik/ but there are no such words as */blik/ or */ftik/. Linguists generally regard */blik/ as a perfectly possible morpheme which just doesn't happen to occur in the lexicon but regard */ftik/ as not "phonologically well-formed". Halle argues that the "ill-formedness" of */ftik/ corresponds to the fact that if */ftik/ were to be admitted as a possible morpheme, then the first segment of such morphemes as /stik/ would have to be marked with sufficient information to distinguish it from the /f/ of */ftik/. Compare a grammar in which such information is marked in the dictionary entries with a grammar in which the first segment of /stik/ etc. is simply marked [+ cns] and the grammar contains the morpheme structure rule

$$[+ \text{ cns}] \rightarrow [- \text{ grv}] \text{ in env. } \& \text{ ______ } \left[\begin{array}{c} + \text{ cns} \\ - \text{ voc} \end{array} \right].$$

This rule takes 5 feature specifications to state (counting the & as one feature specification) but allows the [- grv] specification to be omitted from the first segment of the dictionary entries of all morphemes beginning with /st/; since there are more than 55 such morphemes in the language, the grammar which leaves out the gravity specification and fills it in by a morpheme structure rule will contain less feature specifications than

and thus will be preferred to the grammar which admits */ftik/ as a possible morpheme. Now consider a grammar G_1 in which /blik/ is considered to be a possible morpheme, so that the second segment of /brik/ will then have to be marked with enough information to distinguish it from the /l/ of /blik/, i.e., it will have to be marked [+ cmp]²⁶ in addition to the feature specifications which the /r/ and the /l/ would share, and a grammar G_2 in which */blik/ would not be considered well-formed. In G_2 the second segment of /brik/ would not be marked for compactness and there would be a morpheme-structure rule which would insert a feature specification of [+ cmp] into it. But such a rule would necessarily be quite complicated: it would have to require that the segment which it makes compact be followed by a lax high front vowel (since /l/ can occur if the vowel is either tense: bleed, or back: blue, or non-high: bland) which is in turn followed by a grave obstruent (since /l/ can occur if that segment is either non-grave: blister, or a sonorant: blink), and that it be preceded by a voiced labial consonant (since /l/ can occur if the preceding segment is either non-labial: click, or voiceless: Plimsoll) which is in turn followed by a morpheme boundary (since /l/ can occur if there is no

²⁶) Assuming that in English /l/ is [- cmp] and /r/ [+ cmp].

morpheme boundary: public). Thus the simplest possible morpheme structure rule in G_2 to make the second segment of /brik/ compact would be

$$[+ \text{cns}] \rightarrow [+ \text{cmp}] \quad \text{in env. \& } \begin{bmatrix} + \text{cns} \\ + \text{voic} \\ - \text{cmp} \end{bmatrix} \text{---} \begin{bmatrix} + \text{dif} \\ - \text{grv} \\ + \text{tns} \end{bmatrix} \begin{bmatrix} + \text{obs} \\ + \text{grv} \end{bmatrix},$$

which takes 11 feature specifications to state. While the morpheme structure rules of G_2 will thus cost 11 units of complexity more than do those of G_1 , the dictionary of G_2 will be only one unit less complex, since the only morpheme which will be represented differently in the two dictionaries is /brik/. Thus G_2 is 10 units more complex than G_1 , so that G_1 will be preferred to G_2 .

However, there are also some cases in which the evaluation measure as presented in "Sound Pattern of Russian" yields counterintuitive results, notably the following example constructed by T. M. Lightner. Suppose that in some language all morphemes have underlying forms with a uniform CVCV... shape and that the most common vowel in the first syllable of a morpheme is /e/, there being 381 morphemes with /e/ in the first syllable out of a total of 1000 morphemes in the whole language. Let G_1 be a grammar in which morphemes are represented in their usual CVCV... shape and let G_2 be a grammar in which the /e/ is omitted from the first syllable of those dictionary entries which have it, so that instead of /tepu/ the dictionary would contain /tpu/. If it takes 3 feature

specifications to distinguish /e/ from the other vowels, then the /e/'s which have been omitted account for $381 \times 3 = 1143$ units of complexity. In the dictionary forms of G_2 it will be necessary to mark whether the second segment of each dictionary ^{entry} is a consonant or not, which is unnecessary in G_1 ; G_2 will have to have a rule which inserts /e/ when the second segment is a consonant; this rule takes 7 feature specifications to state. Thus G_2 will be less complex than G_1 by $1143 - 1000 - 7 = 136$ units and will be preferred to it. However, unless there is some morphophonemic alternation which demands an /e/-insertion rule, and I assume here that there is none, the "economy" of G_2 over G_1 is completely spurious: the omission of the /e/ from the dictionary entries clearly corresponds to no linguistic regularity whatever.

To exclude such spurious economies as this, Halle has proposed the following refinement of the evaluation measure (and of the definition of "grammar"): economy in the phonological rules is to take precedence over economy in the morpheme structure rules and dictionary, and morpheme structure rules are allowed only to fill in blanks (so that a rule which inserted a new segment, such as the /e/-insertion rule above, could not be a morpheme structure rule but only a phonological rule). Under this

new evaluation measure, G_2 contains all the phonological rules of G_1 plus the /e/-insertion rule; since its phonological rules are thus 7 units more complex, it is less highly valued than G_1 even though its lexicon is 143 units less complex. It should be noted that under this revised evaluation measure (of which I make use below), the morpheme structure rules are treated as part of the lexical component of the grammar rather than part of the phonological component, as has hitherto generally been assumed.

CHAPTER II

THE SEGMENTAL PHONOLOGY OF JAPANESE

2.1 The strata of vocabulary

Consider the following phonetic (not phonemic!) data:

	Present	Negative	Polite present
'wait'	macU	matanai	maćimasU

(c denotes the dental affricate [t^s], ć the palatalized dental stop, and capitalized vowel letters voiceless vowels). Accepting for the moment the segmentation of these forms into a stem [mac~mat~mać] plus a residue which can be identified with the appropriate inflectional or derivational morphemes, let me take up the questions of (1) what is the appropriate dictionary entry for the verb stem in question? and (2) what are the appropriate rules for deriving the given forms?

If a Japanese verb stem ends in a non-grave stop, that stop can only be [c] in the present, [t] in the negative, and [ć] in the polite present. Thus in the dictionary representation, the final segment of the stem need only be marked as $\begin{bmatrix} + & \text{cns} \\ + & \text{obs} \\ - & \text{cnt} \\ - & \text{grv} \end{bmatrix}$ to distinguish it from other verb stems; from this information it will be possible to predict the exact phonetic form which the stem takes in any environment.

This essentially answers the question about the appropriate underlying form. Now to the question of the rules. [t], [c], and [ć] differ only on the Jakobsonian

get non-sharp consonants before /i/ (e.g., [paatii] 'party'). The existence of such items implies that something other than rules 1-4 will have to be set up to predict the stem-final consonant in the paradigm of [macU].

Let me quickly consider and reject a number of possible solutions. The incorrect solution corresponding to rules 1-4 essentially involves taking the stem alternant in [t] as basic and saying that [t] becomes [c] or [č] in certain environments. What about taking one of the other alternants as basic, say, the one in [c], and saying that [c] becomes [č] or [t] in the relevant environments? This solution will, of course, work. However, the rules it would require are appreciably more complicated than they need to be. First of all, a rule would be needed to give you [c] to begin with (since all that is marked in the underlying form is that the final consonant is a non-grave stop):

$$0. \begin{bmatrix} + \text{ obs} \\ - \text{ grv} \\ - \text{ cnt} \end{bmatrix} \rightarrow [+ \text{ str}] \text{ in env. } \text{ ______ } \text{) Verb-stem}$$

Then there would be a rule saying that consonants become [- str] before [a] and a rule saying that strident stops become [+ shp] before [i]. However, the specification of stridency in the rules serves no other function than to mark that the consonant in question is at the end of a verb stem. If the sharpening rule were changed to the

equally simple rule that stops at the end of a verb stem become sharp before /i/, rule 0 would become superfluous, as would the rule about consonants becoming non-strident before /a/ (stridency would be predictable by the same rules as above, 2 and 4). Since (at least, at this stage of the analysis) verb stems are the only morphemes which end in a consonant, an even simpler solution would be just to have a rule saying that consonants become sharp in the environment ___ & /i/ (recall that & is morpheme boundary).

However, the improved solution thus obtained is still inadequate in that stem-final position is not the only position in which sharpness is predictable: indeed, anywhere in a verb, a consonant will be sharp if and only if it is followed by /i/. Thus the rule could be generalized from

$$[+ \text{ cns}] \rightarrow [+ \text{ shp}] \text{ in env. } \text{---} \& \begin{bmatrix} - \text{ cns} \\ - \text{ grv} \\ + \text{ dif} \end{bmatrix}$$

to

$$\begin{bmatrix} + \text{ cns} \\ + \text{ verb} \end{bmatrix} \rightarrow [+ \text{ shp}] \text{ in env. } \text{---} \begin{bmatrix} - \text{ cns} \\ - \text{ grv} \\ + \text{ dif} \end{bmatrix}$$

However, even this solution leaves something to be desired, since verbs are not the only category of morphemes in which sharpness is predictable: for example, it is also predictable in adjectives and enclitics. It would be possible to modify the last rule by replacing the specification [+ verb] by a list of the different categories in which sharpness occurs before /i/. But a much simpler solution

would be simply to return to the idea with which I started this discussion, namely that it is the native Japanese part of the vocabulary in which sharpness is predictable. What I mean is that every morpheme in the language should be supplied with a mark of [+ native] or [- native] and that the rule should be given as

$$[+ \text{cns} \atop + \text{native}] \rightarrow [+ \text{shp}] \text{ in env. } \text{---} \begin{bmatrix} - \text{cns} \\ - \text{grv} \\ + \text{dif} \end{bmatrix}$$

This solution not only simplifies the sharpness rule but also allows for many other simplifications in the grammar and lexicon, since there are a great many other phonological characteristics common to native morphemes besides the predictability of sharpness. Furthermore, while there are some syntactic categories which only contain phonologically native¹ morphemes (verbs, adjectives,

¹) Membership in the class corresponding to the feature [+ native] is based on synchronic considerations, not historical considerations. While there are a few Western loan elements which have become verb stems, e.g., demoru 'to demonstrate', they are phonologically indistinguishable from historically native items and would be marked [+ native]; similarly, the anecdote related in Martin [2] indicates that the loan word miruku 'milk' is phonologically native. Classifying morphemes into "native" and "non-native" on the basis of their phonological behavior is basically no

enclitics), most syntactic categories contain both native and non-native morphemes. Unless there is some way of distinguishing the native from the non-native members of these classes, it will be necessary to mark the native members with enough information to take care of all contrasts which can occur in the entire vocabulary, non-native as well as native; this would include the sharpness contrast, the g/ŋ contrast, and the p/φ/h contrast. I will show later that none of these contrasts need be marked in the dictionary entry of a native morpheme; thus marking a morpheme [+ native] allows one to omit from its dictionary entry all sharpness specifications, the nasality specification of velar stops, and the continuance specification of grave obstruents. If one were not to use the morpheme-feature of nativeness, these feature specifications could only be omitted from the representations of morphemes of those syntactic categories — — — different from classifying nouns into "first declension", "second declension", etc. on the basis of what their paradigms look like. If the Latin third declension consisted just of borrowings from Etruscan, one would be able to speak of "Etruscan nouns" instead of "third declension nouns". A description which used the former term would differ only terminologically from one which used the latter.

which fortuitously happen to contain only native morphemes.

I thus replace rules 1-4 by the following rules:

- 1a [] --> [- str]
- 1b [+ native] --> [- shp]
- 2 $\begin{bmatrix} + \text{ obs} \\ - \text{ grv} \\ + \text{ cnt} \end{bmatrix}$ --> [+ str]
- 3a $\begin{bmatrix} * \text{ cns} \\ + \text{ native} \end{bmatrix}$ --> [+ shp] in env. — $\begin{bmatrix} - \text{ cns} \\ + \text{ dif} \\ - \text{ grv} \end{bmatrix}$
- 4 $\begin{bmatrix} + \text{ obs} \\ - \text{ grv} \end{bmatrix}$ --> [+ str] in env. — $\begin{bmatrix} - \text{ cns} \\ + \text{ dif} \\ + \text{ grv} \end{bmatrix}$

It actually will be necessary to split the vocabulary up into four parts, not two: native, Sino-Japanese, onomatopoeia², and foreign. To see this, consider the behavior of [p], [h], and [ɸ] (which I will henceforth write as [f] for ease of typing). In foreign morphemes these three items are mutually contrastive: [paatii] 'party', [haapu] 'harp', [faʃizumu] 'fascism'. In onomatopoeia, [h] and [f] do not contrast, since [f] occurs only before [u] and [h] only elsewhere; but h/f contrasts with [p]: harahara 'trembling', parapara 'falling in drops'.

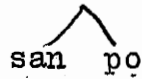
²) For want of a better term, I will use with some reluctance the traditional designation "onomatopoeia". Japanese "onomatopoeia" differ from English onomatopoeia in that they are adverbs and may refer to any aspect (visual, emotional, etc.) rather than just the sound of the activity involved.

In the remaining categories (Sino-Japanese and native morphemes), there is no need to distinguish between p, f, and h in the lexicon: they can all be represented the same way and rules given which will correctly predict whether a given occurrence of the item in question will be pronounced [p], [h], or [f]. First of all, [h] and [f] stand in the same complementary distribution as in the case of onomatopoeia: [f] only before [u], [h] only elsewhere. In the morpheme classes under discussion, [p] occurs only geminate or after the "syllabic nasal". If h/f were impossible in those two positions, my conclusion would be established. In reality, however, h/f can follow the syllabic nasal, so that [p] and [h/f] are not in "phonemic" complementary distribution. But while the phonetic environment is not sufficient to decide whether a segment preceded by the syllabic nasal will be [p] or [h/f], if one is allowed to look at the syntactic environment as well, he can tell whether [p] or [h/f] will arise. Specifically, except for numeral compounds with yon 'four' (e.g., yonhiki 'four (animals)') and reduplications like hanhan 'half and half', [p] occurs after the syllabic nasal precisely when the [np] combination is in the "innermost layer of compounding". Thus one gets [p] in the following compounds:

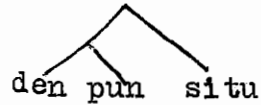
compound

IC structure

sanpo 'stroll'



denpunsitu 'starchy matter'



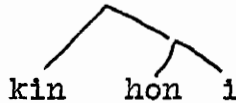
but [h] in the following compounds:

eizenhi 'cost of building
and repairing'

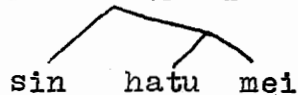
mannenhitu 'fountain pen'



kin-hon-i 'gold standard'



sinhatumei 'new invention'



From full syntactic information one thus can always predict whether a given segment will be realized as [p], [h], or [f].

In all four of these strata of vocabulary, the other voiceless non-sharp obstruents which it will be necessary to distinguish in dictionary entries will be t, s, and k. The complete system of voiceless obstruents for each stratum, together with a non-redundant set of feature specifications distinguishing between them in each case are as follows:

	native and Sino-Japanese				onomatopoeia				foreign						
	p	t	k	s	p	t	k	s	f/h	p	t	k	f	s	h
grv	+	-	+	-	+	-	+	-	+	+	-	+	+	-	+
dif	+		-		+		-		+	+		-	+		-
cnt		-		+	-	-			+	+		-	-	-	+

Note that for native and Sino-Japanese morphemes, continuance only needs to be marked for dentals; for onomatopoeia it must be marked for dentals and labials but is predictable for velars ([f/h] counts as a labial in the dictionary entries); for foreign morphemes it must be marked in all voiceless obstruents.

It is important to keep in mind throughout what will follow that while I am splitting the lexicon into four strata, I cannot split the grammar in four. Rules may, of course, make reference to the information as to which stratum of vocabulary a morpheme belongs to, but since morphemes of the different strata can combine with great freedom, the resulting rules must form one grammar and not four. Note in particular that a specification of [- foreign] in a rule refers only to that particular segment; the other segments to which the rule refers need not belong to that stratum of vocabulary.

2.2 Miscellaneous problems.

Before showing how the various segments are to be represented by features in the lexicon, I must first discuss some problems involved in the analysis. The first

of these is the problem of palatalization. The Hepburn system of romanization (which is used in virtually all romanized dictionaries and many textbooks) uses the symbols sh, ch, and j to denote palatalized dental obstruents. Phonetically these are identical to the Polish sounds written ś, ć, and dź in standard orthography. The Hepburn system in addition uses the combinations py, ky, by, gy, hy, my, ny, ry to denote palatalized counterparts of p, k, b, g, h, m, n, r. In the other systems of romanization which have any currency, the National Romanization (kokutei roomaji) and the almost identical Bloch-Jorden romanization (see Jorden), the palatalized dental obstruents are treated parallel to the other palatalized consonants and represented sy, ty, zy.

Bloch in 1950 rejects the "neat and systematic National Romanization" which he had used before, stating that the Hepburn Romanization, "unsystematic and cumbersome as it seems to be, is the one that turns out to be closer to a phonemic notation". What forces Bloch to represent sy, ty, and zy as unit items but ky, gy, etc. as clusters, as in the Hepburn romanization, is the very low-level phonetic fact that the Japanese palatalized dentals are phonetically identical to the Polish ś, ć, dź rather than to the Russian s, t, d. This had the consequence that Bloch was unable to say that these items were phonetically sequences of two segments, although he was able to make such an

assertion in the case of py, ky, etc., where he could identify the sound between the release of the consonant and the onset of the following vowel with [y]. If sy, ty, zy had had the "Russian" sounds instead of the "Polish" sounds, Bloch would presumably have been able to analyse them as sy, ty, dy, and would thus have had a transcription like the National Romanization. This example illustrates a major defect of attempts to define the phonemes of a language as the entities which result from some fixed procedure for analyzing phonetic data, namely that the results can be changed sharply by quite minor differences in allophonics: two Japanese dialects which differed only to the extent that the one had "Russian palatalized dentals"³ where the other had "Polish palatalized dentals" would be given different phonemic inventories according to Bloch's definition of the phoneme. It should also be pointed out that the difference between the two types of palatalized dentals is "subfeatural": in grammars of Polish and Russian the Polish [ć] and the Russian [t,] would be given the same feature representation; the phonetic difference between them would only appear in the "feature interpretation rules" which convert the feature specifications into ranges of physical

³) Some Shikoku dialects in fact have "Russian palatalized dentals" (see Polivanov [2]).

variables.

I thus will treat Japanese as simply having two series of consonants: plain (p, t, k, s, ...) and palatalized (py, ty, ky, sy, ...). In native morphemes, as I pointed out above, palatalization is predictable: a consonant is [+shp] before /i/ and [-shp] elsewhere. However, the distribution of these two series in Sino-Japanese morphemes is somewhat peculiar. Indeed, Trubetzkoy cites it in Grundzüge (p. 208) as an example of a pathological kind of neutralization, namely neutralization which is assimilative in one environment and dissimilative in another. Specifically, while both series can occur before /a, o/ u/, only the palatalized consonants can occur before /i/ and only the plain consonants can occur before /e/.

I am going to present a re-analysis of the sound system of Japanese in which the distribution of palatalized and plain consonants ceases to exhibit the pathology which Trubetzkoy saw in it. This reanalysis comes close to saying that /i/ and /e/ are in complementary distribution.⁴ If /i/ and /e/ could occur only after a consonant they indeed would be in complementary distribution, since ~~from~~ the palatalization of the consonant one could tell whether /i/

⁴) The idea which I present here was mentioned in a footnote in Bloch [1] in 1946.

or /e/ followed. However, they are not quite in complementary distribution, since both can occur initially, and there are minimal pairs such as eki 'profit', iki 'region'. /y/ also has a somewhat restricted distribution: it can occur before /a, o, u/ but not before /i, e/. Suppose that syllable-initial /i/ were interpreted as if it had a /y/ in front of it, i.e., as /yi/. Then /i/ and /e/ would indeed be in complementary distribution: /i/ would occur only after a palatalized consonant or /y/, /e/ only elsewhere.

Lumping /i/ and /e/ together in a single phoneme and calling it, say, /i/, thus would yield for the Sino-Japanese vocabulary a four-vowel system /i, a, o, u/ plus parallel series of plain and palatalized consonants whose occurrence before these vowels is completely free. The /i/ in underlying forms will take the phonetic form [i] when it is preceded by a palatalized consonant or [y] and will take the phonetic form [e] when it is preceded by a plain consonant or no consonant at all. This suggests the proportion: palatalized consonant is to plain consonant as /y/ is to nothing. This in turn would suggest that the absence of an initial consonant be interpreted as the "unpalatalized counterpart" of /y/ and represented as a [-shp] glide, as against /y/, which would be a [+shp]

glide. Such an analysis has been suggested by Hattori [1, 3], who would transcribe the word for 'phonology' as /'oN'iNron/, /'/ being his symbol for the "glottal constriction" phoneme, whose palatalized counterpart is /y/. Phonetically, the glottal constriction phoneme (which I will henceforth write /?/ rather than /'/, to avoid confusion with my accentuation mark) is precisely that: a glottal constriction, and serves as the phonetic distinction between such minimal pairs as [suuri] 'mathematical principle', [su?uri] 'vinegar vendor'. On first glance, writing glottal constriction in phonemic transcriptions of Japanese seems to be just as uninituitive as writing glottal stops in phonemic transcriptions of English: just as the English words which begin phonetically with glottal stops can be represented as beginning with vowels and the glottal stops inserted by rules, so also the Japanese morphemes which begin with glottal constriction could be represented as beginning with vowels and the glottal constrictions inserted by rules. However, the situations in Japanese and English actually are very different. In English a word has an alternant beginning with a glottal stop if and only if it also has an alternant without that glottal stop: the alternant with the glottal stop occurs in phrase-initial position, the other alternant elsewhere. Thus English must

be supplied with a rule which yields a /ʔ/↔∅ alternation, i.e., either a /ʔ/-insertion rule or a /ʔ/-deletion rule. Either rule is just as complicated to state, so that (assuming that the absence of glottal stops in the underlying forms would not complicate the rules), the solution with the /ʔ/-insertion rule and underlying forms without initial glottal stops would give at least as simple a set of ~~phonological~~ rules as the other solution. Since it would require less information to be marked in the dictionary entries it would then be preferred to the other solution, so that a grammar of English would have to involve underlying forms without initial /ʔ/. But in Japanese, on the other hand, there is no alternation of initial /ʔ/ with zero: morphemes which have an initial /ʔ/ when phrase-initial retain it when they are preceded by other morphemes. Thus there is no need for a phonological rule which inserts /ʔ/ before initial vowels in Japanese any more than there is a need for a phonological rule which inserts /e/ between consonants in Lightner's example. Consequently, the evaluation procedure will prefer a grammar of Japanese in which /ʔ/ is represented in the dictionary entries of those morphemes which begin with it phonetically. I will thus assume henceforth that Japanese dictionary entries may involve a segment /ʔ/ which differs from /y/ only on the feature of sharpness

(/?/ is [-shp] and /y/ [+shp]). As a piece of ^{ti}stistical evidence for saying that /?ana/ begins with /?/ rather than with /a/, etc., I might cite the fact that Japanese has roughly as many words beginning with /?/ or /y/ as it has beginning with any of the more frequent consonants. The following are the numbers of pages taken up in Kenkyuusha's "New Little Japanese-English Dictionary" by words with various initials:

/k/ and /ky/	103 pages
^{ti} /?/ and /sy/	89
/?/ and /y/	87
/t/ and /ty/	65
/h/ and /hy/	56

I now have arrived at an analysis in which Sino-Japanese morphemes are treated as having a four-vowel system and distinctive palatalization. My earlier treatment of native morphemes involved a five-vowel system and rules by which palatalization was completely predictable. Will the analysis I give to Sino-Japanese morphemes force a change in my analysis of native morphemes? For example, would it simplify things to treat native morphemes as if they had a four-vowel system and mark the palatalization of the consonant rather than the diffuseness of the vowel in sequences of consonant followed by front vowel? If

consonant followed by a front vowel only occurred within a morpheme, the change to a four-vowel system would shorten the rules somewhat, albeit not by an overwhelming amount.⁵ However, there are sequences of morpheme-final consonant followed by morpheme-initial front vowel, and it is the diffuseness of the vowel in these sequences which determines the palatalization of the consonant, rather than vice versa. The grammar will thus be simpler if I assume a 4-vowel system for Sino-Japanese morphemes and a 5-vowel system for native morphemes:

	Sino-Japanese				native				
	i/e	a	o	u	i	e	a	o	u
dif	+	-	-	+	+	-	-	-	+
grv	-	+	+	+	-	-	+	+	+
cmp	-	+	-	-			+	-	

The following rules fill in the blanks of these vowels and adjust the sharpness of consonants:

1. [+ native] --> [- shp]
2. [+ dif] --> [- cmp]
3. $\begin{bmatrix} - \text{cns} \\ - \text{dif} \\ + \text{Sino} \end{bmatrix}$ --> [+ grv]
4. $\begin{bmatrix} - \text{cns} \\ - \text{grv} \\ + \text{Sino} \end{bmatrix}$ --> [- dif] in env. [- shp] _____
5. [+ cns] --> [+ shp] in env. _____ $\begin{bmatrix} - \text{cns} \\ + \text{dif} \\ - \text{grv} \end{bmatrix}$

5) I prefer, of course, to a grammar of the entire language and not just of the native part. The sets of rules which I am comparing must cover the behavior of morphemes of all strata.

One problem still remains, namely that of the distribution of /y/ in native morphemes. My earlier statement that palatalized consonants in native morphemes only occur before /i/ does not hold for /y/, which, while palatalized, can occur before /u, o, a/ even in native morphemes (yuki 'snow', yoru 'evening, yak- 'to roast'). In its present form rule 1 would eliminate the contrast between /y/ and /ʔ/ in such morphemes; thus rule 1 must be revised so as not to apply to /y/. Assuming that /y/ is represented as a glide (i.e., as $[- \begin{smallmatrix} \text{cns} \\ \text{voc} \end{smallmatrix}]$), rule 1 can be changed to

$$1' \quad [\begin{smallmatrix} + \text{cns} \\ + \text{native} \end{smallmatrix}] \rightarrow [- \text{shp}]$$

(the fact that the earlier version of rule 1 also made vowels $[- \text{shp}]$ but this one does not is of no consequence, since subsequent rules never make reference to the sharpness of vowels). The fact that /y/ can not occur before /i/ or /e/ in native words must also be accounted for. The simplest way of doing this is to change rule 5 to read

$$5' \quad [\begin{smallmatrix} + \text{cns} \\ - \text{voc} \end{smallmatrix}] \rightarrow [\text{shp}] \quad \text{in env.} \quad \text{---} \quad \left[\begin{smallmatrix} - \text{cns} \\ - \text{grv} \\ \text{shp} \end{smallmatrix} \right]$$

i.e., non-vowels become palatalized before /i/ and plain before /e/. Suppose that before an initial front vowel in native morphemes one writes $[- \begin{smallmatrix} \text{cns} \\ \text{voc} \end{smallmatrix}]$ with no sharpness specification. Rule 5' will make that segment /y/ before /i/ and /ʔ/ before /e/. Recall now that in Sino-Japanese

morphemes the syllables /i/ and /e/ are each represented in the dictionary as a sequence of two segments, the first of which is /y/ or /?/ and the second of which is /i/. Rule 4 lowers /i/ to /e/ when preceded by /?/ in a Sino-Japanese morpheme, thus yielding /yi/ and /?e/. Since these two syllables differ phonetically only in the vowel and not in the onset of the syllable, a later rule must convert /y/ into /?/ before /i/. If this rule applies not only to Sino-Japanese morphemes but to native morphemes as well, it will also eliminate the /y/ before /i/ there. Thus the small changes which I made in rules 1 and 5 will suffice to yield the correct distribution of /y/.

Let me now return to the consonant system. Above I gave a rule which converts /p/ into /h/ in native and Sino-Japanese morphemes. This rule not only accounts for the restrictions I stated on the distribution of [p] and [h/f] (which I will henceforth write simply as [h]) but also for the well-known p-h alternation, for example, ippiki 'one (animal)', gohiki 'five (animals)'; bunpoo 'grammar', hooritu 'law'. The underlying representations are

it, & piki bun & poo
 go & piki poo & ritu

In the second line the /p/'s are in the environment where p→h, but not in the first line, where they stay /p/'s.

The distribution of [h] in non-foreign words is even more restricted than I indicated. Specifically, except for the 10 words listed below, intervocalic [h] only occurs at the beginning of one of the elements of a compound. The following are the remaining items in which an intervocalic [h] occurs:

ahen	'opium'
ahiru	'duck'
haha	'mother'
hihi	'baboon'
hoho	'cheek'
kehai	'sign'
kuhoo	'scheme'
nihon	'Japan'
roha	'gratis'
yahari	'as expected'

While these words are not obviously compounds, they are not obviously monomorphemic either. Ahen, ahiru, kehai, kuhoo, nihon, and yahari historically are compounds and are all written with two characters in the standard orthography. However, they involve components which either have fallen out of the language (the hiru of ahiru) or take a unique form in these compounds (the ni of nihon takes the form nit, or nit in other compounds). Haha, hihi, and hoho evidently display a reduplication, but the corresponding unreduplicated forms do not occur. The remaining word roha is a peculiar kind of spelling pronunciation which arises from the character 白 (pronounced tada 'gratis') being split into the katakana characters 白 /ro/ and 白 /ha/. In view of

of the fact that if these ten words were interpreted as monomorphemic they would be the only non-compounds which had an intervocalic /h/, I will say that phonologically they are compounds and will represent them in the lexicon the same way as other non-productive compounds, i.e., a compound boundary will be marked in the lexicon between the two "components". It will then be necessary to have a rule which excludes intervocalic /h/ except at ; - boundary. I propose a rule of rank : which converts /h/ into glottal constriction. Since this rule is of rank :, the /h/ of hoo:hoo is retained, but tape & ru -> tahe & ru -> taʔe & ru.

Consider now Japanese [w]. The extremely limited distribution of [w] in Japanese is a well-known item of linguistic folklore: [w] can only occur before the vowel [a]. Moreover, [w] is the only Japanese non-vowel which has no palatalized counterpart: there is no *[wya]. As a result, in the tables of the morae of Japanese such as are given in Hattori [1, 3], there is no place where /wa/ really fits, and it is simply put by itself (Hattori includes it in the row /ʔe, ʔa, ʔo, ʔu, ʔi, ya, yo, yu, wa/, but that row is one longer than the other rows of the table: the "wa-column" contains only /wa/).

Note the following restrictions on vowel sequences:

unless at least :-junction intervenes, a sequence *ua, *oa, *ea, *ia (or rather, *u?a, *o?a, *e?a, *i?a) cannot occur, although virtually all other vowel sequences occur.

Moreover, the sequence [aa] is extremely rare: in the native and Sino-Japanese strata of vocabulary it occurs only in honorific names for members of the family: o-kaa-san 'mother', o-baa-san 'grandmother'. Indeed, in this semantic-syntactic category, monosyllabic stems are always long: o-too-san 'father', o-zii-san 'grandfather', o-nee-san 'elder sister', o-nii-san 'elder brother'.⁶

Moreover, all these words have accented stems. It will be necessary for a grammar to contain rules which impose these two restrictions on Japanese honorifics. The requirement that honorific monosyllabic family relation names have long vowels and be accented corresponds simply to a rule which geminates the vowel of a monosyllabic stem which is marked [+ honorific] and marks the syllable [+ acc]. As for the exclusion of vowel sequences ending in /a/ (other than those created by the preceding rule), I propose to combine that restriction with the

⁶) the ozi and oba of ozi-san 'uncle' and oba-san 'aunt' are disyllabic stems rather than honorific prefix plus monosyllabic stem, since there is no form without the /o/ and since ozi and oba are used even in non-honorific contexts.

restrictions on the occurrence of /w/ and state a rule by which glottal constriction is converted into /w/ in the environment V__a . Since morpheme-internal glottal constriction can be assumed to come from /p/ via /h/, this means that morpheme-internal /w/'s can be represented by /p/ in the dictionary. Kawa 'river', for example, would be represented as /kapa/. In addition to explaining the restrictions in question, this rule also sheds light on a number of doublets such as ba?ai/bawai 'case', and kehai/kewai 'sign'. The first member of each doublet is phonologically a compound, so that /?/ is not converted into /w/ and /h/ is not converted into /?/. The second member of each doublet is phonologically a unit, so that /h/ becomes /?/, /?/ becomes /w/, and the forms bawai, kehai result. This rule is also involved in the /w, p, b/ alternation in itiwa 'one (bird)', sanba 'three (birds)', zippa 'ten (birds)'. This alternation is, of course, an irregularity, but the irregularity consists only in the loss of /;/ between the numeral and /pa/, so that /iti:pa/ is replaced by /iti&wa/, which is converted through the stages iti & ha and iti & ?a into iti & wa.

While these considerations eliminate morpheme-internal /w/'s from dictionary entries, morpheme-initial /w/'s still remain and will have to be represented somehow, since there

are such minimal pairs as ?akai 'red', wakai 'young'. I propose treating the initial /w/ of wakai somewhat like /y/: if /y/ is a palatalized glottal constriction, then /w/ will be a labialized ([+flt]) glottal constriction. This interpretation allows the /?/-- /w/ rule to assume the following simple form:

$$\left[\begin{array}{l} - \text{cns} \\ - \text{voc} \\ - \text{shp} \end{array} \right] \rightarrow [\alpha \text{flt}] \text{ in env. } [- \text{cns}] \text{ --- } \left[\begin{array}{l} - \text{cns} \\ \alpha \text{cmp} \end{array} \right].$$

In the Western dialects which preserve the old labio-velar series of consonants (which has coalesced with the velars in standard Japanese), the feature of flatness will be needed not only to oppose /w/ to /?/ but also to oppose /k^w/ to /k/ and /g^w/ to /g/.

I now turn to the topic of the "syllabic obstruent" and "syllabic nasal". The syllabic obstruent counts as a separate mora and is phonetically the gemination of the following consonant⁷. The syllabic nasal likewise counts as a separate mora and is phonetically either a nasal consonant homorganic with the following consonant or (if there is no following consonant) something which has been variously described as a nasalized transition to the following vowel (Hattori, p. 752) or a velar nasal consonant (Han, p. 78) or a velar nasal consonant with incomplete closure (Jorden, p. xxxi). What everyone

⁷) The syllabic obstruent is always followed by an obstruent.

agrees on is that when no consonant follows, the syllabic nasal is a nasalized segment colored by the surrounding vowels and with the back of the tongue close to but not touching the back of the mouth. My own auditory impression is that it is a nasalized prolongation of the preceding vowel, followed by a (possibly nasalized) [w] or [y] if the following vowel is respectively u/p or i/e. This is the way I will interpret it in the rules.

The syllabic nasal and syllabic obstruent often arise from an ordinary non-syllabic consonant; note the following alternations:

iti 'one', it, & sai = issai, it, & pai = ippai

karu 'cut', kar & ta = katta

yomu 'read', yom & ta = yonda.

Putting aside for the moment the question of how to represent morphemes which have a syllabic obstruent or nasal throughout their paradigms, let me answer the question of what rules are needed to account for these alternations. When a consonant sequence is created, the first consonant becomes either the syllabic nasal or the syllabic obstruent (depending on the nature of the first consonant). Phonetically, the first consonant shares the point of articulation and the sharpness of the second consonant, and in the case where the syllabic obstruent is created, also the manner of articulation. There is no necessity to have

an intermediate stage of representation in which these consonants are represented as "syllabic nasal" or "syllabic obstruent": it will suffice if the rules convert the underlying forms it, & sai, etc. directly into the proper phonetic forms. What is needed then are rules which regressively assimilate the point of articulation and sharpness of consonant sequences and the manner of articulation in sequences of non-nasal consonants.

A syllabic nasal or syllabic obstruent which is not an alternant of a normal consonant but simply appears as a syllabic nasal or obstruent throughout the paradigm of some morpheme can be represented in the dictionary simply as a nasal or non-nasal ⁿconsonant respectively, with no further specification of point or manner of articulation. If a consonant follows, the above assimilation rules will produce the correct phonetic form. If no consonant follows (which will only be the case with a morpheme-final syllabic nasal), a rule will convert it into a $[\begin{smallmatrix} - & \text{cns} \\ + & \text{voc} \end{smallmatrix}]$ segment which agrees in gravity, compactness, and diffuseness with the preceding vowel (i.e., it becomes a nasalized continuation of it). Note that it is unnecessary to distinguish between a syllabic nasal and an ordinary nasal in a dictionary entry: from syntactic information and information about the surrounding segments one can always tell which he has).

I turn now to the well-known problem of the velar nasal

in Japanese. My remarks are to a great extent based on the treatment given by S.-Y. Kuroda in the M.I.T. Japanese seminar, March 14, 1964. It is well-known that [g] and [ŋ] are almost in complementary distribution: word-initially only [g] occurs, and word-internally [ŋ] occurs in a great majority of cases, although there are still numerous cases of internal [g]. Moreover, there is a regular alternation between initial [g] and internal [ŋ]: gakusei 'student', suunaku 'mathematics'; gaikoku 'abroad', inai 'aside from'. It will thus be necessary to give some rule of $g \rightarrow \eta$ alternation. The rough description I gave above of the distribution of [g] and [ŋ] suggests that one attempt to make the [g] \rightarrow [ŋ] alternation rule account for all [ŋ]'s. This would amount to interpreting the terms "initial" and "internal" in such a way that for the purposes of the rule the [g]'s which occur in non-initial positions would be in environments which would count as "initial". Unfortunately that is not possible, since there are minimal pairs such as oogama 'big toad', oogama 'big kettle' (< kama 'kettle'). Note the following facts about this and similar minimal pairs: (1) the "internal [g]" occurs after one of the prefixes o, go, oo; (2) the [g] after the prefix corresponds to a [g] when there is no prefix but the [ŋ] corresponds to a [k]. The $k \rightarrow \eta$ alternation involved here is part of a phenomenon known as "sequential voicing" (rendaku 連濁),

in which the initial segment of the second element of certain compounds becomes voiced, for example, tama 'ball', sorobandama 'abacus bead'; suru 'do', oozuru 'reply'; hako 'box' (pako), doogubako 'toolbox'; kuruma 'vehicle', katanuruma 'piggy-back'. Fact (1) could be explained by saying that the prefixes o, go, oo do not count as initial syllables and that the syllable after such a prefix counts as the initial syllable. However, that would not work, since then the [ŋ] of conama would also count as initial, and no matter whether the [g] → [ŋ]-rule or the sequential voicing rule applied first, a [g] would result in both words. Or at least, that would be the case if the voicing rule were precisely that --- a voicing rule. But if it did something to /k/ other than just to voice it, then [g] and the result of applying the "voicing rule" to [k] would be distinct and the two words would not coalesce. What then should be the new form of the voicing rule? One obvious answer would be a rule which voices all the obstruents except /k/ and converts /k/ into /ŋ/. Another possibility, which takes less feature specifications to state, would be to have the rule mark all obstruents as [+nas] in the "voicing environment"⁸ (this would yield

⁻⁸⁻) I am unable to state the environment in which the "voicing rule" applies. The relevant data are completely bewildering. Martin [1] gives a thorough description of the phenomenon.

segments marked $\left[\begin{smallmatrix} + & \text{nas} \\ + & \text{obs} \end{smallmatrix} \right]$, which are the specifications characterizing "prenasalized obstruents" ($[m^np]$, $[n^nt]$, etc.) and then have rules $\left[\begin{smallmatrix} + & \text{cmp} \\ + & \text{nas} \end{smallmatrix} \right] \rightarrow [- \text{obs}]$ (which would turn "nasalized $[k]$ " into $[n]$), and $[+ \text{nas}] \rightarrow [+ \text{voice}]$ and $[+ \text{obs}] \rightarrow [- \text{nas}]$, which would convert the other "nasalized obstruents" into ordinary voiced obstruents. It is this form of the "voicing rule" which I accept.

Internal $[g]$ occurs not only after the prefixes o , go , and oo , but also in reduplicated onomatopoeia (garagara 'rattle'), in the morpheme go 'five' ($[sengo]$ '1005' vs. $[senpo]$ 'postwar'), and at the beginning of the second member of a "long" compound (here there is often free variation between $[n]$ and $[g]$: kootoogakkoo or kootoonakkoo 'high school'). What this suggests is that some junctural element * be inserted after o, go, and oo and before go 'five' and that the $g \rightarrow n$ rule be made of rank *. This would cause some problems which I am not prepared to discuss here relating to the fact that the addition of * would make the junctural hierarchy only a partially ordered set and that there is no obvious way of using * to explain the internal $[g]$ in long compounds. However, even if some other formal device is used to insure the preservation of $[g]$ in these environments, the fact remains that given full syntactic information one can predict whether $[g]$ or $[n]$ will occur in a non-foreign morpheme, so that the g/n distinction

does not have to be marked in dictionary entries of native, Sino-Japanese, or onomatopoeic morphemes; however, it does have to be marked in foreign morphemes. In view of the fact that the [ŋ]'s created by the "voicing rule" are represented as [+ obs / + nas] segments, the [ŋ]'s of foreign morphemes can be represented that way as well. Thus I will represent the [g] and [ŋ] of foreign morphemes as velar obstruents which are [- nas] and [+ nas] respectively. Similarly, the g → ŋ rule will simply say that

--> [+ nas] in env. [] ____.

+ obs
+ voice
+ cmp
- foreign

2.3 Segment inventories

I thus conclude that the following inventories of segments will have to be distinguished for each of the four strata of lexical items discussed:

I Native

p	t	k	s	m	n	r	ʔ	w	y	i	u
b	d	g	z							e	o
										a	

II Sino-Japanese

The same with the elimination of /e/ from the vowel system and the addition of palatalized counterparts to the [+ cns] segments. Since /d/ and /z/ have the same palatalized counterpart, there will be only one voiced palatalized dental segment.

III Onomatopoeia

The same as for Sino-Japanese but with the addition of /h/.

IV Foreign

p	t	k	f	s	h	m	n	ŋ	r	ʔ	w	y	i	u
b	d	g		z									ɛ	o
p, t, k,				s, h, m, n,				r,					a	
b, d, g,														

(, after a consonant letter denotes palatalization).

I now have the task of choosing appropriate sets of feature specifications with which to represent these segments in the lexicon. In assigning feature specifications to the segments involved in a dictionary, Halle and pupils of his such as Lees have placed great importance on minimizing the number of feature specifications which occur in the inventory of segments. It should be noted that this demand is an extra demand which does not follow from the requirement that the number of feature specifications in the grammar be minimized. The grammar consists of just the lexicon and the rules; the inventory of segments is not a part of the grammar but is merely something which the linguist sets up as an aid in writing the grammar. Thus there is no a priori reason why minimizing the number of specifications in the segment inventory would always entail an economy in the grammar, and indeed, it may actually conflict with economy by forcing the rules of the grammar to be more complicated or making it impossible to simplify the lexicon by leaving out redundant information. It can easily be shown that to minimize the number of

feature specifications in an inventory of n segments it is necessary that the segments first be divided according to a feature which yields two classes each of at least 2^{m-1} members if $2^m \leq n < 2^m + 2^{m-1}$, and two classes of at most 2^m members if $2^m + 2^{m-1} \leq n < 2^{m+1}$. Suppose that one were given the inventory

p	t	k	u	i
b	d	g	o	a
m n ŋ				
r l				

The feature giving the first split into two classes could be neither consonantalness nor vocalicness nor obstruence, since there are 16 segments, of which 7 are obstruents, 12 are consonantal, and 6 are vocalic, but the theorem quoted above implies that the first split must be into two sets of 8 segments. The only feature satisfying that criterion is graveness (there are 8 grave and 8 non-grave segments). Suppose that one were then to divide the segments first into grave and non-grave. Suppose further that the morphemes of the language were subject to the constraint that a vowel could only be followed by a consonant (i.e., there are no vowel sequences in dictionary entries). One would expect to handle this situation by having a rule that after a [-cns] segment the next segment is made [+cns] and omitting from the dictionary the redundant [+cns] specification of consonants which are preceded

by vowels. However, that will be impossible here since the segment inventory will include some segments not specified for consonantalness (since otherwise consonantalness could have been taken as the feature which gives the primary split, which has already been proved impossible), so that when one of those segments is involved there will be no consonantalness specification there to omit nor will there be any other redundant specification which could be omitted, since every other feature specification will be needed to distinguish it from other consonants. Consequently, if the feature representation which minimizes the number of +'s and -'s in the inventory matrix is chosen, it will be impossible to omit from the dictionary feature specifications corresponding to such basic redundancies as the above sequential constraint.

I will now present feature assignments for the inventories of segments given above. In view of the above discussion, I feel no need to apologize for the fact that the number of +'s and -'s is more than the minimum number needed to distinguish the segments listed.

I. Native

	p	t	k	s	b	d	g	z	m	n	r	ʔ	w	y	i	e	a	o	u
cns	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-
voc												-	-	-	+	+	+	+	+
obs	+	+	+	+	+	+	+	+	-	-	-								
voice	-	-	-	-	+	+	+	+											
grv	+	-	+	-	+	-	+	-	+	-					-	-	+	+	+
nas									+	+	-								
dif	+				+										+	-	-	-	+
cmp																	+	-	
cnt		-		+		-		+											
shp													-	-	+				
flt													-	+					

II. Sino-Japanese

	p	t	k	s	b	d	g	z	m	n	r	p,t,k,s,	b,d,g,	m,n,r,	
cns	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
obs	+	+	+	+	+	+	+	+	-	-	-	+	+	+	-
voice	-	-	-	-	+	+	+	+	-	-	-	-	-	-	+
grv	+	-	+	-	+	-	+	-	+	-	+	+	-	+	+
nas									+	+	-				+
dif	+				+							+			-
cnt		-		+		-		+				-		+	
shp	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+

	?	w	y	i	a	o	u
cns	-	-	-	-	-	-	-
voc	-	-	-	+	+	+	+
grv				-			+
dif				+	-	-	+
cmp				+			-
shp	-	-	+				
flt	-	+					

Since /d/ and /z/ both palatalize to [dʒ] and there is no morphophonemic ground for having separate /d,/ and /z,/ in dictionary entries, it is only necessary to have one sharp voiced dental, which will be unmarked for continuance (I refer to this segment as /d,/).

III. Onomatopoeia

The same as for Sino-Japanese, except for the part

	p	t	k	s	h	p,	t,	k,	s,	h,
grv	+	-	+	-	+	+	-	+	-	+
dif	+				+	+				+
cnt	-	-	-	+	+	-	-			+
shp	-	-	-	-	-	++	+	+	+	+

IV. Foreign

	p	t	k	f	s	h	b	d	g	z	ŋ	p,t,k,s,h,b,d,g,							
cns	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
obs	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
voice	-	-	-	-	-	-	+	+	+	+	+	-	-	-	-	-	+	+	+
grv	+	-	+	+	-	+	+	-	+	-	+	+	-	+	-	+	+	-	+
nas									-		+								
dif	+		-	+		-	+		-		-	+		-			+		-
cnt	-	-	-	+	+	+			-		+	-	-		+	+			
shp	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+	+	+	+	+

	m	n	r	m,n,r,	?	w	y	i	e	a	o	u
cns	+	+	+	+	+	-	-	-	-	-	-	-
voc						-	-	-	+	+	+	+
obs	-	-	-	-	-	-	-	-	-	-	-	-
grv	+	-		+	-			-	-	+	+	+
nas	+	+	-	+	+	-						
dif								+	-	-	-	+
cmp									+	-		
shp	-	-	-	+	+	+	-	-	+			
flt							-	+				

2.4 Inflection

2.4.1 Regular inflection

In Japanese, only adjectives and verbs are inflected. Moreover, they are inflected for almost exactly the same set of categories, and most of the affixes are the same for verbs as for adjectives.

Before taking up the problem of how to represent these affixes, it will be necessary for me to discuss the notions of consonant-stem verb and vowel-stem verb. Consider the following forms:

	'eat'	'force'	'see'
Simple Pres.	taberu	siiru	miru
Polite Pres.	tabemasu	siimasu	mimasu

'walk'	'call'	'swim'	'read'	'put out'
aruku	yobu	oyogu	yomu	dasu
arukimasu	yobimasu	oyogimasu	yomimasu	dasimasu

'wait'	'die'	'return'	'laugh'
matu	sinu	kaeru	warau
matimasu	sinimasu	kaerimasu	waraimasu

It is natural to regard the first three verbs as consisting of a stem *tabe*, *sii*, or *mi*, to which is added a present tense ending *-ru* or a politeness marker *-masu*. The remaining verbs have /u/ in place of the /ru/ in the simple present and have an /i/ inserted before /masu/ in the polite present. If one makes the obvious segmentation (*aruk & u*, *aruk & i & masu*), all of these verbs will have stems ending in consonants except for warau. However, the grammar will be simplified considerably if warau is also treated as having a stem ending in a consonant which is later eliminated. The other verbs given above have stems ending in the consonants

t	k	s	m	n	r
b	g				

The only consonants which do not appear in this list are /p, d, z/. If the stem of warau were assumed to end in /p/, no further rules would be needed to eliminate the /p/ in the forms given above, since by the rules already given, *p-- h-- ?* intervocalically (I write warau instead of the more correct wara?u in accordance with the Bloch-Jorden romanization, which does not indicate /?/) unless it is preceded by at least :-boundary. Saying that warau

has the stem /warap/ has three immediate advantages. First, the rules involved in generating the present and polite present forms of Japanese verbs need only refer to whether the stem ends in a consonant. Secondly, no special rule is needed to generate the correct past form waratta, since warap & ta → waratta by the consonant assimilation rules already present in the grammar. Thirdly, the morpheme structure rules are simplified somewhat. It is necessary to have rules which exclude from verb-stem-final position those consonants which cannot occur there, and in the analysis given here, all that will be needed to fulfill that requirement is a rule which excludes /d, z/:

[₋ ⁺ cns] → [- voice] in env. ____) verb-stem
 grv

Consider now the provisional, passive, causative, and tentative forms of the verbs given above:

Pres. taberu	miru	yobu	yomu	dasu	warau
Prov. tabereba	mireba	yobeba	yomeba	daseba	waraeba
Pass. taberareru	mirareru	yobareru	yomareru	dasareru	warawareru
Caus. tabesaseru	misaseru	yobaseru	yomaseru	dasaseru	warawaseru
Tent. tabeyoo	miyoo	yoboo	yomoo	dasoo	warao

The vowel-stem verbs have affixes beginning with /r/, /s/, or /y/: -ru, -reba, -rare, -sase, -yoo; while the consonant-stem verbs have affixes without the /r/, /s/, or /y/: -u, -eba, -are, -ase, -yoo (the intervocalic /w/ of warawareru is put in automatically by the rule given in the preceding section for V?a sequences and is thus not part of the affix). Following S.-Y. Kuroda⁹, I will describe these

⁹) Gengo no kijutsu, pp. 59-60.

facts by giving a rule which deletes /r/, /s/, or /y/ in the environment [+ cns] & ___ and will represent the affixes as -ru, -reba, -rare, -sase, and -yoo in the underlying representations, regardless of whether a consonant or vowel stem verb precedes. Warau, for example, is derived as follows:

underlying form	warap & ru
r,s,y --> ∅	warap & u
p--> h	warah & u
h--> ?	wara? & u

The verbs given above have the following past tense forms:

Fres.	taberu	siiru	miru
Past	tabeta	siita	mita

aruku	yobu	oyogu	yomu	dasu	matu	sinu	kaeru	warau
aruita	yonda	oyoida	yonda	dasita	matta	sinda	kaetta	waratta

The simplest generative description of these forms is clearly one which takes /ta/ as the basic form of the past tense morpheme and has rules for assimilative and other changes which take place when the /t/ of the ending is immediately preceded by a consonant. A voicing assimilation rule is needed to account for the forms which have [da] instead of [ta]. This assimilation rule will operate after all voiced stem-final consonants except /r/ and can be stated most simply by the rule

[] --> [+ voice] in env. [$\bar{\text{VOC}}$ voice] & ___

This rule plus the assimilation rules given in the discussion of the syllabic nasal and syllabic obstruent are sufficient to yield the correct past tense forms of yomu, sinu, matu, warau, and kaeru. In the past tense of oyogu, aruku, and dasu, an /i/ is inserted at the end of the stem, and the stem-final velar of aruku and oyogu is lost. The simplest rules to account for these phenomena would be a rule making velars [+ cnt] before the past tense ending (i.e., turning them into [h]) and a rule inserting /i/ between a spirant and the past tense ending:

$$\begin{bmatrix} + \text{ obs} \\ + \text{ cmp} \end{bmatrix} \rightarrow [+ \text{ cnt}] \text{ in env. } \underline{\quad} \& [+ \text{ cns}]$$

$$\emptyset \rightarrow \begin{bmatrix} - \text{ cns} \\ + \text{ dif} \\ - \text{ grv} \end{bmatrix} \text{ in env. } \begin{bmatrix} + \text{ obs} \\ + \text{ cnt} \end{bmatrix} \underline{\quad} \& [+ \text{ cns}]$$

A rule is needed to nasalize the /b/ of yobu in the past tense form yonda, perhaps,

$$\begin{bmatrix} + \text{ obs} \\ + \text{ voice} \end{bmatrix} \rightarrow [+ \text{ nas}] \text{ in env. } \underline{\quad} \& [+ \text{ cns}]$$

However, a slight change in this rule will make it also explain the alternation between syllabic nasal and syllabic obstruent in the "intensive infix" of adverbs in -ri.¹⁰ The syllabic obstruent occurs before a voiceless segment: hakkiri, hissori, battari,¹¹ and the syllabic nasal before all other non-vowels: manziri, nonbiri,

¹⁰) All data cited here are from Martin [1].

¹¹) Martin shows that these forms are segmentable into a stem (the haki of hakihaki, the hiso of hisohiso, the bata of batabata) plus intensive infix plus -ri.

honnori, yanwari, bonyari. If the intensive infix is represented as $[+ \text{cns}]$, the consonant assimilation rule generalized so as to assimilate voicing as well as point of articulation and sharpness, and the above rule modified to $[- \text{voc}] \rightarrow [+ \text{nas}]$ in env. $[- \text{voice}] \rightarrow [+ \text{cns}]$, nonbiri will be derived as follows:

	nobi & C & ri
infixation	noCbi & ri
assimil.	nobbi & ri
nasalizn.	nonbi & ri

These rules will also yield the correct gerund (-te), conditional (-tara), and representative (-tari) forms of all regular verbs:

Past	tabeta	aruita	yonda	dasita	kaetta	waratta
Ger.	tabete	aruite	yonde	dasite	kaette	waratte
Cond	tabetara	aruitara	yondara	dasitara	kaettara	warattara
Repr	tabetari	aruitari	yondari	dasitari	kaettari	warattari

In the negative, an /a/ is inserted after consonant stems; in the "infinitive" and all compounds (including the desiderative and polite forms, which are really compounds of the verb with an adjective -tai and a verb -masu respectively), an /i/ is inserted after consonant stems:

Present	taberu	aruku	yomu	dasu	warau
Negative	tabenai	arukanai	yomanai	dasanai	warawanai
"Infinitive"	tabe	aruki	yomi	dasi	warai
Desiderative	tabetai	arukitai	yomitai	dasitai	waraitai
Polite pres.	tabemasu	arukimasu	yomimasu	dasimasu	waraimasu

The imperative ending has the form /ro/ after vowel stems and /e/ after consonant stems:

Present taberu miru aruku yomu dasu oyogu warau
 Imper. tabero miro aruke yome dase oyoge warae

I see no way of representing the ending which would allow anything simpler than just giving the item-and-arrangement statement that /ro/ occurs after a vowel and /e/ after a consonant.

Only consonant-stem verbs have a distinct potential form; for vowel-stem verbs, the passive is used in place of the potential. The potential morpheme has the form /e/: arukeru, yomeru, daseru, oyogeru, waraeru.

Adjective stems always end in a vowel. Moreover, there are only four possible vowels: /i, u, o, a/. The diffuseness of a front vowel thus need not be marked and can be filled in by the morpheme structure rule

[₋ cns] → [+ dif] in env. ____) Adj-stem
 [₋ grv]

The only inflectional categories for adjectives which are not also inflectional categories for verbs are the adverbial and honorific forms. Some typical adjectives have the following adverbial and honorific forms:

	'high'	'new'	'thick'	'cold'
Pres.	takai	atarasii	hutoi	samui
Adv.	takaku	atarasiku	hutoku	samuku
Hon.	takoo	atarasyuu	hutoo	samuu

The present tense ending is -i and the adverbial ending is -ku. As for the honorific, note first that in the variety of Japanese which I am describing, no distinction is made

between /ou/ and /oo/ (nor between /ei/ and /ee/) so that the honorific forms of takai and hutoi could just as well be written takou and hutou. If that is done, then the honorific ending can be taken to be /u/ and an assimilation rule given by which /a/ becomes /o/ and /i/ becomes /u/ before /u/:

$$\left[\begin{array}{l} - \text{ cns} \\ + \text{ voc} \end{array} \right] \rightarrow \left[\begin{array}{l} - \text{ cmp} \\ + \text{ grv} \end{array} \right] \text{ in env. } \text{ --- } \left[\begin{array}{l} - \text{ cns} \\ + \text{ grv} \\ + \text{ dif} \end{array} \right]$$

The remaining forms of the adjective conjugation differ from the corresponding verb conjugation forms by the presence of an insert between stem and ending. Compare

taberu tabeta tabete tabetara tabereba tabeyoo
takai takakatta takakute takakattaratakakereba takakaroo

The underlying representations of these forms will be taka & ta, taka & te, etc., and the inserts will be put in by an obligatory transformation:

$$\emptyset \rightarrow \left\{ \begin{array}{l} \text{ku} \\ \text{ke} \\ \text{kar} \end{array} \right\}_1 \text{ in env. Adj. + --- + } \left\{ \begin{array}{l} \text{te} \\ \text{reba} \\ \text{ta} \\ \text{yoo} \end{array} \right\}_{2,1}$$

(note that the insert in the past, conditional, and representative can be taken to be the same as in the tentative, namely /kar/, since kar & ta \rightarrow katta).¹²

The adverbial form of the negative of a verb has an

¹²) These inserts arose historically from the adverbial ending -ku plus an auxiliary verb: takakatta < takaku & atta, takakereba < takaku & ereba.

alternative form in -zu: tabenakute = tabezu 'without eating', yomanakute = yomazu 'without reading', etc. The rule which generates these forms,

Neg & te $\overset{opt}{\rightarrow}$ /zu/ ,

applies before the insert -ku- is inserted.

2.4.2 Irregular verbs

All Japanese adjectives are conjugated regularly. The following verbs have some irregularities in their conjugations:

	'come'	'do'	'go'	'exist'	'be' ¹³
Pres.	kuru	suru	iku	aru	irassyaru
Past	kita	sita	itta	atta	irassyatta
Neg.	konai	sinai	ikanai	nai	irassyaranai
Polite	kimasu	simasu	ikimasu	arimasu	irassyaimasu
Imper.	koi	siro	ike	- -	irassyai
		or se			
Prov.	kureba	sureba	ikeba	areba	irassyareba
Pass.	korareru	sareru	ikareru	- -	- -
Caus.	kosaseru	saseru	ikaseru	- -	- -
Tent.	koyoo	siyoo	ikoo	aroo	- -

Iku is simply an exception to the /k/-->/h/ rule, so that ik & ta is not converted into the expected *iita but retains the stop sequence, which is then automatically converted into a geminate /t/ by the assimilation rule; The irregularity of aru is that the stem is lost before the negative morpheme /na/, so that ar & na & i becomes nai and not *aranai. It will be noted that nai is accented, in contrast to the regular negatives of accented verbs, where

¹³) A handful of other honorific verbs in -aru are also conjugated this way: gozaru, ossyaru, kudasaru.

the accent is on the syllable before nai. The deletion of the stem thus must occur before the accent assignment rule. The na & i which remains after the deletion will still retain the specification [+ acc], so that the accent assignment rule will put the accent on /na/. The irregularity of the honorific verbs is that the imperative ending is /i/ rather than /e/ and that the /r/ of the stem is lost before /i/.

Kuru and suru display irregular vowel alternations. Both have a /u/ in the present and provisional but an /i/ or (in some forms of kuru) an /o/ elsewhere in the paradigm. Since kuru behaves like a vowel-stem verb in that the endings are simply tacked onto something which remains unchanged except for the vowel alternation, I will say that it has a vowel stem. Since I see no reason for giving up the generalization that vowel stems can end only in /i/ or /e/, I will say that the stem is /ki/ and will supply the grammar with rules whereby the /i/ is changed into /o/ in the negative, imperative, tentative, causative, and passive and into /u/ in the present and provisional.

Suru is best treated as having a stem consisting of the single consonant /s/. This gives the correct forms for the causative and passive: s & sase & ru --> s & ase & ru, s & rare & ru --> s & are & ru; the past tense: s & ta --> si & ta (just like das & ta --> dasi & ta); and one of the

imperatives: s & e. The forms still to be accounted for are the present and provisional (with the appa^rent stem su-), the negative (which is sinai and not *sanai), the tentative (which is siyoo and not *soo), and the other imperative, siro. I can find no simpler solution than to have a rule which inserts an /i/ into all these forms (optionally in the imperative). The /i/ will be converted into /u/ in the present and provisional by the same rules as for kuru. In addition, there is a /u/ in the literary-flavored form subeki 'must do', so that beki must be added to the list of affixes before which /i/ → /u/ in the paradigm of suru. In the case of kuru, beki is added to the present tense instead of the stem, so that the expected *kubeki does not arise. The verb eru 'obtain' can also be rendered as uru; the beki-form is ubeki, and the provisional may be rendered as ureba, although ereba is much more common. Thus the full rule will say that the stem vowel becomes /u/ before -ru, -reba, and -beki in the verbs suru, kuru, and optionally eru.

There still remain a couple of irregularities to be discussed, namely the irregularities in the conjugation of the copula da and the politeness marker mas. The copula has the following forms:

	Present	Past	Gerund	Condit.	Provis.	Tentative
Simple	da	datta	de	dattara	nara(ba)	daroo
Polite	desu	desita	(désite)	desitara	(desitaraba)	desyoo

(the forms desite and desitaraba are rare, generally being replaced by de and desitaraba respectively). What little regularity these forms exhibit can be exploited by taking dar as the basic form of the copula; then the past, conditional, representative (dattari), and tentative simple forms are regular. To generate the present, gerund, and provisional forms, the following completely ad-hoc rules are needed:

r & ru → ∅ in env. # da ___ #
 ar & t → ∅ in env. # d ___ e #
 dar & reba → nara .

To generate the polite forms, it is necessary to have a rule which contracts dar & mas into des. Since the irregularity of having -syoo instead of -soo in the tentative occurs only in desyoo and polite forms in -masyoo, some advantage is gained by stating the contraction rule in the somewhat pedantic form ar & ma → e in env. # d ___ s , since then no extra rule will be needed to get desyoo instead of *desoo (assuming that the contraction rule follows the rule which palatalizes the /s/ of masyoo).

The irregularities of /mas/ are that the tentative form is masyoo and not *masoo, that the negative present tense form is masen (not *masanai), and that the other forms of the negative consist of masen followed by the

corresponding polite form of the copula:

tabe & mas & NEG & ta → tabemasen desita

tabe & mas & NEG & yoo → tabemasen desyoo

These facts may be described by rules which insert # dar & mas after mas & neg, shorten the negative morpheme from /na/ to /n/, and delete the polite copula in the present (so that tabemasen is derived from *tabemasen desu):

1. mas & NEG & Aux → mase & 2 # dar & mas & 3.
2. $\begin{bmatrix} + \text{ obs} \\ - \text{ grv} \\ + \text{ cnt} \end{bmatrix}$ → [+ shp] in env. _____) Polite & yoo
3. /a/ → ∅ in env. _____) NEG #
4. desu → ∅ in env. masen # _____

2.5 Sino-Japanese morphemes

Many syntactic and phonological phenomena require that the class of Sino-Japanese morphemes be distinguished in the grammar. These morphemes are borrowings from Chinese which can function syntactically either as nouns (e.g., ai 'love') or as components of compounds, often with a learned flavor much like learned compounds of Greek and Latin elements in English (e.g., dansyoku 'sodomy'). Many of these single elements or compounds can be compounded with the verb suru to form "uninflected verbs" or with the enclitic na or no to form "uninflected adjectives".

A Sino-Japanese morpheme can be one or two morae long. If it is two morae long, there are very few possibilities for the second mora: it can be either the syllabic nasal or /i/ or a prolongation of the preceding vowel, or one of the morae /ki, ku, ti, tu/. Examples:

ka	geki
kan	kaku
kai	niti
koo	katu

Most Sino-Japanese morphemes ending in -ku, -ki, -tu, or -ti have an alternant in which the syllabic obstruent replaces the -ku, -ki, tu, or -ti; thus

iti 'one'	<u>i</u> ppon 'one (slender object)'
daig <u>a</u> ku 'university'	<u>a</u> kkoo 'school'
<u>b</u> uturyoo 'quantity'	<u>b</u> ussitu 'substance'

To my knowledge, all authorities who treat these alternations regard the alternant in -ku, etc. as basic and the other alternant as derived from it by deletion of the final vowel. Thus, Martin says ([1], p. 29), "When followed within a word by any morpheme of the assimilative type which begins with the phoneme k, the vowel of the syllable -ku is replaced by zero".

Note, however, that the final vowel of the long alternant of the morpheme is completely predictable: if the preceding consonant is sharp, then the vowel is /i/, and if the preceding consonant is non-sharp, then the vowel is

/u/. The alternation between syllabic obstruent and full syllable could thus perfectly well be described by a rule of vowel-insertion rather than of vowel-deletion. Forms such as *ikkai* 'first floor' and *itizi* 'one o'clock' would have derivations such as:

underlying form	<i>it, : kai</i> ¹⁴	<i>it, : zi</i>
vowel insertion	(no effect)	<i>iti : zi</i>
assimilation	<i>ik : kai</i>	(no effect)

I henceforth assume that these forms are derived in this way. I turn now to the question of the environment in which the vowel is inserted. A vowel must be inserted if the morpheme is word-final: *kyoo:ik* → *kyooiku* 'education', or if the following segment is voiced: *it,:zi* → *itizi* 'one o'clock', *kat:yoo* → *katuyoo* 'conjugation', *set:mei* → *setumei* 'explanation', *pat:on* → *hatuon* 'pronunciation'.

If the morpheme-final consonant is /k/ or /k,/, a vowel must be inserted unless the following consonant is /k/ or /k,/¹⁵: *rok:sai* → *rokusai* 'six years old', *tok:pon* → *tokuhon* 'anthology', *sek,!*tan* → *sekitan* 'coal'. One might then formulate the rule

¹⁴) The elements of a compound are always separated by at least a :-junction.

¹⁵) Combinations of rok 'six' with morphemes beginning with /p/ are an exception to this statement: *rok:pyak* → *roppyaku* '600' rather than the expected **rokuhyaku*.

$$\emptyset \rightarrow \begin{bmatrix} - & \text{cns} \\ + & \text{voc} \\ + & \text{dif} \\ \alpha & \text{grv} \end{bmatrix} \text{ in env. } \left\{ \begin{array}{l} [+ \text{ cns}] \\ [\alpha \text{ shp}] \end{array} \right\} \text{ --- } + \text{ Sino} \quad \& \quad \left\{ \begin{array}{l} \# \\ [+ \text{ voice}] \end{array} \right\} \\ \left\{ \begin{array}{l} + \text{ cns} \\ + \text{ cmp} \\ \alpha \text{ shp} \end{array} \right\} \text{ --- } + \text{ Sino} \quad \& \quad [- \text{ cmp}] \end{array} \right\}$$

Unfortunately, this rule will not suffice, since there are many instances where a vowel is inserted even though this environment is not met, for example, zirokukei 'magnetometer' (not *zirokkei), syazituha 'realist movement' (not *syazippa), betuhaitatu 'special delivery' (not *beppaitatu), itikiromeetoru 'one kilometer' (not *ikkiromeetoru). In the first three examples, it will be noted that the vowel is inserted at the major constituent break of a "long" compound: $\begin{array}{c} \diagup \quad \diagdown \\ \text{zi} \quad \text{rok} \quad \text{kei} \end{array}$ $\begin{array}{c} \diagup \quad \diagdown \\ \text{sya} \quad \text{zit} \quad \text{pa} \quad \text{bet} \quad \text{pai} \quad \text{tat.} \end{array}$ In the fourth example, the second component is a morpheme of more than two morae. All the instances in which a vowel is inserted after /t/ or /t,/ which do not fit the above environment are of these two types. Indeed, ~~the converse assertion is also true: in all cases of these two types in which the morpheme in question ends in /t/ or /t,/, a vowel is inserted.~~ It will thus be necessary to modify the rule so that it will not apply across the major constituent break of such compounds. I will defer the reformulation of the rule until the section on compounds, where devices will be introduced which allow an extremely simple reformulation.

In most cases of morphemes ending in /k,/ and many cases of morphemes ending in /k/, both a form with and a form without the vowel are possible when the following morpheme begins with /k/ or /k,/: sekikan or sekkan 'sarcophagus', tekikoku or tekkoku 'enemy country', sekika or sekka 'bolshivism'. Even across the major constituent break of a "long" compound it is not always necessary to insert a vowel after /k/ or /k,/: sekkekyuu 'red blood cell' sek, ket kyuu, sankakkei 'triangle' san kak kei. As a first approximation to describing the behavior of Sino-Japanese morphemes, I will simply say that vowel insertion operates optionally in environment [+ obs]____:[+ obs], regardless of whether a major constituent break occurs.

One class of items which superficially look like exceptions to the above treatment of vowel-insertion is exemplified by the word dangoppana 'snub nose' (lit. 'dumpling nose'), where there is a geminate stop other than /kk/ across a major constituent break: dan go pana. However, here the syllabic obstruent is not part of the Sino-Japanese morpheme which one might suspect it of belonging to. The word for 'dumpling' is dango, not *dangotu or *dangoti. In the class of compounds involved,

an obstruent is inserted between the two members. This obstruent is not in the environment of the vowel-insertion rule, since it is not the final segment of a Sino-Japanese morpheme; hence no vowel is inserted. Note that in this type of compound it is also possible to get a geminate consonant after a long vowel, which is otherwise impossible in Japanese: tyuuppara 'state of indignation'.

Zyuu 'ten' has an alternant ending in the syllabic obstruent when followed by a voiceless obstruent. Some speakers have zikko, zippon, etc., and others have zyukko, zyuppon, etc. Following Martin ([1], p. 28), I represent zyuu as having an underlying form of either zip or zyup. In isolation, either of these forms converts into zyuu:

underlying form	zip	zyup
vowel insertion	zipu	zyupu
p → h	zihu	zyuhu
h → ?	zi?u	zyu?u
i?u → yuu	zyuu	zyuu

the last step by a rule not mentioned so far which is involved in the paradigm of yuu 'say', past tense itta. Yuu is entered in the dictionary as /ip/, and ip & ru → ip & u → i? & u → yu & u. Stated in the most general form, this rule will also eliminate the /?/ of zyu?u. When an obstruent follows zyuu, the usual assimilation rule applies and zip:ko → zikko, zyup:ko → zyukko, etc.

Only the following long vowels and diphthongs are possible in Sino-Japanese morphemes: ee, ai, oo, ui, uu. The sequences [ee] and [oo] could just as well be represented /ei/ or /ou/, since there is no ee/ei or oo/ou contrast within a morpheme. Making this change, I observe that now the final segment of a diphthong or long vowel in a Sino-Japanese morpheme will always be either /u/ or /i/, so that all that need be marked in the dictionary is that that segment is a vowel and whether it is [+ grv] or [- grv]. Since the grammar already contains a rule by which /a/ and /o/ coalesce before /u/, it is not necessary to mark the compactness of the first segment of /ou/. That rule also excludes the sequence *eu. To exclude */ii/ and */iu/, it is necessary that there be a morpheme structure rule making a segment [- shp] if it precedes a [- grv] first member of a vowel sequence in a Sino-Japanese morpheme. The remaining non-occurring vowel sequence, */oi/, can be excluded by a morpheme structure rule which makes a back vowel [α cmp] before an [α grv] vowel.

The dictionary entry of a Sino-Japanese morpheme will contain two or three segments: a non-vowel (which may be /?/) followed by a vowel, followed by either nothing at all or one of the following segments: p, t, t,, k, k,,

i, u, n. The latter eight segments can be distinguished by marking them as follows:

	p	t	k	t, k, n	i	u
cns	+	+	+	+	+	-
obs	+	+	+	+	-	
grv	+	-	+	-	+	-
dif	+		-	-		
shp		-	-	+	+	

The constraints mentioned correspond to the morpheme structure rules:

1. [] \rightarrow [- voc] in env. + Sino (_____)
2. [] \rightarrow $\left[\begin{smallmatrix} - \text{cns} \\ + \text{voc} \end{smallmatrix} \right]$ in env. + Sino ([] _____)
3. [+ cns] \rightarrow [- cnt] in env. _____) + Sino
4. [- cns] \rightarrow $\left[\begin{smallmatrix} + \text{voc} \\ + \text{dif} \end{smallmatrix} \right]$ in env. $\left[\begin{smallmatrix} - \text{cns} \\ + \text{voc} \end{smallmatrix} \right]$ _____) + Sino
5. [] \rightarrow [- shp] in env. + Sino (_____ $\left[\begin{smallmatrix} - \text{cns} \\ + \text{dif} \\ - \text{grv} \end{smallmatrix} \right]$)
6. $\left[\begin{smallmatrix} - \text{cns} \\ + \text{grv} \end{smallmatrix} \right]$ \rightarrow [α cmp] in env. _____ $\left[\begin{smallmatrix} - \text{cns} \\ + \text{grv} \end{smallmatrix} \right]$) + Sino

There should also be morpheme structure rules to express the fact that a Sino-Japanese morpheme must be at least two and at most three segments long. To my knowledge, rules of this type have hitherto never been stated formally in generative-phonological descriptions. However, a slight reinterpretation of a couple of concepts allows such rules to be incorporated easily into a generative-phonological description. The first reinterpretation consists in recognizing that the square brackets indicating "segment" really amount to a feature. This can

be seen best by considering the two phonological rules

M. [- cns] → [+ tns] in env. _____ []

N. [- cns] → [+ tns]

Rule N, which makes all vowels tense, is more general than rule M, which only makes non-final vowels tense, and if that generality is to correspond to a measure of complexity which counts symbols, the [] must thus be included in the count.¹⁷ The second reinterpretation is that where I took the notion "possible morpheme" to mean simply an arbitrary matrix of pluses and minuses, presumably with a finite number of columns, it should now be taken to be an arbitrary matrix of pluses and minuses with infinitely many columns, one of the rows being a feature corresponding to []; the morpheme structure rules corresponding to morpheme length will then "throw away" all but a finite number of columns of this matrix by specifying them as "-[]". The following two rules might be given to specify that Sino-Japanese morphemes are respectively at least 2 segments long and at most 3 segments long:

A. → [] in env. -[][]____...)+Sino

B. → -[] in env. [][][]____...)+Sino

¹⁷) However, for sake of legibility, I will not omit

redundant brackets from the rules.

Some restrictions must be imposed on the random matrices if this is to work. First, note that if one took the matrix which had all of its columns specified as [], then every column would be preceded by three segments and rule B would make every column a non-segment; thus it is necessary to require that the matrices on which the morpheme structure rules apply contain at least one non-segment. Similarly, if one took the matrix whose columns are all non-segments, rule A could not apply to it to make at least two of its columns segments, as it is supposed to; thus every matrix must be required to contain at least one segment. The rules of morpheme length must precede all other morpheme structure rules. After they have applied, the other morpheme structure rules and the phonological rules will apply to matrices with only finitely many columns, namely those obtained by discarding all but a finite sequence of segments bounded on each end by a non-segment.

2.6 The rules of segmental phonology

The following are the morpheme structure and phonological rules which I have arrived at in the above discussion, plus a few minor rules which I did not mention. They apply in the order given. The rules will not fill in all specifications left blank in dictionary entries; however, the blanks they do not fill in will not figure in the feature interpretation rules, for example, sharpness

specifications for vowels.

The junctural rank of a rule, if it is lower than \$, is written after the number of the rule. In some rules a double word boundary ## appears. The reasons for distinguishing between single and double word boundary will be given in the next chapter. At the present stage of the analysis, one may perfectly well identify single with double word boundary. The list of phonological rules is reasonably complete, but the list of morpheme-structure rules is highly incomplete, since I have made no real attempt to make a thorough study of the sequential constraints on the segments in Japanese morphemes.

2.6.1 Morpheme structure rules

A, B, 1, 2, 3, 4, 5, 6 as in sec. 2.5.

7. [] → [- str]

8. $\begin{bmatrix} + \text{ cns} \\ + \text{ native} \end{bmatrix}$ → [- shp]

Rule 7 corresponds to the fact that stridency is non-distinctive; later rules will make [+ str] those segments which are actually strident. Similarly, rule 8 corresponds to the fact that sharpness is non-distinctive in consonantal segments of native morphemes.

9. [+ cns] → [- voc]

10. $\begin{bmatrix} + \text{ cns} \\ - \text{ obs} \\ - \text{ nas} \end{bmatrix}$ → $\begin{bmatrix} - \text{ grv} \\ + \text{ voc} \end{bmatrix}$

Rules 9 and 10 say that all consonantal segments are [- voc]

except for /r/, which is [+ voc] as well as being [- grv].

$$11. \begin{bmatrix} - \text{cns} \\ - \text{voc} \end{bmatrix} \rightarrow \begin{bmatrix} - \text{flt} \\ + \text{shp} \end{bmatrix} \text{ in env. } [\quad] \underline{\quad}$$

A glide in a dictionary entry can only be /y/ if it is non-initial.

$$12. \begin{bmatrix} - \text{cns} \\ - \text{dif} \\ + \text{Sino} \end{bmatrix} \rightarrow [+ \text{grv}]$$

corresponding to the fact that the only non-diffuse vowels in Sino-Japanese morphemes are /a/ and /o/.

$$13. \begin{bmatrix} - \text{cns} \\ - \text{voc} \\ \alpha \text{shp} \end{bmatrix} \rightarrow [\alpha \text{grv}]$$

which says that /y/ is non-grave and all other glides grave. This is involved in the later rule that /r,s,y/ → ∅ in the environment [+ cns] + , which can be stated

$$\text{in the form } \left\{ \begin{array}{l} + \text{cns} \\ - \text{voc} \\ - \text{grv} \\ + \text{cnt} \end{array} \right\} \rightarrow \emptyset$$

$$14. [- \text{cns}] \rightarrow [- \text{obs}]$$

$$15. [+ \text{grv}] \rightarrow [- \text{cnt}] \text{ except in env. } \left\{ \begin{array}{l} \overline{+ \text{dif}} \\ \overline{+ \text{onomat}} \\ \overline{- \text{voice}} \\ \overline{+ \text{foreign}} \end{array} \right\}$$

$$16. [- \text{obs}] \rightarrow \begin{bmatrix} + \text{voice} \\ + \text{cnt} \end{bmatrix}$$

(this rule makes all non-obstruents continuant, even /m/ and /n/, which are actually non-continuants; a later rule will make them [- cnt]).

$$17. \begin{bmatrix} + \text{obs} \\ + \text{cnt} \\ + \text{grv} \\ \left\{ \begin{array}{l} + \text{onomat} \\ + \text{foreign} \end{array} \right\} \end{bmatrix} \rightarrow [- \text{voice}]$$

i.e., onomatopoeia and foreign words may contain /f, h/
but not /v, ʃ/.

18. $\begin{bmatrix} - & \text{cns} \\ - & \text{grv} \end{bmatrix} \rightarrow [- \text{cmp}]$

19. $\begin{bmatrix} + & \text{cns} \\ - & \text{grv} \end{bmatrix} \rightarrow [+ \text{dif}]$

Rule 18 says that front vowels are non-low, rule 19 that non-grave consonants are dental [t, d] rather than palatal [ç, ʝ].

20. $\begin{bmatrix} + & \text{cns} \\ + & \text{nas} \\ - & \text{obs} \end{bmatrix} \rightarrow \begin{bmatrix} + & \text{dif} \\ - & \text{cnt} \end{bmatrix}$

Nasals, except for the [ŋ] of foreign words (which is represented in the dictionary as if it were [n^g], i.e., [+ nas]) are non-velar non-continuants, which is to say that outside of foreign words the only nasals in dictionary entries are /m/ and /n/.

2.6.2 Phonological rules

1. $\emptyset \rightarrow \left[\begin{array}{l} - \text{cns} \\ + \text{voc} \\ \left\{ \begin{array}{l} - \text{dif} \\ + \text{grv} \end{array} \right\} \\ \left\{ \begin{array}{l} + \text{cmp} \\ + \text{dif} \end{array} \right\} \\ \left[- \text{grv} \right]_1 \end{array} \right]$ in env. [+ cns])_{Verb&} — { & NEG }₁

After a consonant stem, /a/ is added before the negative morpheme and /i/ is added before compound boundary. Note that rule 1 will apply in the "infinitive", where the ending is zero. There the stem-final consonant will be followed by #, and the rule will apply since a # is also a : .

2. rank ##. $\emptyset \rightarrow \begin{bmatrix} - & \text{cns} \\ + & \text{voc} \\ + & \text{dif} \\ \alpha & \text{grv} \end{bmatrix}$ in env.
- a. $\begin{bmatrix} + & \text{cns} \\ \alpha & \text{shp} \end{bmatrix} \text{ --- } \left\{ \begin{array}{l} \# \\ : [+ \text{ voice}] \end{array} \right\}$
- b. $\begin{bmatrix} + & \text{cns} \\ - & \text{dif} \\ \alpha & \text{shp} \end{bmatrix} \text{ --- } : [+ \text{ dif}]$
- c. (OPT) $\begin{bmatrix} + & \text{cns} \\ - & \text{dif} \\ \alpha & \text{shp} \end{bmatrix} \text{ --- } : \begin{bmatrix} + & \text{cns} \\ - & \text{dif} \end{bmatrix}$

Environment a. corresponds to the insertion of /i/ or /u/ after the final consonant of a Sino-Japanese morpheme when it is either final or followed by a voiced segment (vowels included). Environment b. corresponds to vowel insertion when a final /k/ or /k,/ of a Sino-Japanese morpheme is followed by something other than /k/ or /k,/. Environment c. corresponds to the optional vowel insertion between /k/ or /k,/ and /k/ or /k,/.

3. $\begin{bmatrix} \{ + & \text{cns} \\ - & \text{voc} \} \\ - & \text{grv} \\ + & \text{cnt} \end{bmatrix} \rightarrow \emptyset$ in env. $[+ \text{cns}] \ \& \ \text{---}$

Affix-initial /r, s, y/ are deleted after a consonant verb-stem. This rule requires the representation of /r/ as [+ cnt], which is perhaps questionable, since it is a flap phonetically; but this treatment is admissible since there is no continuant/non-continuant opposition in liquids in Japanese.

4. $[+ \text{obs}] \rightarrow [\alpha \text{ voice}]$ in env. $\begin{bmatrix} + & \text{cns} \\ - & \text{voc} \\ \alpha & \text{voice} \end{bmatrix} \ \& \ \text{---}$

By this rule /t/ becomes /d/ after verb-stems ending in b, g, m, or n.

5. $\begin{bmatrix} + \text{ obs} \\ + \text{ cmp} \end{bmatrix} \rightarrow [+ \text{ cnt}]$ in env. _____ & $[+ \text{ obs}]$

6. $\emptyset \rightarrow \begin{bmatrix} - \text{ cns} \\ + \text{ dif} \\ - \text{ grv} \end{bmatrix}$ in env. $\begin{bmatrix} + \text{ obs} \\ + \text{ cnt} \end{bmatrix}$ _____ & $[+ \text{ obs}]$

Rule 5 converts kak & ta and oyog & da into kah & ta and oyoh & da. Rule 6 then converts them into kahi & ta and oyohi & da (which eventually become kaita and oyoida) as well as converting kas & ta into kasi & ta.

7. $\begin{bmatrix} - \text{ cns} \\ - \text{ grv} \\ + \text{ Sino} \end{bmatrix} \rightarrow [\alpha \text{ dif}]$ in env. $\begin{bmatrix} \{- \text{ voc} \} \\ \alpha \text{ 'shp} \end{bmatrix}$ _____

A front vowel in a Sino-Japanese morpheme is /i/ or /e/ according as it is preceded by a sharp or non-sharp segment.

8. $\begin{bmatrix} \{ + \text{ cns} \} \\ - \text{ voc} \\ - \text{ foreign} \end{bmatrix} \rightarrow [\alpha \text{ shp}]$ in env. _____ $\begin{bmatrix} - \text{ cns} \\ \alpha \text{ dif} \\ - \text{ grv} \end{bmatrix}$

In non-foreign morphemes, a non-vowel becomes sharp before /i/ and non-sharp before /e/.

9. rank ##. $\begin{bmatrix} + \text{ obs} \\ + \text{ grv} \\ + \text{ dif} \\ - \text{ onom} \\ - \text{ foreign} \end{bmatrix} \rightarrow [+ \text{ cnt}]$ in env. $\left\{ \begin{matrix} \# \\ [- \text{ cns}] \end{matrix} \right\}$ _____ $[- \text{ cns}]$

Rule 9 converts initial and intervocalic /p/ into /f/ in native and Sino-Japanese morphemes.

10. rank : . $[- \text{ cns}] \rightarrow \begin{bmatrix} - \text{ cmp} \\ + \text{ grv} \end{bmatrix}$ in env. _____ $\begin{bmatrix} - \text{ cns} \\ + \text{ grv} \\ + \text{ dif} \end{bmatrix}$

/au/ coalesces with /ou/ and /iu/ with /yuu/, so that taka & u \rightarrow takoo, atarasi & u \rightarrow atarasyuu.

11. rank :: $\begin{bmatrix} + \text{ obs} \\ + \text{ cnt} \\ + \text{ grv} \\ - \text{ shp} \end{bmatrix} \rightarrow \begin{bmatrix} - \text{ cns} \\ - \text{ obs} \end{bmatrix}$ in env. $[- \text{ cns}] ___ [- \text{ cns}]$

12. $\begin{bmatrix} - \text{ cns} \\ - \text{ voc} \\ - \text{ shp} \end{bmatrix} \rightarrow [\alpha \text{ flt}]$ in env. $______ \begin{bmatrix} - \text{ cns} \\ \alpha \text{ cmp} \end{bmatrix}$

Rule 11 makes intervocalic /h/ into a glide, which rule 12 will make into /w/ before /a/ and /?/ elsewhere. Rules 11 and 12 are involved in such alternations as yowai/yo?oo:

underlying form	yopa & i	yopa & u
rule 9	(no effect)	yopo & u
rule 10	yoha & i	yoho & u
rule 11	yoHo & i	yoHo & u
rule 12	yowa & i	yo?o & u

where H denotes the feature complex $\begin{bmatrix} - \text{ cns} \\ - \text{ voc} \\ - \text{ shp} \end{bmatrix}$ (i.e., the {w, ?} archiphoneme).

13. $\begin{bmatrix} + \text{ cns} \\ + \text{ voc} \end{bmatrix} \rightarrow [+ \text{ obs}]$ in env. $______ \& [+ \text{ obs}]$

This rule only affects verb-stem final /r/, which becomes an obstruent before an ending beginning with /t/.

14. "Voicing rule"

$[+ \text{ obs}] \rightarrow [+ \text{ nas}]$ in some as yet to be specified environment.

15. rank *. $\begin{bmatrix} + \text{ obs} \\ + \text{ cmp} \\ + \text{ voice} \\ - \text{ foreign} \end{bmatrix} \rightarrow [+ \text{ nas}]$ in env. $[\quad] ______$

Non-initial /g/ becomes /ŋ/ (actually, [ⁿg], which then becomes [ŋ]). Since rule 15 is of rank *, it does not nasalize those /g/'s which immediately follow the prefixes o, go, oo, which are followed by *.

16. $\begin{bmatrix} + \text{ nas} \\ + \text{ cmp} \end{bmatrix} \rightarrow [- \text{ obs}]$

The [n̥g]'s created by the last two rules, as well as those marked in the dictionary entries of foreign morphemes, become [ŋ].

17. rank ##. $\begin{bmatrix} + \text{ cns} \end{bmatrix} \rightarrow \begin{bmatrix} \alpha \text{ grv} \\ \beta \text{ cmp} \\ \delta \text{ shp} \end{bmatrix}$ in env. _____ $\begin{bmatrix} + \text{ cns} \\ \alpha \text{ grv} \\ \beta \text{ cmp} \\ \delta \text{ shp} \end{bmatrix}$

Syllabic nasal and syllabic obstruent assimilate the point of articulation and the sharpness of a following consonant.

18. rank ##. $\begin{bmatrix} + \text{ cns} \end{bmatrix} \rightarrow \begin{bmatrix} \alpha \text{ cnt} \\ \beta \text{ voice} \end{bmatrix}$ in env. _____ $\begin{bmatrix} - \text{ voc} \\ \alpha \text{ cnt} \\ \beta \text{ voice} \end{bmatrix}$

A syllabic obstruent assumes the continuance and voicing of a following consonant or glide. The voicing assimilation has a non-null effect only on those syllabic obstruents which rule 19 will turn into syllabic nasals, e.g.,

boCyari \rightarrow boyyari \rightarrow bonyari.

19. $\begin{bmatrix} - \text{ voc} \\ + \text{ voice} \end{bmatrix} \rightarrow [+ \text{ nas}]$ in env. _____ $[+ \text{ cns}]$

Yob & ta becomes yob & da by rule 4, yod & da by rule 17, and yon & da by rule 19.

20. $[+ \text{ nas}] \rightarrow \begin{bmatrix} - \text{ cns} \\ + \text{ voc} \\ \alpha \text{ grv} \\ \beta \text{ dif} \\ \delta \text{ cmp} \end{bmatrix}$ in env. $\begin{bmatrix} - \text{ cns} \\ \alpha \text{ grv} \\ \beta \text{ dif} \\ \delta \text{ cmp} \end{bmatrix}$ _____ $\left\{ \begin{array}{l} : [- \text{ cns}] \\ [- \text{ cns}] \\ [- \text{ voc}] \\ \# \end{array} \right\}$

The "syllabic nasal" becomes a nasalized continuation of the preceding vowel if it is followed by word boundary or a glide or :-junction and a non-consonantal segment.

21. [+ nas] → [+ voice]

22. [+ obs] → [- nas]

These two rules convert the [ᵐp], etc. created by rules 14 and 15 into voiced oral obstruents.

23.
$$\begin{bmatrix} + \text{ obs} \\ - \text{ grv} \\ + \text{ cnt} \\ - \text{ shp} \end{bmatrix} \rightarrow [+ \text{ str}]$$

/s/, but not /s/, becomes strident.

24.
$$\begin{bmatrix} + \text{ obs} \\ + \text{ grv} \\ + \text{ cnt} \\ - \text{ foreign} \end{bmatrix} \rightarrow [+ \text{ cmp}] \text{ in env. } \left\{ \begin{array}{l} \text{---} \left\{ \begin{array}{l} - \text{ cns} \\ - \text{ grv} \\ - \text{ dif} \end{array} \right\} \\ [+ \text{ shp}] \end{array} \right\}$$

In non-foreign words, a grave spirant is [h] if it is followed by a vowel other than /u/ or if it is sharp; otherwise it is [f].

25.
$$\begin{bmatrix} - \text{ cns} \\ + \text{ dif} \end{bmatrix} \rightarrow [- \text{ voice}] \text{ in env.}$$

$$\begin{bmatrix} + \text{ cns} \\ - \text{ voice} \end{bmatrix} \text{ --- } \left\{ \begin{array}{l} [+ \text{ cns} \\ - \text{ voice} \\ \# \end{array} \right\}$$

subject to some other restrictions.

This is the rule which devoices /i/ and /u/ between voiceless consonants or word-finally after a voiceless consonant. I am unprepared to state the exact form of the rule, which will be considerably more complicated than this due to the fact that when several consecutive syllables each contain a diffuse short vowel between voiceless consonants, only alternate vowels become voiceless; however, whether it is the 1st, 3rd, etc.

vowels that become voiceless or the 2nd, 4th, etc., depends on several factors such as which vowels are /i/'s and which /u/'s and what the consonants are. The most thorough treatment I know of this topic is to be found in Han.

$$26. \begin{bmatrix} + \text{ obs} \\ - \text{ grv} \\ - \text{ shp} \end{bmatrix} \rightarrow [+ \text{ str}] \text{ in env. } \text{---} \begin{bmatrix} - \text{ cns} \\ + \text{ dif} \\ + \text{ grv} \end{bmatrix}$$

Before /u/, the dentals /t/ and /d/ become [c] and [d^z] (which then becomes [z]).

$$27. \begin{bmatrix} + \text{ obs} \\ - \text{ grv} \\ + \text{ voice} \\ \alpha \text{ cnt} \\ \left\{ \begin{array}{l} + \text{ shp} \\ + \text{ str} \end{array} \right\} \end{bmatrix} \rightarrow [-\alpha \text{ cnt}]$$

By rule 27, [d^z] → [z] and [z,] → [d,].

$$28. \text{rank} : \cdot \begin{bmatrix} - \text{ cns} \\ - \text{ voc} \\ - \text{ shp} \end{bmatrix} \rightarrow \emptyset \text{ in env. } \begin{bmatrix} - \text{ cns} \\ + \text{ dif} \end{bmatrix} \text{---} \begin{bmatrix} - \text{ cns} \\ + \text{ dif} \end{bmatrix}$$

$$29. \text{rank} : \cdot \begin{bmatrix} - \text{ cns} \\ + \text{ voc} \end{bmatrix} \rightarrow [+ \text{ grv}] \text{ in env. } \text{---} \begin{bmatrix} - \text{ cns} \\ + \text{ voc} \\ + \text{ grv} \\ + \text{ dif} \end{bmatrix}$$

Rules 28 (which probably ought to be more general) and 29 convert i?u into yuu 'say'.

$$30. \begin{bmatrix} - \text{ cns} \\ - \text{ voc} \end{bmatrix} \rightarrow [- \text{ shp}] \text{ in env. } \text{---} \begin{bmatrix} - \text{ cns} \\ - \text{ grv} \end{bmatrix}$$

Rule 30 turns /y/ into /?/ before /i/.

$$31. \begin{bmatrix} - \text{ cns} \\ - \text{ voc} \\ - \text{ shp} \\ - \text{ flt} \end{bmatrix} \rightarrow \begin{bmatrix} + \text{ nas} \\ \left\{ \begin{array}{l} + \text{ shp} \\ + \text{ flt} \end{array} \right\} \end{bmatrix} \text{ in env. } [+ \text{ nas}] \text{---} \begin{bmatrix} - \text{ cns} \\ - \text{ cmp} \\ \left\{ \begin{array}{l} - \text{ grv} \\ + \text{ grv} \end{array} \right\} \end{bmatrix}$$

When glottal constriction is between the syllabic nasal and a non-low vowel, it becomes a nasalized transition to

the following vowel ([\tilde{y}] before front vowels, [\tilde{w}] before back vowels), e.g., /pon?e/ = [ho \tilde{o} ye] 'to the book',
/pon?o/ = [ho \tilde{o} w \tilde{o}] 'book (acc. case)'.

CHAPTER III

ACCENT

3.1 General remarks

A sentence of standard Japanese is divided into phonological phrases (bunsetsu \downarrow $\frac{44}{\text{AB}}$), each of which may contain at most one significant fall in pitch. I will refer to the syllable or mora where this fall in pitch occurs as the accented mora or syllable of the phrase. Then, disregarding intonational factors, the morae of a phonological phrase display the following pitches: the morae up to and including the accented mora are high-pitched, except that the first mora is low-pitched if it is not accented; the morae after the accented mora are low-pitched; in phonological phrases which contain no accented mora, the first mora is low-pitched and all subsequent morae high-pitched. Examples:

tabete imasu 'is eating'

akete imasita 'was opening'

akete oite kuru 'go and open'

It will be noted that to specify the pitch shape of a phonological phrase, it is necessary only to specify which syllable is accented. Using ' after the accented mora to

mark accent and % to mark phonological phrase boundary, the above three utterances are then transcribed as follows:
 %ta'bete imasu% %akete ima'sita% %akete oite kuru%.

Japanese differs from languages with "stress accents" such as English and German in that, at least within the word, there is no such thing as secondary stress in Japanese. The only analogue to secondary stress to be found in Japanese is the phenomenon that when two or more consecutive accented phonological phrases form a single syntactic constituent, the second and subsequent ones are pronounced with their high syllables on a lower pitch than in the first phrase, for example, hamada-san ni aimasita 'I met Mr. Hamada'. However, while it is correct to label the /ma/ of aimasita as having a secondary accent in the above example, it is impossible for a single word to contain several different degrees of stress, as in the English compound "Port of New York Authority ticket book sales office". Japanese compounds have only one accent, for example, itidankatuyoodosi 'vowel-stem verb'.

3.2 Nouns

I will begin my discussion of how the accent of a phonological phrase is derived from its underlying structure by a consideration of a reasonably simple class of phonological phrases: those consisting of a noun

followed by any number of enclitics (joshi 助辞). Consider the following combinations of a noun with the copula

desu:

inoti desu 'it's a life'

kokoro desu 'it's a heart'

atama desu 'it's a head'

miyako desu 'it's a city'

I will explain these data by saying that the nouns *inoti*, *kokoro*, *atama*, and *miyako* are entered in the dictionary with accent respectively on the first syllable, the second syllable, the third syllable, and absent: *i'noti*, *koko'ro*, *atama'*, *miyako*. The nouns retain these accents when pronounced in isolation: inoti, kokokoro, ataama, miiyako (note that as a consequence of the nature of accent in standard Japanese, in contrast to many Japanese dialects, unaccented items are indistinguishable in isolation from items with accent on the final mora).

Now consider the combinations of an unaccented noun such as *miyako* with various enclitics:

miiyako made miiyako kara miiyako made wa miiyako kara wa

I will explain these data by saying that made and kara are respectively accented on the first syllable and accented on the second syllable. When combined with an unaccented noun, the accent of these enclitics becomes the

accent of the entire phonological phrase. What happens, however, when an enclitic such as made or kara is combined with an accented noun? In this case, only the accent of the noun is manifested:

i'noti kara koko'ro kara atama' kara

i'noti made koko'ro made atama' made

I will explain this fact by giving a rule that when a phonological phrase contains two accents, the second accent is eliminated. Thus kokoro made arises from koko'ro & ma'de by an application of this rule.

There is a second type of enclitic whose behavior differs from that of kara, made, desu, etc. in that it bears the accent regardless of what kind of noun it follows.

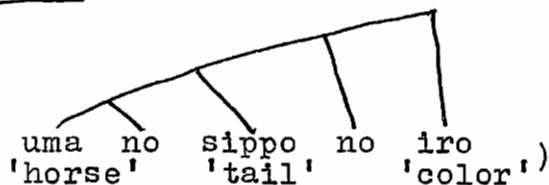
For example,

inoti gu'rai	'as much as a life'	inoti rasi'i	'like a life'
kokoro gu'rai	'as much as a heart'	kokoro rasi'i	'like a heart'
atama gu'rai	'as much as a head'	atama rasi'i	'like a head'
miyako gu'rai	'as much as a city'	miyako rasi'i	'like a city'

Tentatively I will represent phonological phrases involving these enclitics as having a junctural element, say, @, between the noun and the enclitic and that the junctural rank of the accent elimination rule is @ (I will eventually discard this solution, as it will turn out later to be inconsistent with the facts). Thus the accent elimination rule will not affect i'noti@gu'rai and will leave the accent on gu'rai.

The remaining types of enclitics are:

1. no (possessive particle). no is peculiar in that a final-accented noun of more than one syllable often loses its accent before no. The conditions under which this loss of accent takes place are syntactic. For example, there is no loss of accent when the Noun & no combination functions as an adjective: onna no ko 'girl' (onna' = 'woman', ko = 'child'), which contrasts with onna no ko 'the woman's child'. In nested possessives, the loss of accent only occurs in the innermost Noun no Noun constituent: uma no sippo no iro 'the color of the horse's tail' (IC structure



but sippo no iro 'color of the tail'. Also there is no loss of accent if the noun has any modifiers: sdno uma no sippo 'the tail of that horse', akai uma no sippo 'the tail of the red horse'. In all other cases final accented nouns lose their accent before no. I will defer my explanation of these phenomena to section 3.6.

2. ra, tati, sika. When one of these three particles is combined with an accented noun, the accent of the noun is manifested. When one of them is combined with an unaccented

noun, the noun acquires an accent on its final syllable.

Examples:

i'noti sika 'only a life' ana'ta tati 'you (pl.)'
 miyako' sika 'only a city kodomo'tati 'children'
 miyako kara 'from the city' kodomo kara 'from the child'

bo'kura 'us'
 kore'ra 'these'
 kore ga 'this (nom. case)'

These data are most simply explained by saying that these morphemes are preceded by an accent: 'ra, 'tati, 'sika.

The accent elimination rule will automatically remove this accent when they are preceded by accented nouns:

i'noti &'sika → i'noti sika.

3. dake. The only peculiarity of dake is that after accented nouns, two forms are possible: i'noti dake, inoti dake'. After unaccented nouns the accent is always on the /ke/ of dake. What these facts amount to is that dake is accented on the second syllable and can optionally be preceded by @. In the case of unaccented nouns, the same form results regardless of whether @ is present.

4. nagara. Nagara is accented after an accented noun and unaccented after an unaccented noun: inoti nagara, miyako nagara. It is necessary to have a rule of accent attraction which moves accent from the noun onto the first syllable of nagara.

3.3 Verbs and adjectives

I now turn to the considerably more interesting question

of accentuation in verbs and adjectives. First I will consider the question of how much freedom there is in the position of accent in the different syntactic categories. Recall that in the preceding section examples were given of three-syllable nouns whose underlying forms had accent on the first syllable, on the second syllable, on the third syllable, and no accent at all. It thus may be said that the location of accent in nouns is free: in specifying the basic accentuation of an n-syllable noun, one is giving the value of a variable which can take any of the values 0, 1, ..., n. In verbs and adjectives, however, there is much less freedom in the position of accent. Considering for the moment just present tense forms and forgetting about some exceptions which I will discuss later, there are only two possible accentuations: there are verbs taberu 'eat' and akeru 'open, but *haseru would not be possible; there are adjectives takai 'high' and akai 'red', but *sakai would not be possible. Thus to specify the accentuation of a verb or adjective, all that need be marked in the dictionary entry is the value of a binary variable:

accented or unaccented.¹ I will accordingly call verbs which have an accented present tense form accented verbs

1) To see that akeru is unaccented rather than final-accented, add a noun: akeru to 'the door which he opens' and not *akeru to results.

and those which have an unaccented present tense form unaccented verbs. If it is kept in mind that the terms accented and unaccented refer to the underlying form and not to the phonetic form, no confusion should be caused by the fact that many of the inflected forms of unaccented verbs are in fact accented.

Consider now an accentual alternation which takes place in almost all accented adjectives and vowel-stem verbs:²

Present	tabe'ru	Present	taka'i
Past	ta'beta	Adverbial	ta'kaku

This alternation could be described in either of two ways: either say that the accent is basically on the final syllable of the stem (tabe', taka') and that it is shifted to the left in the past and adverbial forms, or say that it is basically on the penultimate syllable of the stem (ta'be, ta'ka) and that the accent is attracted towards the present tense ending. I will choose the latter

²) Below I will give an exhaustive account of the verbs and adjectives which do not undergo this alternation. I should point out here that in the speech of many young male speakers the alternation takes place only in verbs, not in adjectives, which have stem-final accent throughout their paradigms: taka'i, taka'ku. However, women and older men have the alternation as described here.

alternative, following S.-Y. Kuroda³ and John Chew⁴, who independently discovered that taking the stem-penultimate accent as basic gives a much simpler set of phonological rules. First of all, note that in the case of accented adjectives, the only inflectional forms in which the accent is on the final vowel of the stem are the present and the honorific; elsewhere in the paradigm the accent is either stem-penultimate or on an obligatorily accented ending. In the case of accented vowel-stem verbs, there are three other forms which have accent on the final vowel of the stem: the negative, the provisional, and the imperative. Since the negative of an accented consonant-stem verb is accented on the insert -a- which goes between the stem and the negative morpheme: yo'mu 'reads', yoma'nai 'does not read', the fact that the accent is on the stem-final syllable in vowel-stem verbs is attributable to whatever process puts the accent on the insert of consonant-stem verbs. Thus if the stem-penultimate accent is taken as basic, the only accent shift rule needed will be a rule which attracts the accent towards the present, provisional, and imperative endings (and in adjectives,

³) Unpublished work.

⁴) "Transformational Analysis of Modern Colloquial Japanese", Yale Univ. dissertation, 1961.

the honorific).

Further reason for taking the stem-penultimate accent as basic is given by a consideration of "uninflected adjectives" and "uninflected verbs". There are a handful of accented stems which can function as both inflected adjectives and uninflected adjectives. When they function as uninflected adjectives, the accent is on the penultimate syllable of the stem:⁵

ooki'i mado 'big window'	tiisa'i zibiki 'small dictionary'
o'oki na mado	ti'isa na zibiki
o'kiku	ti'isaku
okasi'i hanasi 'queer story'	siro'i suutu 'white suit'
oka'si na hanasi	si'ro no suutu
oka'siku	si'roku

Uninflected verbs (compounds of a Sino-Japanese morpheme or compound with suru 'do') can be of three kinds: (1) those accented exactly like ordinary unaccented verbs, (2) those accented exactly like ordinary accented verbs, and (3) those with a fixed accent on the Sino-Japanese part throughout the entire paradigm. Examples:

'subtract'	'love'	'scheme'
Pres. genzuru	aisu'ru	kito'suru
Past genzita	a'isita	kito'sita
Prov. genzire'ba	aisu'reba	kito'sureba

5) There is one anomalous stem which is accented when uninflected but unaccented when inflected: akai, a'ka no 'red'. However, here too the accent is stem-penultimate.

Insofar as the Sino-Japanese parts of these verbs can be used as independent words, those of type (1) are unaccented, those of type (2) are accented monomorphemic, and those of type (3) are accented compounds. Type (3) verbs must be assumed to have some junctural element between the Sino-Japanese part and suru which will prevent the accent-placement and accent attraction rules from moving the accent. In verbs of types (1) and (2), these rules will put the accent in the right places. Note, however, that if the stem-final accented alternants of verbs had been chosen as basic, it would be necessary to add a fairly complicated rule to the grammar which would shift the accent from the Sino-Japanese part onto suru in some but not all forms of the paradigm.

Consonant-stem verbs do not undergo any accentual alternation between present and past: tano'mu, tano'nda, always having the accent on the vowel preceding the stem-final consonant except in those forms where an ending is accented. This position of the accent is thus the natural one to take as the basic accent of these verbs. As argued above, the basic accent in accented adjectives and vowel-stem verbs is on the penultimate syllable of the stem. It is necessary to give a rule which will convert the binary morpheme feature [\pm accented] into an accent mark on an actual syllable. The rule takes the form

so that it only applies to the outermost pair of verb-stem parentheses. This modification can be accomplished by requiring that the rightmost parenthesis be followed by Aux. Thus the causative-passive *tabesaserare'ru* 'to be subjected to being made to eat' is derived as follows:

$$\left(\left(\left(\text{tabe} \right)_{\text{v-stem}} \& \text{sase} \right)_{\text{v-stem}} \& \text{rare} \right)_{\text{v-stem}} \& \text{ru} \right)_{\text{verb}} \rightarrow$$

+ acc

$$\left(\left(\text{tabe} \& \text{sase} \right)_{\text{v-stem}} \& \text{rare} \right)_{\text{v-stem}} \& \text{ru} \right)_{\text{verb}} \rightarrow$$

+ acc

$$\left(\text{tabe} \& \text{sase} \& \text{rare} \right)_{\text{v-stem}} \& \text{ru} \right)_{\text{verb}} \rightarrow$$

+ acc

(accent placement rule) \rightarrow *tabe & sase & ra're & ru*

(accent attraction rule) \rightarrow *tabe & sase & rare' & ru*

Now consider the negative. The negative of a verb is morphologically an adjective and can take all the inflections of an adjective except that it does not have a negative or an honorific form. Accentually, the negative verb differs from other adjectives in that it does not undergo the accentual alternations described above but has accent on the "stem-penultimate" syllable, which in this case is the syllable immediately before the negative morpheme *-na-*. The negative is thus irregular solely to the extent that the accent attraction rule does not apply to it. The simplest formulation of this irregularity is to claim that a junctural element / precedes the negative morpheme and that the accent attraction rule is of rank /. The

derivation of tabe'nai and yoma'nai is thus as follows:

$((\text{tabe})_{V\text{-stem}/na})_{A\text{-stem} \& i} \rightarrow$
+ acc

vowel-insertion (no effect)

derivation rule $\rightarrow ((\text{tabe}/na)_{A\text{-stem} \& i})$
+ acc

accent assignment $\rightarrow \text{tabe}'/na \& i$

$((\text{yom})_{V\text{-stem}/na})_{A\text{-stem} \& i} \rightarrow$
+ acc

vowel-insertion $\rightarrow ((\text{yom} \& a)_{V\text{-stem}/na})_{A\text{-stem} \& i}$
+ acc

derivation rule $\rightarrow ((\text{yom} \& a / na)_{A\text{-stem} \& i})$
+ acc

accent assignment $\rightarrow \text{yom} \& a' / na \& i$

The accent attraction rule, being of rank /, does not operate on these items as wholes, but splits them into the stretches: #tabe'/ and /na & i#; #yom & a'/ and /na & i#. Neither piece of either word contains an accented item followed by an attracting morpheme, and the rule thus has no effect; consequently, the correct forms tabe'nai and yoma'nai are obtained.

Now consider the desiderative form of a verb:

yomita'i 'would like to read', yobitai 'would like to call'.

The desiderative, like the negative, is morphologically an adjective. For some speakers of standard Japanese the desiderative displays the ordinary alternation: yomita'i,

yomi'taku, whereas for others the accent in the desiderative of an accented verb is always on the desiderative morpheme -ta-: yomita'ku. For the first kind of speakers there is no problem: the accent placement rule puts accent on the syllable before -ta- and in the present tense the attraction rule draws the accent onto -ta-. For the latter kind of speakers, the desiderative must be considered to be a compound: in accented compound verbs and adjectives the accent always stays on the second member, for example, nozokimiru 'peer', past tense nozokimi'ta (= nozok 'peer' & mi 'see'), magariide'ru 'emerge', past tense magariide'ta (= magari 'turn' & de 'emerge'), sumiyo'i 'comfortable', adverbial sumiyo'ku (= sum 'live' & yo 'good'). Assuming compound boundary to be the rank of the accent assignment rule, yomita'ku is derived as follows:

$$(((yom)V\text{-stem:ta})_{A\text{-stem}} \& ku) \rightarrow$$

+ acc

vowel-insertion rule $\rightarrow \lambda(((yom \& i)V\text{-stem:ta})_{A\text{-stem}} \& ku)$

+ acc

derivation rule $\rightarrow ((yom \& i : ta)_{A\text{-stem}} \& ku)$

+ acc

The accent placement rule applies to the chunk $:ta)_{A\text{-stem}}$

+ acc

Note that since the accent placement rule does not divide negatives (which contain /-juncture), / is lower than : in the junctural hierarchy.

There are a few verb inflections still to be discussed.

The gerund in *-te* and the infinitive (ending \emptyset) have the basic accent:

Present	tabe'ru	akeru	yo'mu	yobu
Gerund	ta'bete	akete	yo'nde	yonde
Infinitive	ta'be	ake	yo'mi	yobi

In the conditional and representative, the basic accent is manifested in accented verbs and the ending is accented in unaccented verbs:

Present	tabe'ru	akeru	yo'mu	yobu
Conditional	ta'betara	aketa'ra	yo'ndara	yonda'ra
Representative	ta'betari	aketa'ri	yo'ndari	yonda'ri

The endings thus are accented in the underlying forms:

ta'ra, ta'ri, and the accent elimination rule deletes

this accent after accented stems: ta'be & ta'ra \rightarrow

ta'betara. The provisional ending is accented after

unaccented stems and attracts the accent of an accented

stem onto the stem-final vowel:

Present	tabe'ru	akeru	yo'mu	yobu
Provisional	tabe'reba	akere'ba	yo'meba	yobe'ba
Imperative	tabe'ro	akero	yo'me	yobe

The provisional ending *-re'ba* thus has an accent on its first syllable and is included in the list of morphemes which attract accent. The imperative ending *ro/e* is often described as if it were an accented and accent-attracting morpheme like the provisional⁶. However, since the imperative ending is one mora long, it could unambiguously manifest an accent only when followed by something. Since

⁶) Jorden, pp. 360-361 writes akero', yobe'.

the only things which can follow it are certain clause-final particles (principally yo) which put an accent on the preceding syllable anyway, any accent which the imperative exhibits can be attributed to the following particle, and the imperative of unaccented verbs can be regarded as unaccented. The tentative always has the accent on the ending -yo'o; this is handled the same way as are those post-nominal enclitics which are always accented (i.e., for the time being, -yoo will be assumed to be preceded by some juncture @ over which accent deletion does not apply; however, this solution will be rejected in favor of another later in this dissertation). Jordan's analysis is based on a variety of Japanese in which the tentative of an unaccented verb is unaccented. That variety of Japanese differs from the one under discussion in that there the tentative is considered an accent-attracting morpheme and is not preceded by @.

This exhausts verb inflection; let me now take up what remains of adjective inflection. It will be recalled that for most forms, adjectives have the same endings as do verbs except that an insert appears between the stem and ending. Forms with an insert of -kar- or -ke- are all accented, but (except for the tentative, where the ending is always accented) the accent is in a different place

for accented adjectives than for unaccented: in these forms an accented adjective has its basic stem-penultimate accent but unaccented adjectives have stem-final accent:

	Present	Gerund	Past	Conditional
'high'	taka'i	ta'kakute	ta'kakatta	ta'kakattara
'red'	akai	akakute	aka'katta	aka'kattara

Representative	Provisional	Tentative
ta'kakattari	ta'kakereba	takakaro'o
aka'kattari	aka'kereba	akakaro'o

These data can be accounted for easily by saying that the inserts -kar- and -ke- are preaccented. Then, for example, the conditional forms are generated as follows:

	ta'ka & ta'ra	aka & ta'ra
Insert-insertion	ta'ka & 'kar & ta'ra	aka & 'kar & ta'ra
Accent elimination	ta'ka & kar & tara	aka & 'kar & tara

The honorific ending -u attracts accent onto the final vowel of the stem: tako'o gozaimasu, akoo gozaima'su. In another common variant of standard Japanese, the honorific form has the basic accent: ta'koo gozaimasu. The difference between these two types of Japanese is whether the -u is or is not an attracting morpheme.

I should also mention here the topic of post-clause particles. Most post-clause particles have homonymous post-nominal particles with closely related meanings (for example, to means 'with' after a noun and 'if' after a verb; kara means 'from' or 'after' after a noun and 'because' or 'after' after a verb). The only phonological

difference between post-clause particles and post-nominal particles is that most of the former are pre-accented.

Thus, *iku' kara* 'because he goes', *aka'i no de* 'since it is red', *akeru' no wa* 'the one which he opens'. Compare *iku to* 'if he goes', *akai koto' wa* 'the fact that it is red'.

When a pre-accented post-clause particle follows an adverbial form in *-ku*, the accent may be shifted one syllable to the left: *akaku' wa nai*, *aka'ku wa nai* 'it is not red'. However, this shift is only possible when the preceding syllable is voiced; thus '(he) is not sad' can only be *kanasiku'wa nai*, not **kanasi'ku wa nai*.

3.4 Some exceptions to the rules of 3.3

In the preceding section I treated accented adjectives and vowel-stem verbs as if they all underwent an alternation between stem-final accent in the present tense and stem-penultimate accent in the past or adverbial form. However, there are a large number of adjectives and a few verbs which have accent on the same syllable in both forms:

'near'	'deep'	'low'	'obstinate'	'foul-smelling'
<i>tika'i</i>	<i>huka'i</i>	<i>hiku'i</i>	<i>situko'i</i>	<i>kusa'i</i>
<i>tika'ku</i>	<i>huka'ku</i>	<i>hiku'ku</i>	<i>situko'ku</i>	<i>kusa'ku</i>

'thick'	'wise'	'rescue'	'get moist'
<i>huto'i</i>	<i>kasiko'i</i>	<i>tasuke'ru</i>	<i>sike'ru</i>
<i>huto'ku</i>	<i>kasiko'ku</i>	<i>tasuke'ta</i>	<i>sike'ta</i>

In addition, there are a handful of other verbs for which some forms have the accent one syllable later than expected, while elsewhere in the paradigm they behave like other accented verbs:

'blow'	'like'	'adhere'	'conceal'	'come'
huku'	suku'	tuku'	kakusu'	ku'ru
hu'ita	su'ita	tu'ita	kaku'sita	kita'

Recall that between voiceless consonants a high vowel becomes voiceless. In all the anomalous forms above, the vowel on which the accent is expected but does not occur is voiceless. If these forms are assumed to have underlying representations with accent on the expected syllable, a rule stating that accent is shifted one syllable to the right when it falls on a voiceless vowel will yield the correct forms.⁷ Thus huka'ku is derived as follows:

	(huka) _{A-stem} & ku
	+ acc
acc. placement	hu'ka & ku
devoicing	hU'ka & ku (capitals denote voiceless vowels)
accent shift	hUka' & ku

This treatment involves an underlying form hu'ka which never occurs anywhere in the paradigm: all forms have the

⁷) This rule is one of the many perceptive observations in Tasiro's most useful book (pp. 88 and 193).

accent on some syllable other than the first. The necessity of taking this as the underlying form becomes more obvious when one considers compounds in which the first segment of *huka'i* becomes voiced: *tyuuibuka'i*, *tyuuiu'kaku* 'cautious', where the accent is on the stem-penultimate syllable of the adverbial form. With the treatment given here, the accentuation of *tyuuibuka'i* requires no extra rules, whereas if *huka'* had been taken as the basic form, an extra rule would be needed to explain the "accent shift" in *tyuuiu'kaku*. Except in the cases where the first element is a single mora, which I will discuss later, compound adjectives in which the previously unvoiced syllable becomes voiced always exhibit the regular accentual alternation.

In the first group of words (*tika'i*, etc.), the accent is always as indicated. However, for the words of the second group except *kuru*, there are alternate forms in which the accent is not shifted. In the first group of words the accent shift leaves the accent within the stem, but in the second group it moves the accent onto the ending. Thus the accent shift rule becomes optional across morpheme boundary for speakers who have both forms (except that *kita'* then becomes an irregularity, since it has no alternate form *ki'ta*). Stating the exact environment in

which the accent shift rule applies is a difficult task which I have not yet fully solved. Some restrictions on its application are the following: (1) it does not shift accent onto adjective inserts, so that from *yorosii* 'OK' one gets *yorosi*'katta and *yorosi*'kereba rather than **yorosika*'tta and *yorosike*'reba; (2) it does not shift accent onto post-nominal particles; thus *mati*'kara, not **mati*ka'ra 'from the town'; (3) there are further restrictions which depend on the surrounding segments and also the grammatical nature of the form (the rule has wider application in adjectives than in verbs); thus the normal accentual alternation is retained in *tuke*'ru/*tu*'keta 'attach', *huke*'ru/*hu*'keta 'grow old', *tuki*'ru, *tu*'kita '(supply) is exhausted', *susuke*'ru/*susu*'keta 'get sooty'. In some of these cases a more complete treatment of the devoicing rules shows them to be not exceptional at all. For example, *susuketa* can be pronounced with either one or two voiceless vowels: *sUsu*'keta or *sUSU*'keta. Devoicing is probably best handled by a rule which devoices every second vowel in a sequence of several syllables which all have a high vowel between voiceless consonants, and then a later rule which gives the option of devoicing some of the remaining high vowels between voiceless consonants;

thus in *susuketa*, both /u/'s are between voiceless consonants, but the basic devoicing rule will only devoice the first one. If the secondary devoicing is assumed to apply after the accent shift rule, the retention of the basic accent in *sUSU'keta* will be explained. However, it will take more than that to yield an accurate statement of the environment in which the accent shift applies.

If the definition of "syllable" is revised slightly, this accent shift rule will also account for the fact that there is fixed accent in all adjectives such as *suppa'i* 'sour' which have a syllabic obstruent for the next-to-last mora of the stem. If a syllabic obstruent is considered to be not just a separate mora but a separate syllable, the rules will operate as follows:

	((suppa) _{A-stem} & i)	((suppa) _{A-stem} & ku)
	+ acc	+ acc
Accent placement	sup'pa & i	sup'pa & ku
Accent attraction	suppa' & i	(no effect)
Accent shift	(no effect)	suppa' & ku

yielding a stem-final accent in either case.

In the dialect of my informant S.-Y. K., virtually all adjectives other than those treated above have the normal accentual alternation. However, in the type of Japanese recorded in Hirayama's dictionary, there are a great number of other adjectives which have accent on

the same syllable in the adverbial form as in the present tense. The examples which I have found are as follows:

1. Virtually all adjectives ending in -na: kitana'i, okkana'i, obotugana'i, katazikenai, kütisagana'i, tutana'i, turena'i, nasakena'i, hakana'i, sasitukaena'i, hisitana'i (of adjectives in -na, setuna'i/setu'naku 'painful' appears to be the only one which exhibits the normal alternation for Hirayama).

2. Adjective stems of 3 or more morae ending in -to or -do: surudo'i, kiwado'i, sibuto'i, tooto'i (shorter adjectives such as hido'i/hi'doku 'cruel' and kudo'i/ku'doku 'tedious' are all regular).

3. Compounds of a one-mora noun with a two-mora adjective stem: kizuyo'i, nezuyo'i, kedaka'i, nadaka'i, kebuka'i, hagayu'i, kedaru'i, hidaru'i, mazika'i.

4. Adjective stems of 3 or more morae ending in -ka: atataka'i, mizika'i, komaka'i, yawaraka'i.

5. Some miscellaneous items: kawai'i, girigata'i, nagapposo'i, namanuru'i (Kenkyuusha lists this stem as unaccented), monosugo'i, himozi'i, tiisa'i.

One peculiarity of these words is that while their inflected forms always have accent on the stem-final syllable, the uninflected forms of the few adjectives in the above lists which have uninflected forms all have stem-penultimate accent: atata'ka na, koma'ka na, tiisa

na, yawara'ka na. There is thus good reason for assuming that these adjectives first have their accent assigned by the normal rule and then have the accent shifted into stem-final position in inflected forms (or to be more correct, in forms where there is only morpheme boundary between the stem and what follows, since the accent is also stem-final in the derived nouns in -sa: komaka'sa). Classes 1 through 4 above are definable phonologically, but the adjectives of class 5 will have to be marked as exceptional in their dictionary entries.

There remain a couple of peculiarities in certain adjectives. There are some adjectives whose -sa nominalizations can display an accentuation other than the basic one:

	Present	Adverbial	-sa nominalization
'large'	ooki'i	o'okiku	ookisa
'dangerous'	ayau	ayauku	ayau'sa
'cute'	kawai'i	kawai'ku	kawaisa
'difficult'	siniku'i	sini'kuku	sinikusa
'hackneyed'	hurukusa'i	hurukusa'ku	hurukusasa

I see no alternative to simply treating these forms as irregularities (most of them are paralleled by regular forms). The adjective tooi 'far' has the following forms: too'katta 'it was far', too'kereba 'if it were far', tooi' kara 'because it was far'. If an underlying form /topo/ were assumed, the anomaly of the accent on the second mora of a long vowel in the first two forms would be accounted for, but then one would expect

*too'i kara (just like aka'i kara 'because it is red'). If glottal constriction is marked in the transcription, it occurs between the /o/'s in the first two forms, but between the /o/ and /i/ in the third form and in isolation: to?o'katta, to?o'kereba, too?i' kara, too?i. I propose a metathesis rule to explain these forms: in a sequence CV?VV, the /?/ metathesizes with the following vowel unless that is accented (as in o?o'i 'numerous').

3.5 Compound nouns

In this section I will try to make some order out of a topic which has hitherto been presented as utter disorder, namely noun compounds. I will start by discussing the most easily available American and Japanese treatments of any thoroughness, those of Hirayama and Martin respectively. I find both treatments unsatisfactory in that neither approaches the state of a real theory of accent in Japanese compounds, i.e., a set of rules which in the vast majority of cases would correctly predict the accent of a compound from its morphemic and phonological composition and its syntactic structure. Because Hirayama's description comes closer to this goal than does Martin's, I find it more satisfactory; however, even Hirayama completely omits

mention of many important cases and makes vague or ambiguous statements about some of the cases he treats.

Hirayama and Martin both deal with the well-known fact that there are certain morphemes which cause a compound to be unaccented when they are the final element (for example, -mai 'rice': ookyuumai, kahaimai, kyuenmai, zinsoomai, seihakumai, haikyuumai, naitimai, nengumai, haigamai), and others which put accent on the last syllable of the preceding element (for example, -zai 'potion': kyooso'ozai, kyoosi'nzai, gedoku'zai, genetu'zai, sattyu'uzai, syuure'nzai, syooka'izai, syoodoku'zai, tintu'uzai). However, Martin and Hirayama differ sharply as to how to incorporate these facts into rules.

Martin simply says (p. 37) "Many compounds which have one of the following elements for the final member are basically atonic" (Martin's "atonic" = my "unaccented"). He splits pre-accenting second elements into two groups, a group of one-mora morphemes of which he says "many compounds with one of the following monosyllabic S morphs (note that Martin's term "syllable" corresponds to my term "mora" -- J. M.) as the final member have an accent on the next-to-last syllable, unless this is the second member of a vowel sequence within a morph or is \bar{n} , in which case the accent is on the third syllable from the end of the word"; and a group of two-mora morphemes of which he says (p. 36):

"Many compounds in which one of the following two-syllable elements is the final member belong to the thematic accent type⁸; but there are exceptions".

Martin's position is thus that there are certain final elements which make the compound unaccented and other final elements which put an accent on the final syllable of the preceding element, and any compound ending in one of these elements which behaves otherwise is simply an exception. However, his statement that "there are exceptions" (p. 36) is an incredible understatement. It is easy to find exceptions by the dozen; for example, by Martin's rules, eikoku 'England', syuudan 'group', sensui 'fountain', syatyoo 'company president', turibasi 'suspension bridge', tekikoku 'enemy country', doogu 'tool', and kemusi 'caterpillar' should be accented on the first element, and syakki'n 'debt', ryo'okin 'fee', aite 'partner', and gi'te 'assistant engineer' should be unaccented. Note, however, that in all these exceptions the first element is only one or two morae long. If one restricts himself to compounds with a first element of more than two morae in length, Martin's rule holds up very well: there are virtually no exceptions.⁹

⁸) Martin uses the term "thematic" to denote uninflected words with accent on the syllable containing the third from last mora.

⁹) Provided that some corrections are made in his lists of morphemes: -ka 'section' should be deaccenting and

These considerations lead to the position taken by Hirayama (p. 907): "Noun of 3 or more morae + element of 1-2 morae --> accented or unaccented, depending on which of two types the latter element belongs to".¹⁰ Hirayama's position is thus that compounds with a "long" first element and compounds with a "short" first element work according to different rules. In view of the fact that there are rules which work with close to 100% accuracy for long first elements but have perhaps 70% accuracy when applied to short first elements, I find that position eminently reasonable. Before I try to improve on it, let me take up the topic of compounds with a long second member.

Martin's position on compounds with a long second member is diffused over several pages of his dissertation. "Compound nouns of five or more syllables (i.e., morae -- J.M.) are usually thematic" (p. 35). "Any compound of which the second member is a three-syllable word is usually thematic" (p. 36). "A large number of variously accented words of three and four syllables occur as second members of thematic compounds" (p. 38). If the
 - - -
 -gawa 'river' preaccenting rather than vice versa, as Martin has them, and the pluralizers -ra and -tati should not be included at all in his lists of final elements of compounds.

¹⁰) In a footnote Hirayama recognizes that there are also morphemes which are neither preaccenting nor deaccenting.

first quotation is dismissed as obviously a mistake (since most long compounds with a deaccenting second member are of five or more morae in length but are unaccented), Martin's position can be summarized as follows: if the second element is 3 or more morae in length, it will generally have an accent on the syllable containing the 3rd-from-last mora; if it is not accented that way, it is simply an exception. But here again there will be a staggering number of exceptions, for example, *bungaku-sa'kuhin* 'literature', *nomi-to'modati* 'drinking companion', *noogyoo-ku'miai* 'agricultural association', *bunken-mo'kuroku* 'bibliography', *betu-a'turae* 'made to order', *henkaku-ka'tuyoo* 'conjugation', *denki-ka'misori* 'electric shaver', *kita-a'amerika* 'North America', *gensiryoku-ha'tuden* 'atomic power', *teikoku-ge'kizyoo* 'Imperial Theater'. Indeed, one of the examples which Martin gives in his list of elements forming "thematic compounds" is *-a'tukai*, which is not thematic at all since the accent is on the syllable before the one containing the 3rd-from-last mora.

Hirayama states (pp. 909-910) "Noun + unaccented or final-accented or initial-accented word of 3 or more morae → high-pitched up to the first mora of the second member (i.e., it acquires an accent on the first mora of the second member -- J. M.)... Noun + medial-accented word of 3 or more morae → high-pitched up to the accented

mora of the second element". The examples which Hirayama gives are peculiar in that several of the forms which he quotes actually do not occur. I quote his examples in full, substituting glosses in place of his parenthesized characters (the examples in the original are written in katakana followed by the corresponding characters in parentheses):

-tita'i, -ti'tai 'zone'; sinrintita'i, sinrinti'tai
'wooded area'

-tiho'o, -ti'hoo 'region'; kyuusyuutiho'o, kyuusyuuti'hoo
'Kyuushuu region'

-hanbu'n, -ha'nbun 'half'; omosirohanbu'n, omosiroha'nbun
'half in fun'

-hoome'n, -ho'omen 'district'; hatizyuumahoome'n,
hatizyuumaho'omen 'Hachijuu jima district'

-monoga'tari 'tale'; konzyakumonoga'tari 'once-upon-a-
time stories', isoppumonoga'tari 'Aesop's fables'

The forms omosirohanbu'n and hatizyuuzimahoome'n are impossible, as are the forms ti'tai, ha'nbun, and ho'omen. I can offer no explanation for Hirayama's inclusion of the impossible compounds, but a possible explanation for the inclusion of the impossible simple forms is suggested by the fact that Hirayama writes them with the continuation sign ~ (rendered as - above): perhaps when he said "up to the accented mora of the second element" he did not mean the mora which is accented when the word is used

independently but rather some mora which acquires the accent when the word is used as the second member of a compound. However, he gives no indication of the relation between the location of the accent when the word is used independently and the location of the accent when it is the second element of a compound.

Actually, a very small change in what Hirayama says will give a rule which is both precise and correct. The small change consists in taking the term "final-accented" to mean "accented on the final syllable" rather than "accented on the final mora", the latter being the sense in which Hirayama (following Japanese tradition) uses it. If that is done, then all but the last of the above examples will have a final-accented second member and will be subject to Hirayama's earlier rule that final-accented second members acquire an accent on their first syllable. What remains to be explained is the alternative forms *sinrintita'i/ sinrinti'tai* and *kyuusyuuutiho'o/kyuusyuuuti'hoo* (Hirayama's rule, under the above reinterpretation, would only generate the second member of each pair). In these cases the rule generates a form which has the accent on a diffuse vowel between voiceless consonants; the other form has the accent on the next syllable to the right. Since the grammar already has a rule which shifts the accent

to the right when it falls on a voiceless syllable, the alternate forms will be explained if this rule is said to apply optionally across :-boundary. The following are a couple of correct examples for Hirayama's rule about medial-accented long second members: nezi-hati'maki (<hati'maki), kiso-gaku'ryoku 'basic studies' (<gaku'ryoku), bizin-konku'uru 'beauty contest' (<konku'uru).

The rule for compounds with long second elements thus becomes: if the second member of a compound noun is 3 or more morae long, then the compound

(a) is accented on the accented mora of the second element except that it

(b) is accented on the first mora of the second member when that is unaccented or final-accented.¹¹

However, it is possible to generalize the rule even further, since there is a large class of two-mora

¹¹) In fairness to Martin, it must be pointed out that there are quite a few compounds which are regular by his rule but exceptions by this rule, for example, toti-soku'ryoo 'surveying', nizyuu-koku'sei 'dual citizenship', in which the accent is put on the second rather than first mora of an unaccented 4-mora second member.

second members which also acquire an accent on their first syllable. Specifically, if the second element of a compound is itself a compound of two Sino-Japanese morphemes, it will receive an accent regardless of how many morae it contains, 2, 3, or 4. Examples: kyoowa-syu'gi 'communism', tyuuka-so'ba 'Chinese noodles', noten-bu'ro 'outdoor bath', misairu-ki'ti 'missile base', tokan-ya'ne 'zinc roof', totyuu-ge'sya 'stop enroute', toppu-ki'zi 'top reporter'.¹² Thus if a "long" element is taken to be any constituent which contains at least 3 morae or 2 Sino-Japanese morphemes,¹³

¹²) Martin includes syu'gi and ka'si in his list of "compound-final elements with dominant accent", of which he says "each of the following words, as final member of a compound, usually preserves its accent" (p. 38). However, the fact that syu'gi and ka'si are accented on the first syllable when used independently is irrelevant to the accent of compounds which end in them: any Sino-Japanese two-mora compound will receive an initial accent when it ends a compound, even if it does not have initial accent when used independently, e.g., huro' 'bath' but notenbu'ro.

¹³) I am tempted to say here that a Sino-Japanese morpheme counts as one and a half morae; however, later it will develop that the rule can be reformulated so as to make counting morae and morphemes unnecessary.

if a compound has a long second member, the accent is put on the accented syllable of the second member when that is accented and on its first syllable if it is unaccented or final-accented. This notion of "long" element can be found elsewhere in the literature: Kindaichi states his accentuation rules in terms such as "Compound nouns whose second member is a single Sino-Japanese morpheme and whose first member is something consisting of 2 or more Sino-Japanese morphemes or 3 or more morae".¹⁴

This revised definition of "long element" also works in the case discussed earlier of a "long" first element followed by a "short" second element. Examples: kiti'suu 'given number', zimu'tyoo 'head of an office', zimu'syo 'office', tosi'bi 'sights of a city'.

The items which I am calling "long" here can be characterized in a different way which not only will allow for a simpler statement of the accent rules for compounds but will also explain some peculiarities of segmental phonology which were discussed in Chapter II. The cases in which the accentuation rules above apply are those where a morpheme is prefixed or suffixed to an entire word or where two entire words are compounded together, provided that here monomorphemic words of less than 3 morae are not counted

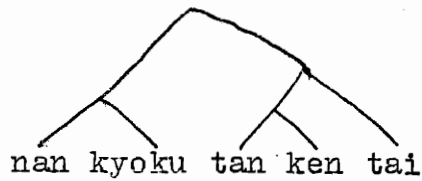
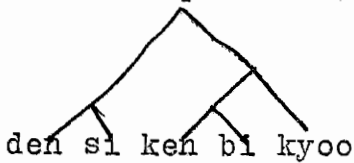
¹⁴) Meikai Nihongo Akusento Jiten, appendix, rule 14.

de-accenting (the rules as I have stated them would either put an initial accent on such a morpheme or leave the original accent, which will be incorrect for some of the morphemes in question). Third, the rules will have to be made to apply only to the last item in the word which fits the description ((a pre-accenting or de-accenting morpheme can only pre-accent or de-accent when it comes at the end of a word). This can be done by replacing the # at the end of each environment by a symbol for "external word boundary". If each word begins and ends with #, then external word boundaries will be places where there are two #'s in a row, so that external word boundary may be written ##. Fourth, rules 1, 2, and 4 insert an accent into a word which may already have an accent somewhere. Since the accent which is inserted is the accent which is actually pronounced, something will have to be done to get rid of any other accents which may be present. For the moment, let me simply make the convention that any rule which inserts an accent deletes all other accents in the stretch to which it applies (I will later modify this convention somewhat). Note that the pre-accenting morphemes under discussion differ from inflectional pre-accented morphemes such as -sika, -ra, -tati, and

the adjective inserts, since the latter do not remove an accent already present: ro'siya # go → rosiya'go 'Russian language' but ro'siya & 'sika → ro'siya sika 'only Russia'.

Note that the rules now operate differently than when I originally stated them in ordinary language: when I first stated them, the environment in which I said they acted was given in terms of the immediate constituent structure of the compound rather than in terms of the occurrence of #. In compounds where the depth of compounding is no more than 2, i.e., in compounds of the forms ((A:B)#C), (A#(B:C)), or ((A:B)#(C:D)), either version of the rules gives the same answers, since there is only one # and that is at the major constituent break. However, with compounds of greater depth than 2 there are cases where the two versions of the rule would predict different accents. For example, in compounds of the form ((A:B)#((C:D)#E)), where E is a de-accenting Sino-Japanese morpheme and A, B, C, D are any Sino-Japanese morphemes, the IC version of the rule would predict an accent on C and the # version would predict that the compound is unaccented. All compounds which I have been able to find of this type are unaccented, for example, densi-kenbikyoo 'electron microscope', nankyoku-tankentai 'South Pole exploration party', dai-seizika 'prominent statesman', hakusi-ininzyoo 'carte blanche'; the IC-structure

of these compounds is



With this understanding of #, it is no longer necessary to put in the environment of the $p \rightarrow h$ and vowel-insertion rules the condition that they also apply across the major IC-breaks of nested compounds: if the rules are stated in exactly the shape in which I gave them above but with the new interpretation of #, they will automatically apply in those environments as well. The environments I gave for the rules were $\left\{ \begin{array}{c} \# \\ [- \text{cns}] \end{array} \right\} \text{---} [- \text{cns}]$ for $p \rightarrow h$ and $\text{---} \left\{ \begin{array}{c} \# \\ [+ \text{voice}] \end{array} \right\}$ for vowel insertion, where at the time I was using # to denote external word boundary. If the # is now taken to be any word boundary, either internal or external, these rules will convert #bet#pai:tat# into #betu#hai:tatu# 'special delivery'.

I mentioned above that there are a number of morphemes which can act as the final member of a compound but which are neither pre-accenting nor de-accenting. I have observed the following types (there may be more than those which I list), none of which is very numerous:

1. -zin 'person', used in forming nationality words, is pre-accenting except when preceded by a noun whose accent is on the last syllable, in which case the accent is on -zin:

amerika	'America'	amerika'zin	'American'
do'itu	'Germany'	doitu'zin	'German'
supe'in	'Spain'	supei'nzin	'Spaniard'
ma'nsyuu	'Manchuria'	mansyu'uzin	'Manchurian'

but

tyoose'n	'Korea'	tyoosenzi'n	'Korean'
niho'n	'Japan'	nihonzi'n	'Japanese'
taiwa'n	'Taiwan'	taiwanzi'n	'Taiwanese'

2. -ya 'house' and -mono 'thing' generally give unaccented compounds when they are suffixed to something unaccented and accented compounds when they are suffixed to something accented, regardless of the length of the thing they are suffixed to or its status as a word. They thus appear to work like inflectional elements rather than pieces of a compound and to obey a rule of accent attraction (so far, all cases of accent attraction rules have involved either enclitics or verb/adjective inflectional morphemes). However, there are many exceptions, and in the case of -mono there is considerable variation as to where the accent is attracted to (there are some words in which it is on the syllable before -mono, some in which it is on the first syllable of -mono, and some in which it is on the second syllable of -mono):

a. -ya

so'ba (type of noodles)	soba'ya 'soba shop'
udon (type of noodles)	udonya 'udon shop'
ryo'ori 'cuisine'	ryoori'ya 'restaurant'
sakana 'fish'	sakanaya 'fishmonger'

-ya attracts the accent onto the syllable preceding it except in a fairly large number of cases where a compound of -ya with an accented stem is unaccented:

natto'o 'fermented soybeans'	nattooya 'fermented soybeans dealer'
tyooti'n 'lantern'	tyootinya 'lantern maker'

b. ~~mono~~15

sentaku 'washing'	sentakumono 'clothes to be washed'
takara' 'treasure'	takaramono' 'treasure'
sitate 'tailoring'	sitatemono 'tailor-made clothes'
no'm- 'drink'	nomi'mono 'beverage'
ta'te- 'build'	tate'mo'no 'building'
e'- 'obtain'	emono' 'weapon'
ki'nu 'silk'	kinu'mono 'silken goods'
ma'ze- 'mix'	maze'mono 'mixture'

I know of no way of predicting which syllable the accent will be attracted onto. Also, there are a large number of accented-stem & mono compounds which have an unaccented variant in addition to their accented variant, although

15) I will write two accents on a word when the accent can occur in either of two places. Thus tate'mo'no denotes a word which can be pronounced either tate'mono or tatemo'no.

to my knowledge kudasaremono 'bestowal' and nihonmono 'Japanese goods' are the only exceptions to the rule that -mono compounds from accented stems always have an accented alternant and those from unaccented stems have only an unaccented alternant.

3. There are a number of elements which take accent on the first syllable when they are final elements of a compound:

ito 'thread'	tumugii'to 'pongee thread'
ka'sa 'umbrella'	koomoriga'sa 'umbrella'
hu'ne 'ship'	wataribu'ne 'ferry'
o'bi 'belt'	hakatao'bi 'Hakata belt'
a'me 'rain'	niwakaa'me 'shower'
si'ru 'soup'	nidasizi'ru 'broth'
ha'to 'pigeon'	densyoba'to 'carrier pigeon'
ku'mo 'cloud'	hikoogu'mo 'vapor trail' (aviation)
ta'ko 'kite'	hipparida'ko 'great popularity'
ko'e 'voice'	hukumigo'e 'muffled voice'
i'ta 'board'	burikii'ta 'sheet metal'
so'ra 'sky'	yuuyakezo'ra 'sunset'
ga'su 'gas' ¹⁶	mokutanga'su 'CO ₂ '

In addition, there are a couple of monosyllables for which there is free variation between final accent and no accent at all:

-syo 'writing'	sinkokusyo/sinkokusyo' 'report'
-syo 'place'	hatudensyo/hatudensyo' 'power plant'
-zyo 'place'	hoyoozyo/hoyoozyo' 'health resort'

¹⁶) Note that all these examples have initial accent when used independently. Chew notes the correspondence:

in isolation:	as second member of compound:
unaccented	pre-accenting
final-accented	de-accenting
initial-accented	initial-accented

However, there are several exceptions to this correspondence, and for my present purposes I will ignore it, although it deserves further investigation.

I spoke above about a class of compounds which can have accent in either of two places, one accent being obtained from the other by the rule which shifts accent to the right if it falls on a voiceless syllable. There is also a case of alternate accents which seems to correspond to a shift of accent to the left and which occurs regardless of whether the accented vowel is voiceless. Examples: kaga'ku'sya 'chemist', nyoodo'ku'syoo 'uremia', zatie'ki'hu 'Jack of all trades', baiko'ku'do 'traitor', neturi'ki'gaku 'thermodynamics', nooma'ku'en 'meningitis', nooga'ku'bu 'agricultural faculty', haise'tu'bu 'excrement'. In all these cases the shift occurs within a Sino-Japanese morpheme of the form $CVC\begin{Bmatrix} i \\ u \end{Bmatrix}$ followed by #. I propose a rule which shifts accent to the left in the environment $[]\begin{Bmatrix} + & \text{cns} \\ - & \text{voice} \end{Bmatrix}\begin{Bmatrix} - & \text{cns} \\ + & \text{dif} \\ + & \text{acc} \end{Bmatrix}\# []$. (the [] after the # is necessary since the rule does not apply in word-final position, e.g., bati' 'plectrum').

3.6 The phonological phrase

I stated above that Japanese has nothing comparable to secondary stress within a word but that larger constructions can contain a "secondary accent" in which the accented mora is on a mid rather than a high pitch, for example, tabete imasu 'is eating' (┌┐ denotes mid

pitch), aoi dressu 'blue dress', asita kuru hito desu
 'it's the man who is coming tomorrow', yukkuri hanasimasita
 'spoke slowly', tuyoku narimasita 'got strong(er)'. Each of
 these phrases consists of two pieces, the first with a
 primary accent, the second with a secondary accent.

Moreover, these two accents are on the same syllable as
 would be accented if the corresponding pieces were
 pronounced independently. To account for this phenomenon,
 it is thus necessary to assume that each piece goes through
 the regular accentuation rules (at the end of which each
 piece contains exactly one accent), and that then the
 accent on the second piece is reduced from primary to
 secondary. Note now that this phenomenon can involve more
 than two pieces; for example, Jordan gives the sentence
donna tokoro e ittara ii ka osiete kudasaimasen ka? 'can
 you tell me what kind of place it would be best to go to?'

Here the accents on tokoro', itta'ra, and i'i are all
 reduced to secondary. The rule needed thus does not just
 reduce the second accent but indeed all accents after the
 first in the appropriate stretch. Note, however, that this
 rule is very similar to the accent elimination rule given
 earlier, which said that within a certain stretch, all
 accents except the first are eliminated entirely. I propose
 that I have not two rules here but really just one, an
 accent reduction rule which applies in a cycle, first

operating on smaller constituents and then to larger constituents, reducing all accents except the first each time it applies. Thus the accent of kabutte mitara 'If (I) were to try putting on (a hat)' would be derived as follows:

((kabu'r & te)(mi' & ta'ra))

original accents	1	1	1
1st pass through cycle: accent reduction	1	1	2
2nd pass through cycle: accent reduction	1	2	3

Since only one accent can occur within a word, a rule will be necessary which deletes all accents other than the highest one within a word; this rule would delete the "tertiary accent" in mitara and yield the correct form: primary accent on the second syllable of kabutte and secondary accent on the first syllable of mitara.

In the preceding section I introduced a convention that when a rule inserts an accent it eliminates all other accents present. Suppose that this convention is changed to read that when an accent is inserted it reduces all accents present (in the stretch to which the rule is applying) by one degree. Since within a word all but the heaviest accent present is deleted, this change in the convention would have no effect on the rules for compounds,

for which the original convention was introduced. With this revised convention, the accent-reduction rule given above can be recast in a much simpler form: put an accent on the first primary accent. Since this rule puts an accent on a syllable which is accented already, it does not have any overt effect on that syllable; however, since it still is an accent insertion rule, it reduces all other accents by 1 as a result of the convention on accent insertion.

When I treated morphemes such as *-yoo* and *-mas-*, which are accented regardless of whether the preceding stem is accented or unaccented, I said that they were preceded by a junctural element over which the accent elimination rule did not apply. It can now be seen that that solution is wrong, since it would imply that phrases ending in a verb-form with *-mas-* or *-yoo* would have a primary accent on that verb-form, which simply is not true: in the examples given above, *-mas-* received a secondary accent and the preceding item received a primary accent. The accent of *-mas-* or *-yoo* only predominates within a verb form to which it belongs; in larger constructions, a verb form containing *-mas-* or *-yoo* is subject to exactly the same process of accent reduction as is any other item. The same also holds, *mutatis*

mutandis, for noun postpositions such as *gurai* and *rasii*, whose accent also predominates within the word. What is needed is a rule which accents *-mas-* or *-yoo* when the cycle applies to the constituent Verb and accents *gurai* or *rasii* when the cycle applies to the constituent Noun or Adjective (Noun & *rasii* is an adjective):

S → [+ acc] in env. $\left[\begin{array}{l} + \text{ accent} \\ + \text{ predominating} \\ \text{morpheme} \end{array} \right] \left. \vphantom{\left[\begin{array}{l} + \text{ accent} \\ + \text{ predominating} \\ \text{morpheme} \end{array} \right]} \right\} \left. \begin{array}{l} \text{Noun} \\ \text{Verb} \\ \text{Adjective} \end{array} \right\}$

The accent attraction rule can also be described as a rule of accent insertion:

S → [+ acc] in env. [+ acc] — & $\left. \begin{array}{l} \text{Present} \\ -\text{reba} \\ \text{Imperative} \\ -\text{u} \end{array} \right\}$

Examples:

atama rasii 'like a head' atama rasiku nai 'not like a head'

atama' & ra'si & i ((atama'&ra'si&ku)(na'&i))

original accent	1	1	1	1	1
predominating items rule	2	1	2	1	no effect
attraction	3	2 1	no effect		no effect
			reduction	3	1
					2

adjustment rule 0 0 1 0 1 2

I turn now to the question of what kind of stretches these cycles apply over. If the rules were just to apply once to each constituent of the IC structure, finally

to the entire sentence, then a sentence could have only one primary accent (the last application of the accent reduction rule would eliminate all but the first primary accent remaining at that point). However, in reality a sentence can contain any number of primary accents, e.g., mada gobyooki desu ka 'are you still sick?', hito to site wa ii desu nee 'he's nice as a person, isn't he?' I will assume that somehow or other the sentence gets broken up into pieces which will be the widest stretch over which the accent rules operate; in the last example, the division will be into the pieces hito to site wa, ii desu, and nee. The boundaries of these pieces I will refer to as major phrase boundaries. Each of these pieces is subdivided into smaller pieces of which the first may have a primary accent and the subsequent ones may have secondary accent; the boundaries of these smaller pieces I will refer to as minor phrase boundaries or just plain phrase boundaries. Where I said above that there can be only one accent per word, I should have said that there can be only one accent per minor phrase; the domain over which the rule converting weak accents into no accent at all operates is defined by phrase boundary rather than word boundary. While at present I am unable to say much about major phrase boundary (beyond the essential fact that it

can only occur at minor phrase boundary), it is reasonably easy to give rules for the location of minor phrase boundaries.

First, consider the case in which all the nouns, verbs, auxiliary verbs, adjectives, and adverbs involved in the sentence are accented, or better yet, where they are all accented somewhere other than the final syllable. In this case there will be a phrase boundary at the end of each noun phrase (including all postpositions and particles attached to it), adverbial phrase, verb or auxiliary verb, or subordinate clause. When I say "subordinate clause" here, it is to be taken as including relative clause modifiers of a noun, and relative clauses include all adjectives and genitive modifiers as a special case.

In the case of unaccented (or in some cases, final-accented) elements, some of these phrase boundaries are or may be absent. Examples:

<u>gonen</u> <u>gurai</u> <u>imasita</u>	'I was there about 5 years'
<u>gonen</u> <u>imasita</u>	'I was there 5 years'
<u>yukkuri</u> <u>hanasimasita</u>	'He spoke slowly'
<u>issyoo ni</u> <u>hanasimasita</u>	'We spoke together'
<u>asita</u> <u>kuru</u> <u>hito</u> <u>desu</u>	'It's the man who is coming tomorrow'
<u>asita</u> <u>iku</u> <u>hito</u> <u>desu</u>	'It's the man who is going tomorrow'
<u>aoi</u> <u>doresu</u>	'blue dress'
<u>akai</u> <u>doresu</u>	'red dress'

The simplest description will probably be to have a rule which inserts phrase boundary after the constituents listed and deletes it in the appropriate cases. The rules involved in the deletion of phrase boundary are as follows:

1. remove final accent from a noun followed by no.
2. delete accent in the final mora (not syllable!) of a phrase.
3. Delete phrase boundary between a modifier and its head if either of them is unaccented. Here subject, direct object, adverbial elements, etc. count as modifiers of the verb (as they are traditionally regarded by Japanese scholars).

If rule 3 is part of the cycle, it will be unnecessary to use concepts such as "modifier" and "head"; it will suffice to say that phrase boundary is deleted when it is preceded or followed by no accents. In a sequence such as atarasi'i tokuhon o yomima'sita 'he read the new reader', there should only be a phrase boundary after /o/. If rule 3 is in the cycle, it will first apply to the sequence %atarasi'i % tokuhon o% and delete the internal phrase boundary. On the next pass through the cycle there are accents on both sides of the remaining internal %, so that rule 3 does not apply (where % means minor phrase boundary). Rule 2 must precede rule 3 since ni' is accented (note tookyoo ni wa 'as for in Tookyoo') but tookyoo ni sumimasu

'(he) lives in Tookyoo' is a single phrase. It cannot precede the cycle since some final accents are created in the cycle; thus rule 2 must also be in the cycle. For the same reason, rule 1 must also be in the cycle.

But here an unexpected dividend appears. A slight modification of rule 1 will explain why it does not apply to those nouns which have any modifiers and in particular, why it only applies to the innermost layer of a series of nested genitives. The slight modification is to make the rule applicable only in the environment
 _____)Noun & no. In the case of a noun which has a modifier, the no will be preceded not by)Noun but by)Noun-phrase:
 (((ano)_{Det} (uma')_{Noun})_{Noun-phrase} no), so that the rule will not apply and in this example ano uma' no will result.

There is also a rule which optionally deletes phrase boundary entirely even when it occurs between accented items; such a rule is needed in the grammar to account for the existence of both tabete imasu and tabete imasu as alternative pronunciations. Consider a major phrase which has 3 or more minor phrases, for example,
 doo ittara hi desu ka 'how would it be best to go?'. This utterance has the following alternative pronunciations:¹⁷

¹⁷) I am indebted to Akira Komai for this example.

This rule accents the accented syllable of predominating morphemes such as -yoo, -mas, -rasi-, -dake, and -gurai when they occur at the end of the constituent to which the cycle is applying and that constituent is Noun, Adj, or Verb. This last restriction is necessary, since otherwise the rule would re-apply in later passes through the cycle and yield such ungrammatical sentences as *koohii demo nomimasyoo, instead of the correct koohii demo nomimasyoo 'let's have some coffee or something'.

C-4 Accent reduction rule

S \rightarrow [+ acc] in env. ... [1 acc].

This rule accents the first primary accent in the constituent to which the rule is applying, i.e., reduces all other accents in that constituent.

C-5 no-rule.

remove accent from [1 acc])_{Noun} & no

C-6 remove accent from C_Y acc %

(i.e., remove accent when it is on the last mora before %).

C-7 Boundary deletion rules

- a. Delete % if no accents either precede or follow it.
- b. Optionally delete all %

3.8 Concluding remarks

A language with a "pitch accent" system like Japanese and a language with a "stress accent" system like Russian

have the formal similarity that the accentual information which must be recorded in dictionary entries is at most the location of some accentual phenomenon, rather than separate information as in a true tone language such as Chinese. My discussion of accent placement and accent reduction in Japanese shows an even greater formal similarity with "stress languages", namely that the rules which generate the accentual shape of an utterance, whether in English or in Japanese, are of exactly the same formal nature, namely, rules which insert accent on one syllable while reducing all other accents present; moreover, in both languages these rules must apply in a cycle which deduces the accentual shape of any constituent from the accentual shapes of the constituents of that constituent. The difference between the "pitch-accent language" Japanese and the "stress-accent language" English that the latter but not the former admits several degrees of stress within a single word thus turns out to be more superficial than had at first seemed the case: this difference is not reflected in the stress assignment rules and only appears in the very late phonetic rules which give acoustic shape to abstract accentual patterns.

One apparently different kind of rule appearing in the Japanese accentual cycle is exemplified by rules C-2c, C-5, and C-6, which remove accent from a constituent.

However, these rules can also be interpreted as having the same formal nature as the stress assignment rules just discussed. Earlier I defined a "language with free accent" as a language in which the accentual information marked in the dictionary entry is an integer, whose value gives the location of the "accented syllable". In the textbook case of free accentuation, this integer can take any value from 1 to n , where n is the number of syllables in the morpheme in question. Suppose that an item in a hypothetical language with free accent consists of two constituents, one m syllables long and the other n syllables long, and accented respectively on their i -th and j -th syllables. Suppose further that this hypothetical language has a rule which accents the first accent in such a combination; then the resulting $m+n$ syllable item has accent 1 on its i -th syllable and accent 2 on its $m+j$ -th syllable. This operation of accent reduction can be characterized mathematically as two operations performed on sequences of integers. Representing the two items as $(0, \dots, 1, \dots, 0)$ and $(0, \dots, 1, \dots, 0)$, the operations consist in converting the second sequence into $(0, \dots, 2, \dots, 0)$ and amalgamating the two sequences into the one $m+n$ term sequence $(0, \dots, 1, \dots, 2, \dots, 0)$.

In Japanese nouns of \underline{n} syllables, the dictionary entries must distinguish between not \underline{n} but $\underline{n} + 1$ types: the dictionary form of a noun can be accented on any of its syllables or be completely unaccented. This can be expressed formally by saying that the accentual information marked in the dictionary entries of Japanese nouns is an integer which can take any of the values $0, 1, 2, \dots, \underline{n}$ rather than $1, 2, \dots, \underline{n}$). Suppose now that Japanese items are represented by sequences of integers but that the possibility of unaccentedness is expressed by saying that the sequence starts with a 0-th term rather than a first term. If this 0-th term is regarded as just as good a place to assign an accent as any other place, accent removal can be regarded as simply assignment of accent to the 0-th term. Amalgamation of sequences corresponding to an \underline{m} -syllable item and an \underline{n} -syllable item in Japanese would mean constructing a sequence which first had a 0-th term, then \underline{m} terms corresponding to the \underline{m} syllables of the first item, and then \underline{n} terms corresponding to the \underline{n} syllables of the second item. Each composite constituent of a Japanese utterance would correspond to a sequence of terms which had a 0-th term, and a rule could de-accent the whole constituent by putting an accent on that term.

It is worth pointing out here that in Serbo-Croatian, which requires dictionary entries in which a contrast is made between unaccented items and items with accent on one of their syllables, the grammar also contains rules of accent removal, exactly as in Japanese.¹⁸ I would conjecture that the languages whose grammars require such rules are precisely those languages in which the accentual information recorded in dictionary entries is an integer whose values run from 0 to \underline{n} , where \underline{n} is the number of syllables in the morpheme in question.

¹⁸) I am indebted to E. Wayles Browne for this observation about Serbo-Croatian.

APPENDIX I

A list of elements which yield unaccented compounds (an asterisk marks those elements for which some of the compounds have an alternate accented form).

-ban	'phonograph record'	erupiiban	'LP record'
-ban	'board'	keiziban	'bulletin board'
-ben	'dialect'	kansaiben	'Western (Japanese) dialect'
-betu	'difference'	hooryokubetu	'difference in ability'
-busi	'composition'	kusimotobusi	'composition by Kushimoto'
-byoo	'illness'	kokkyuukibyoo	'respiratory ailment'
-dai	'university'	toritudai	'(Tookyo) Metropolitan University'
-dai	'machine'	dantoodai	'guillotine'
-dama	'ball'	zyuuzudama	'rosary bead'
-dera	'temple'	kiyomizudera	(name of temple)
-doo	'press'	sanseidoo	(name of publisher)
*-e	'picture'	sukasie	'transparency'
-ga	'drawing'	sansuiga	'landscape'
		pasuteruga	'pastel'
-gaki	'writing'	kotowarigaki	'note of refusal'
-gao	'face'	huheigao	'expression of displeasure'
-gara	'character'	zisetugara	'this time of year'
-gata	'form'	kihukugata	'accented' (phonology)
-gawa	'side'	hidarigawa	'left side'
-go	'language'	doitugo	'German'
*-go	'word'	han-i-go	'antonym'
-goya	'shed, hut'	karukigoya	'log cabin'
-gumi	'association'	tonarigumi	'neighborhood association'
-ha	'sect'	kyuusinha	'radical movement'
-hen	'neighborhood'	kokorahen	'around here'
*-hoo	'law'	koomuinoo	'civil service law'
-hoo	'style'	nihonhoo	'Japanese style'
-hyoo	'list'	zikanhyoo	'timetable'
-iro	'color'	midoriiro	'green'
-ka	'person'	kinbenka	'diligent person'
*-ka	'-ification'	denkika	'electrification'
-ke	'family'	tokugawake	'house of Tokugawa'
-kei	'form'	ren-yoo-kei	'continuative form' (of a verb)

*-kin	'money'	gunsikin	'military funds'
*-ko	'powder'	komugiko	'wheat flower'
-kyoo	'mirror, lens'	kenbikyoo	'microscope'
-kyuu	'class'	meizinkyuu	'the experts'
*-ma	'room'	oosetuma	'drawing room'
-mai	'rice'	kahaimai	'extra ration of rice'
-mura	'village'	gurinitimura	'Greenwich village'
		tookaimura	'East coast village'
-nin	'person'	kyuubyoonin	'person suddenly taken ill'
-ryuu	'style'	huransuryuu	'a la Française'
-sei	'system'	teinensei	'age limit system'
-sei	'nature'	syakaisei	'sociality'
-sei	'manufacture'	doitusei	'made in Germany'
*-sen	'railway line'	tookaidoosen	'Tookaidoo line'
*-sen	'ship'	renrakusen	'ferry boat'
*-sen	'battle'	setuzyokusen	'return match'
-siki	'style'	nihonsiki	'Japanese style'
-seo	'herb'	turiganesoo	'bellflower'
-tai	'party'	tankentai	'exploration party'
*-tai	'body'	sensyokutai	'chromosome'
		dekisitai	'drowned corpse'
-te	'hand, -ist'	katarite	'narrator'
-teki	'-ish'	hoogenteki	'dialectal'
-too	'island'	hookotoo	'Pescadores'
-tyoo	'list'	denwatyoo	'telephone directory'
-yaki	'roast'	tamagoyaki	'omelet'
-yama	'mountain'	yakagiyama	(name of mountain)
-yoo	'use'	kateiyoo	'(for) household use'
-yuki	'bound for'	kyootoyuki	'bound for Kyooto'
-za	'seat, theater'	kabukiza	(name of theater)
-zima	'island'	miyakezima	(place name)
-zima	'stripes'	mekurazima	'dark blue'
-zura	'façade'	sinzizura	'pose as a gentleman'
-zyoo	'place'	goruhuzyoo	'golf course'
-zyoo	'standpoint'	rekisizyoo	'(from a) historical standpoint'
*-zyoo	'letter'	kokusozyoo	'letter of complaint'
-zyun	'sequence'	aiueozyun	'a-i-u-e-o order'
-zyun	'throughout'	nihonzyuu	'throughout Japan'

A list of elements for which compounds ending
in them have an accent on the final syllable
of the first member

(an asterisk marks those elements for which some of the

compounds have an alternate unaccented form).

-an	'proposal'	syuuse'ian	'proposed amendment'
-bako	'box'	yuubi'nbako	'mailbox'
-bi	'day'	kine'nbi	'anniversary'
		getuyo'obi	'Monday'
-bi	'fire'	kitune'bi	'will-o-the-wisp'
-bi	'beauty'	hakuti'bi	'beautiful but brainless woman'
-bin	'bottle'	inki'bin	'ink bottle'
-bo	'register'	zinme'ibo	'roll' (list of names)
-boo	'fellow'	kaura'iboo	'vagabond'
-boo	'hat'	suihe'iboo	'sailor hat'
		panama'boo	'Panama hat'
-bu	'section'	zire'ibu	'headquarters'
-butu	'thing'	haiset'u'butu	'excrement'
-daka	'height'	sansyutu'dan	'quantity of production'
-dan	'talk'	keike'ndan	'account of personal experiences'
-dei	'day' (Eng.)	haitori'dei	'fly-catching day' (relates to a postwar insect control program)
-do	'door'	kuguri'do	'side door'
-eki	'station'	tookyo'oeki	'Tokyo station'
*-en	'inflammation'	mootyo'o'en	'appendicitis'
-en	'park'	doobutu'en	'zoo'
-gai	'shell'	sinzyu'gai	'pearl oyster'
-gaku	'-ology'	buturi'gaku	'physics'
-gan	'rock'	genbu'gan	'basalt'
-gawa	'river'	sentororensu'gawa	'St. Lawrence River'
-geki	'theater'	kinda'igeki	'modern theater'
-gi	'clothing'	kaisu'igi	'bathing suit'
-goo	'issue'	tokusyo'ogoo	'special issue' (of a periodical)
-gu	'equipment'	undo'ogu	'athletic equipment'
-gun	'army'	kokure'ngun	'U.N. armed forces'
-guti	'mouth, window'	syussatu'guti	'ticket window'
-gyo	'fish'	tansu'igyo	'fresh-water fish'
-gyoo	'work'	sin-ya'-gyoo	'night work'
-han	'criminal'	zyoosyu'uhan	'habitual criminal'
-hei	'soldier'	sigan'hei	'volunteer soldier'
-hi	'expenses'	eize'nhi	'expenses of building and maintaining'
*-hin	'wares'	syuge'ihin	'handicraft'
-hu	'man'	syoo'ohu	'fireman'
-hu	'woman'	baisyu'nhu	'prostitute'

-hu	'prefecture'	kyooto'hu	'Kyooto prefecture'
-huku	'suit'	suihe'ihuku	'naval uniform'
-i	'medical science'	sekketu'i	'bone setting'
-in	'member'	koomu'in	'official'
-ka	'song'	ryuuko'oka	'popular song'
-kai	'meeting'	sinboku'kai	'social gathering'
-kai	'sea'	beeringu'kai	'Bering Sea'
-kai	'world'	kyooiku'kai	'the world of education'
-kan	'interval'	tooka'kan	'interval of 10 days'
-kan	'building'	bizyutu'kan	'art museum'
-kan	'feeling'	appaku'kan	'feeling of suspicion'
-kei	'measuring device'	kanda'nkei	'thermometer'
-ken	'ticket'	waribiki'ken	'discount ticket'
-ken	'prefecture'	wakayama'ken	'Wakayama prefecture'
-ki	'machine'	hiko'oki	'airplane'
-ki	'utensil'	hootyo'oki	'hearing aid'
-ki	'season'	hense'iki	'period when a boy's voice changes'
-ki	'written record'	nenda'iki	'annals'
-ko	'lake'	kawaguti'ko	'bay'
-koku	'country'	kyoowa'koku	'republic'
-koo	'harbor'	koobe'koo	'Koobe harbor'
-koo	'school'	syussin'koo	'Alma Mater'
-ku	'municipality'	setagaya'ku	'Setagaya municipality'
-kyoku	'bureau'	yuubi'inkyoku	'post office'
-kyuu	'wages'	kote'ikyuu	'fixed wages'
-man	'man' (Eng.)	kamera'man	'camera man'
-mati	'city'	ida'mati	'Iida city'
-matu	'end'	nendo'matu	'end of fiscal year'
-men	'surface'	suihe'imen	'level surface'
-min	'people'	zairyu'umin	'resident populace'
-mizu	'water'	koori'mizu	'ice water'
-mon	'gate'	rasyo'omon	'Gate of Hell'
-moo	'net'	hooso'omoo	'radio network'
-musi	'insect'	kabuto'musi	(some kind of bug)
-myaku	'mountain range'	kaza'nmyaku	'volcanic range'
-nada	'channel'	kasima'nada	'Kashima channel'
-nan	'trouble'	zyuutaku'nan	'housing shortage'
-noo	'farming'	kosaku'noo	'tenant farming'
-nusi	'owner'	syota'inusi	'householder'
-on	'sound'	muse'ion	'voiceless sound'
-oo	'queen'	eziputo'oo	'queen of Egypt'
-pan	'bread' (Port.)	genma'ipan	'whole rice bread'
-ran	'column'	bunge'iran	'literary column'
-ri	'official'	sittatu'ri	'bailiff'
*-rin	'forest'	genshi'rin	'primeval forest'
-ritu	'rate'	sibo'oritu	'death rate'

-ro	'road'	kooku'uro	'air route'
-roku	'written record'	koogi'roku	'transcript of lecture'
-ron	'theory'	isookuuka'ron	'topology'
-rui	'type'	gyoka'irui	'type of marine life'
-ryoku	'force'	gensu'ryoku	'atomic energy'
-ryoo	'quantity'	koosetu'ryoo	'quantity of precipitation'
-ryoo	'hostel'	gakuse'iryoo	'student dormitory'
-ryoo	'fee'	tesu'uryoo	'fee'
-saku	'policy'	kanwa'saku	'neutralizing measure'
-san	'mountain'	makinre'isan	'Mt. McKinley'
-satu	'bill'	hyakue'nsatu	'100-yen bill'
-sei	'student'	sotugyo'osei	'alumnus'
-seki	'seat'	kankyaku'seki	'spectator seat'
-si	'poem'	syootyo'osi	'symbolic poem'
-si	'teacher'	ikasama'si	'confidence man'
-si	'city'	yokohama'si	'city of Yokohama'
-si	'paper'	zyoositu'si	'fine quality paper'
-si	'history'	kokugo'si	'history of the Japanese language'
-si	'part of speech'	kando'osi	'interjection'
-siki	'ceremony'	kekko'nsiki	'marriage ceremony'
-sima	'island'	awazi'sima	(place name)
-situ	'substance'	hooro'ositu	'enamel'
-situ	'room'	zikke'nsitu	'laboratory'
-sin	'heart'	dootoku'sin	'moral sense'
-sui	'water'	zyooryu'usui	'water upstream'
-suu	'number'	kooba'isuu	'common multiple'
-sya	'person'	tooti'sya	'ruler'
-sya	'vehicle'	zido'osya	'automobile'
-syoku	'color'	sinda'isya	'sleeping car' (railway)
-syoo	'prize'	tenne'nsyoku	'Technicolor'
		seiki'nsyoku	'attendance prize'
		nooberu'syoo	'Nobel prize'
-syoo	'ministry'	monbu'syoo	'Ministry of Education'
-syoo	'illness'	haiketu'syoo	'blood poisoning'
-syoo	'dealer'	kobutu'syoo	'antique dealer'
-syu	'worker'	unte'nsyu	'driver'
-syuu	'religion'	singo'nsyuu	(sect of Buddhism)
-syuu	'state'	yooroppa'syuu	'the countries of Europe'
-syuu	'collection'	zuihitu'syuu	'collection of essays'
-ten	'shop'	bungu'ten	'stationer's shop'
*-ten	'point'	sooi'ten	'point of disagreement'
-ti	'value'	zetta'iti	'absolute value' (Math.)
-tin	'fee'	densya'tin	'trolleycar fare'
-to	'capital prefecture'	tookyo'oto	'Tookyoo prefecture'

-to	'adherent'	seikyo'oto	'Puritan'
-tyoo	'agency'	rin-ya'-tyoo	'Forestry Agency'
-tyoo	'head'	saiba'ntyoo	'presiding judge'
-u	'rain'	zinko'ou	'artificial rain'
-uo	'fish'	sansyo'o-uo	'salamander'
-uta	'song'	hayari'uta	'popular song'
-yaku	'medicine'	zyoobi'yaku	'medicine for household use'
-yoo	'ocean'	taise'iyoo	'Atlantic Ocean'
*-zai	'potion'	kyooso'ozai	'tonic'
*-zai	'crime'	gisyo'ozai	'perjury'
-zai	'material'	kentiku'zai	'building materials'
-zake	'wine'	huruma'izake	'a treat of <u>sake</u> '
-zei	'tax'	eigyo'ozei	'business tax'
-zi	'child'	koou'nzi	'one blessed by fortune'
-zin	'person'	rosiya'zin	'Russian'
-zoku	'clan'	taiyo'ozoku	'playboys'
-zu	'chart'	kaibo'ozu	'anatomical chart'
-zyoo	'castle'	nagoya'zyoo	'Nagoya castle'
-zyutu	'art'	insatu'zyutu	'typography'

APPENDIX II

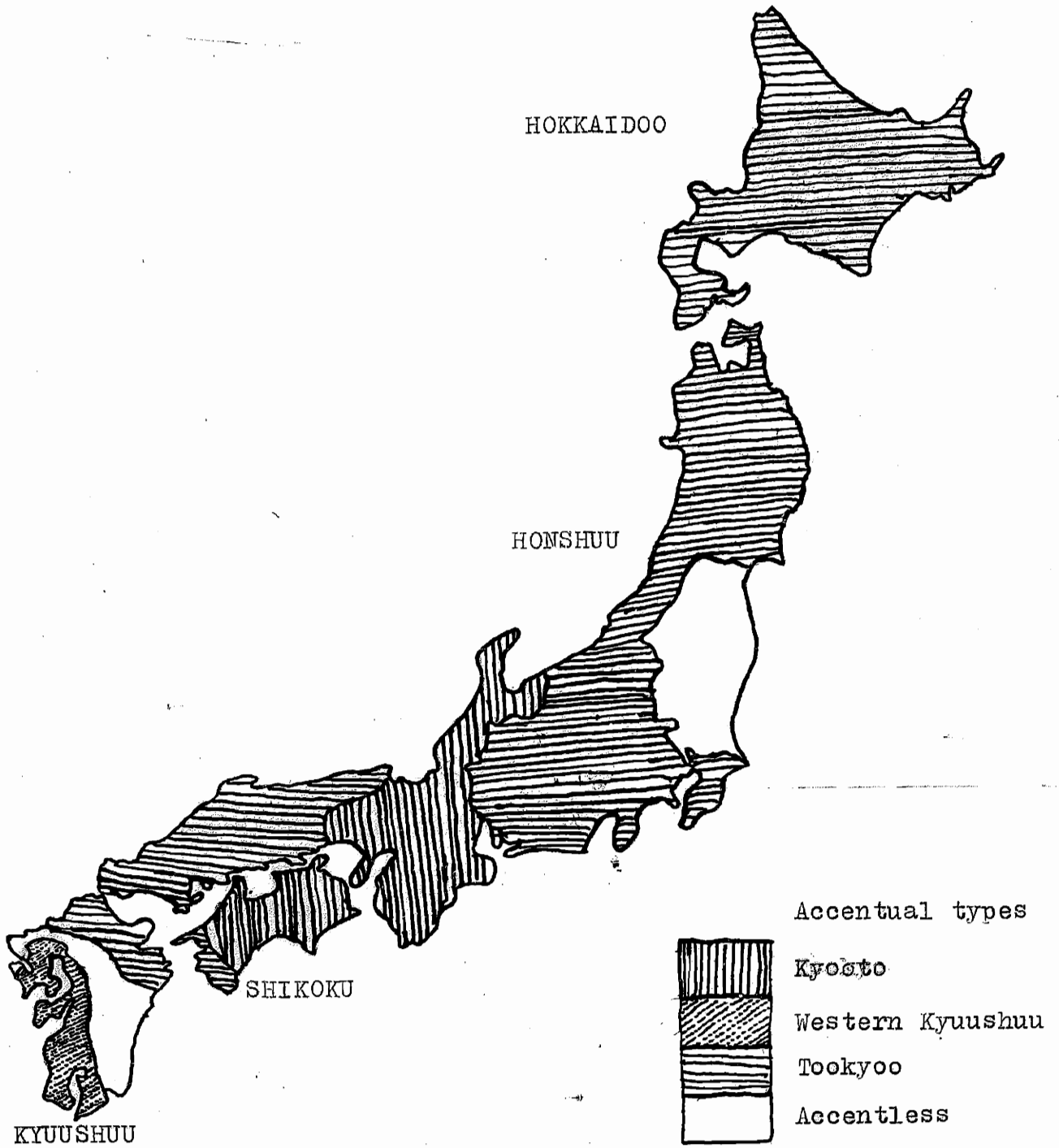
Accent in the Japanese Dialects

With regard to accent, Japanese dialects are traditionally grouped into four types: Tookyoo type, Kyooto type, Western Kyuushuu type, and accentless type.¹

In the accentless type, which is spoken in the northeastern coastal area of Honshuu and in much of central Kyuushuu, accentual distinctions between words have been lost completely.

The Tookyoo type of accentual system is found in the dialects of Hokkaidoo, the Eastern half and western quarter of Honshuu, and parts of Kyuushuu and Shikoku. The accentual systems of these dialects are virtually identical. In each of these dialects a phonological phrase contains at most one "marked syllable", which is generally the same syllable as is accented in standard Japanese. In most of these dialects the "marked syllable" is characterized acoustically by a fall in pitch after its first mora, although there is at least one dialect (that of Narada in Yamanashi prefecture) in which the marked syllable has a

¹) However, some doubt has been cast on the validity of this grouping by Tokugawa's brilliant study, "Nihon Shohoogen Akusento no Keifu Shiron".



low first mora followed by a rise in pitch.²

In the Kyooto type of accent, which is spoken in West-central Honshuu and most of Shikoku, a word may have a distinctive fall in pitch somewhere within it and also may start on either a high pitch or a low pitch (e.g., kakemono 'piece of calligraphy' but murasaki 'purple').

²) There are many differences as to the pitch shape of the part of the phrase before the marked syllable. In Tookyoo (and the standard language), all the morae up to the accent are high-pitched except for the first mora. In Nagoya there is a more slow rise in pitch at the beginning of the phonological phrase, often extending over the first two morae. In Nakamura (Koochi prefecture) the beginning of a phrase is a mirror image of what it is in Tookyoo: the first mora is high-pitched and the remaining morae before the accent are low-pitched. In Akita, the accented mora is high-pitched and all other morae low-pitched; in particular, an unaccented phrase is pronounced entirely on a low pitch, so that (unlike standard Japanese) there is a phonetic difference between end-accented and unaccented phrases. Examples:

Tookyoo	Nagoya	Nakamura	Akita	Narada
<u>atama</u> ga	atama ga	atama ga	atama ga	atama ga
<u>miyako</u> ga	miyako ga	miyako ga	miyako ga	miyako ga
atama	atama	atama	atama	?
miyako	miyako	miyako	miyako	?

A preceding proclitic such as a demonstrative is on a high pitch regardless of whether the following word starts on a high pitch or on a low pitch: hasi 'bridge', kono hasi 'this bridge', hasi 'chopsticks', kono hasi 'these chopsticks'. The words which start on a low pitch could also be said to be preceded by a fall in pitch or an accent. Thus a word in Kyooto Japanese may be said to have up to two accents: one before the word and one within it, so that one might transcribe murasaki as 'mura'saki. The Tookyoo type of accent developed from the Kyooto type by a shift of accent one syllable to the right. Since in Kyooto Japanese proper some accentual shapes have coalesced, this statement does not give an exact correspondence between modern Kyooto and Tookyoo forms. However, the changes in Kyooto Japanese to which I refer did not affect 2-mora nouns, and there the correspondence is exact:

	'bridge'	'chopsticks'	'edge'	'crane'
Kyooto (phonetic)	<u>hasi</u>	<u>hasi</u> , <u>hasi</u> ga	<u>hasi</u>	<u>turu</u>
Kyooto (analyzed)	ha'si	'hasi	hasi	'turu'
Tookyoo	hasi'	ha'si	hasi	tu'ru

The Kyooto type includes some dialects in which the pre-accentuation of 'hasi, etc. has been lost (for example, Taishi in Mie prefecture³). There a phrase can have at most one significant fall in pitch, as in the Tookyoo type.

³) Wada, p. 190.

However, the location of that fall in pitch agrees with Kyooto and not with Tookyoo.

In the Western Kyuushuu type of accent, each word is of one of two types, generally called A and B by Japanese scholars,⁴ which I will call "falling" and "rising" respectively. The exact phonetic shape of falling and rising words varies considerably from locality to locality. Consider the following data from three dialects of the Western Kyuushuu type:⁵

a. Falling

	Fujitsu	Nagasaki	Kagoshima
'day'	<u>hi</u>		<u>hi</u>
	<u>hi</u> ga	<u>hi</u> ga	<u>hi</u> ga
	<u>hi</u> da		<u>hi</u> da
'nose'	<u>hana</u>	<u>hana</u>	<u>hana</u>
	<u>hana</u> ga	<u>hana</u> ga	<u>hana</u> ga
	<u>hana</u> da		<u>hana</u> da
'vehicle'	<u>kuruma</u>	<u>kuruma</u>	<u>kuruma</u>
	<u>kuruma</u> ga	<u>kuruma</u> ga	<u>kuruma</u> ga
	<u>kuruma</u> da	<u>kuruma</u> da	<u>kuruma</u> da
'fish paste'	<u>kamaboko</u>	<u>kamaboko</u>	<u>kamaboko</u>
	<u>kamaboko</u> ga	<u>kamaboko</u> ga	<u>kamaboko</u> ga
	<u>kamaboko</u> da	<u>kamaboko</u> da	<u>kamaboko</u> da

⁴) Hirayama [1], p. 20. Wada, pp. 194-198

⁵) Wada, p. 195.

b. Rising

	Fujitsu	Nagasaki and Kagoshima
'fire'	<u>hi</u>	hi
	<u>hi</u> ga	hi ga
	<u>hi</u> da	hi da
'flower'	<u>hana</u>	hana
	<u>hana</u> ga	hana ga
	<u>hana</u> da	hana da
'oil'	<u>abura</u>	abura
	<u>abura</u> ga	abura ga
	<u>abura</u> da	abura da
'pronunciation'	<u>yomikata</u>	yomikata
	<u>yomikata</u> ga	yomikata ga
	<u>yomikata</u> da	yomikata da

In Fujitsu, the first syllable of a falling word is ~~high pitched and the remaining syllables low-pitched;~~⁶ a rising word is completely low-pitched. In Nagasaki, the second syllable of a falling word is high-pitched, where a noun plus enclitic or enclitics is reckoned as a single "word", except that certain items such as the copula da are not counted within the "word"; however, if

⁶) Note that these statements refer to syllables and not to morae. Western-Kyuushuu Japanese is syllable-counting and not mora-counting, as is standard Japanese.

a word, thus interpreted, of falling type consists of only one or two syllables, then the first syllable is high-pitched. In Kagoshima, the next-to-last syllable of a falling "word" (interpreted as in the Nagasaki case) is high-pitched and the remaining syllables low-pitched. This holds good even when there are several enclitics:

hana 'nose'
hana ni 'to the nose'
hana ni wa 'as for to the nose'

The Western Kyuushuu accentual system arose from the Proto-Japanese accentual system through the loss of accent within the word, leaving only the accentual distinction of low-initial versus high-initial. Thus, roughly speaking, words which are low-initial in Kyooto are rising in Kagoshima and words which are high-initial in Kyooto are falling in Kagoshima:⁷

	Kyooto	Kagoshima
'plum'	ume	<u>ume</u> (F)
'cliff'	i'wa	<u>i</u> wa (F)
'string'	'ito	<u>i</u> to (R)
'autumn'	'aki'	<u>a</u> ki (R)

⁷) Two-mora nouns such as Kyo. a'si, Kag. asi (R) correspond to a Proto-Japanese 'a'si; the types 'X'X and 'XX have coalesced in Kyooto type dialects.

The Kagoshima rule that a compound is rising or falling according as its first element is rising or falling:

na <u>tu</u>	natu <u>o</u> bi
<u>a</u> to	atokat <u>a</u> zuke

corresponds to the Kyooto rule that a compound is low-initial or high-initial according as its first member is low-initial or high-initial:

na'tu	natuobi
'ato	'atoka'tazuke

(this rule has no counterpart in standard Japanese).

It is interesting to consider to what extent the notion "accented syllable" makes sense in Western Kyuushuu type dialects. In Fujitsu one could perfectly well describe falling words as being accented on the first syllable and rising words as having no accent. In Nagasaki one could say that one-syllable falling nouns were accented on the first syllable and 3 or more syllable nouns accented on the second syllable, but 2-syllable nouns would then cause something of a problem: it would be necessary to state an accent shift rule for the two different positions of high pitch. The resulting set of accent placement and accent shift rules would be considerably more complicated than the rule by which one can predict high pitch directly from the feature of [+ falling]:

S → [+ high pitch] in env. # (S)___S ...)_+ falling

The description is thus simplified if words are not required to pass through an intermediate stage in which syllables are marked as "accented". Not recognizing an intermediate stage of "accented syllables" gives a corresponding economy in describing Kagoshima Japanese.

An examination of diglossia in Kagoshima speakers provides an interesting example in this connection. Kagoshima speakers may impose the Kagoshima accentual system of the standard language when they speak standard Japanese. In verb and adjective conjugation, fallingness or risingness is constant regardless of whether the speaker uses a dialect form or a standard form, even though this often causes the high pitch to be on a different syllable in the two forms:

		Kagoshima dialect form	Kagoshima-ized standard form
falling	'go'	<u>i?</u>	<u>iku</u>
	'defeat'	<u>ma</u> ku?	<u>ma</u> keru
rising	'wait'	ma <u>?</u>	ma <u>tu</u>
	'escape'	<u>ni</u> gu?	<u>ni</u> geru

Accentual alternations in the dialects

In Kagoshima Japanese there really are no accentual alternations. The pitch shape of a combination of noun and enclitics or verb or adjective and inflectional morphemes is given by the risingness or fallingness of

the noun or the verb or adjective stem plus the location of boundaries. Assuming that those enclitics which do not count as part of the word are preceded by some juncture, say, /, the pitch shape in Kagoshima is given by the simple rules

S \rightarrow [- high pitch]

S \rightarrow [+ high pitch] in env. $\left\{ \begin{array}{l} + \text{ rising (} \dots \text{ — / } \\ - \text{ rising (} \dots \text{ — S / } \end{array} \right\}$

The Kyoto type dialects, on the other hand, have a rather complicated system of accentual alternations. The rules consist, roughly speaking, of the rules of the standard language plus some extra rules necessitated by the opposition low-initial/high-initial, which is absent from the standard language. However, I must caution the reader that this statement is only a rough approximation to the truth and, furthermore, is based on rather sketchy information about these dialects (namely, the data cited in Hirayama [1] and Hattori [2]).

Accentual alternations in combinations of noun and enclitic are governed by virtually the same rule as in standard Japanese, namely a rule that an accent preceded by an accent is deleted. The only difference is that it only applies to internal accents and not to the preaccentuation corresponding to low-initial-ness. Hattori

gives the following data for the dialect of Kameyama (Mie prefecture)⁸

The actual pitch shapes:

	'cow'	'horse'	'kettle'	'monkey'
	<u>usi</u>	<u>uma</u>	<u>kama</u>	<u>saru</u>
"than the..."	<u>usi</u> yori	<u>uma</u> yori	<u>kama</u> yori	<u>saru</u> yori
"even the..."	<u>usi</u> demo	<u>uma</u> demo	<u>kama</u> demo	<u>saru</u> demo
"from the..."	<u>usi</u> kara	<u>uma</u> kara	<u>kama</u> kara	<u>saru</u> kara

Quasi-phonemic representation and underlying forms:

usi	u'ma	'kama	'saru'
usi'yori<	u'mayori<	'kama'yori<	'saru'yori<
usi & 'yori	u'ma & 'yori	'kama&'yori	'saru'&'yori
uside'mo<	u'mademo<	'kamade'mo<	'saru'demo<
usi & de'mo	u'ma & de'mo	'kama&de'mo	'saru' & de'mo
usikara<	u'ma kara<	'kamakara<	'saru'kara<
usi & kara	u'ma & kara	'kama & kara	'saru' & kara

Before discussing the accentuation of Kyoto verbs and adjectives, I must say a word about one peculiar type of accentuation found in some two-mora nouns and three-mora noun compounds:

'rain'	'crane'	'projecting tooth'
<u>ame</u>	<u>turu</u>	<u>deppa</u>
<u>ame</u> ga	<u>turu</u> ga	<u>deppa</u> ga

In these nouns the first mora is low-pitched and the second

⁸) Hattori [2], pp. 429, 436.

mora (the third is deppa) is either high-to-low falling (if no particle follows) or high-pitched (if there is a following particle); a following particle is low-pitched. The other three accentual types of 2-mora nouns behave as follows:

	'edge'	'chopsticks'	'bridge'
phonetic data	<u>hasi</u>	<u>hasi</u>	<u>hasi</u>
	<u>hasi ga</u>	<u>hasi</u> ga	<u>hasi ga</u>
analysis	hasi	'hasi	ha'si

It will be noted that no such form as *hasi' is possible in Kyooto; indeed, two-mora nouns of the ame type and 3-mora compounds are the only nouns which might be considered candidates for an analysis with an accent on the final mora,⁹ since they are the only nouns in which there is a fall in pitch from the final mora to a following enclitic. Representing these nouns as having an accent on the last syllable would complicate the morpheme structure rules of the language, since the otherwise general rule that excludes accent from the final vowel would have to be made not to apply to these shapes of nouns.

Note now that aside from the nouns in question, the only case where a high-initial accentual shape in Kyooto

⁹) In other Kyooto type dialects such an accentual shape is possible. Final accent has been lost in Kyooto:

Kyooto	<u>asita ga</u>	<u>tikame</u> ga
Kameyama	asita]ga	tikame]ga

fails to have a corresponding low-initial accentual shape is that of words with accent on the first syllable.

For example, the following 4-mora shapes are possible:

High-initial	Low-initial
sanpatu	'gakkoo
hu'zisan	*
yama'yama	'kon'ban
kagiri'bi	'iroga'mi

I propose treating ame, etc., as if they filled the hole in such a table, i.e., representing the given examples as 'a'me, 'tu'ru, 'de'ppa. A rule that 'X'X → 'XX' (where X denotes an arbitrary mora) converts these into 'ame', 'turu', 'dep'pa. Since syllabic obstruents never bear accent, the grammar must have a rule to adjust the accent in forms like *'dep'pa, and a rule identical to that of the standard language which shifts accent to the right yields 'deppa'. If there is no particle after the noun, a rule will apply which puts a fall in pitch on a final accented mora of a phrase (this rule appears in many dialects of Tookyoo type, e.g., Akita, cf. 205, but not in the standard language). It is to be emphasized that the 'X'X → 'XX' rule is a synchronic, not a historical rule. Historically, something quite different happened. Ame had the form 'ame', not 'a'me; in words of the form 'X'X in proto-Japanese, the preaccentuation was lost, e.g., 'a'si > a'si (cf. fn. 7). The loss of final accents in words of 3 or more morae then caused a restructuring of the grammar of Kyooto Japanese,

since ame could now more economically be represented as 'a'me than as 'ame'.

The ame rule not only simplifies the morpheme structure rules but also accounts for some accentual alternations in verbs and adjectives. In Kyooto, verbs have two possible accentuations: high-initial and low-initial, which correspond generally to the unaccented and accented verbs of the standard language. Consider the following data:

	Present	Provisional	Imperative
'go'	iku	i'keba	i'ke
'ascend'	agaru	aga'reba	aga're
'wear'	kiru	ki'reba	ki'ro
'do'	suru	su'reba	si'ro
'borrow'	kariru	kari'reba	kari'ro
'wait'	'matu	'mate'ba	'mate'
'enter'	'hairu	'hai'reba	'hai're
'come'	'kuru	'kure'ba	ko'i
'see'	'miru	'mire'ba	mi'ro
'escape'	'nigeru	'nige'reba	'nige'ro

If the provisional and imperative endings are assumed to be preaccented: 'reba and 'e/'ro, the ame rule will convert 'mi & 'reba into 'mi & re'ba, and 'mat & 'e into 'mat & e' (with an intermediate stage of 'ma't & e). The only forms which present any difficulty are imperatives of one-mora vowel stems, such as mi'ro, ko'i, where one might expect *'miro', *'koi'. But these can be handled by a rule very similar to that of the standard language, by which the imperative ending will attract accent. This

rule can be given the provisional form

'X & Imperative --> X' & Imperative

Note that the rule applies precisely when the accent is exactly one mora before the ending, so that 'mat & 'e does not become *ma'te (thus the attraction rule will have to be earlier in the grammar than the rule which converts 'mat & 'e into 'ma't & e). While the accent attraction rule in the standard language can only be stated by making a list of the attracting morphemes, the Kyoto rule can be stated in a somewhat more compact form. Specifically, it appears that the attracting morphemes are 1-mora pre-accented morphemes which occur in word-final position (as opposed to the adjective inserts, which are not attracting). Thus,

'mi & 'ta --> mi'ta (past tense of 'miru 'see')

'de & 'ta --> de'ta (past tense of 'deru 'emerge')

'yo & 'ku --> yo'ku (adverbial form of 'yoi 'good')

I thus restate the rule in the form:

'X & 'X # --> X & 'X #

It is perhaps premature for me to assume that the past tense ending ta will have a pre-accented underlying form, since I am unprepared to state in general how the past tense forms in Kyoto dialect are generated. For the benefit of the interested reader, I will quote some data

from Hirayama [1] at the end of this appendix. As for the pre-accentedness of the adverbial ending ku, this is evident from such forms as 'aka'ku (← 'aka & 'ku) and 'ao'ku (← 'ao & 'ku).

A treatment of adjectives in Kyooto is considerably simpler than one of verbs, since Kyooto has lost the distinction between accented and unaccented adjectives. Hirayama gives the following data (these are Kyooto pronunciations of standard language forms rather than dialect forms):

	Present	Adverbial	Provisional
'good'	'yoi	yo'ku	'yoke'reba
'red'	a'kai	'aka'ku	'aka'kere'ba
'blue'	a'oi	'ao'ku	'ao'kere'ba

If the provisional ending is assumed to be pre-accented, the ame-rule will produce the correct forms:

'yo & 'ke & 'reba → 'yo & ke & 'reba

'aka & 'ke & 'reba → 'aka & 'ke & re'ba

The high-initial present tense forms a'kai and a'oi can be accounted for by an accent attraction rule, but a different one from that involved in the imperative, since here the accent is attracted from two morae away rather than one:

'XX & (i)_{present} → X'X & (i)_{present}'

so that a'kai arises from 'aka & i. Note that, unlike the standard language, this attraction rule applies only to the present tense of adjectives, not to verbs.

This accent attraction rule accounts for the absence of pre-accentuation in the negative and desiderative forms of 1-mora pre-accented vowel-stem verbs: 'miru but mi'nai, mi'tai. Since these forms are morphologically adjectives, the accent attraction rule applies and converts 'mi & na & i and 'mi & ta & i into mi'nai and mi'tai.

The data promised above on the past tense of verbs are as follows:

	Unaccented			Accented	
	Present	Past		Present	Past
'go'	iku	it'ta	'bite'	'kamu	'kanda
'produce'	umu	u'nda	'cut'	'kuru	'kitta
'sell'	uru	ut'ta	'buy'	'kau	'koota
'carry'	ou	o'ota	'write'	'kaku	'kaita
'put on'	kuru	ki'ta	'come'	'kuru	ki'ta
'do'	suru	si'ta	'emerge'	'deru	de'ta
'sleep'	neru	ne'ta	'see'	'miru	mi'ta
'rise'	agaru	a'gatta	'walk'	'aruku	'aru'ita
'float'	ukabu	u'kanda	'conceal'	'kakusu	'kaku'sita
'loathe'	kirau	ki'roota	'enter'	'hairu	'hai'tta
'open'	akeru	a'keta	'waken'	'okiru	'oki'ta
'borrow'	kariru	ka'rita	'hang'	'kakeru	'kake'ta
'ridicule'	azakeru	azaket'ta			
'inquire'	ukagau	ukago'ota			
'give'	ataeru	ata'eta	'conceal oneself'	'kakureru	'kaku'reta
'pile up'	kasaneru	kasa'neta			

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BIOGRAPHICAL SKETCH

James D. McCawley was born in Glasgow on March 30, 1938. He studied mathematics at the University of Chicago (1954-59 and 1960-61) and the Westfälische Wilhelms-Universität (Münster, Germany, 1959-60) and received an M. S. in mathematics in June 1958 from the University of Chicago. He entered the Ph. D. program in linguistics at M.I.T. in 1961. He was a member of the Mechanical Translation Group of the Research Laboratory of Electronics at M.I.T. from 1961 to 1963. His publications include papers on Finnish and Serbo-Croatian published in the Quarterly Progress Report of the Research Laboratory of Electronics, a review of Harms' "Estonian Grammar" (Word, vol. 19), and translations of three Russian mathematics textbooks. He has been appointed assistant professor of linguistics at the University of Chicago, effective October, 1964.