A STUDY OF GRAPHEME TO PHONEME TRANSLATION OF ENGLISH

by

FRANCIS FAN LEE

S.B., Massachusetts Institute of Technology
(1950)

S.M., Massachusetts Institute of Technology
(1951)

SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
November, 1965

Signature of Author _____
Department of Electrical Engineering, Nov. 1, 1965

Certified by _____

_____
Thesis Supervisors

Accepted by _____
Chairman, Department Committee on Graduate Students

A STUDY OF GRAPHEME TO PHONEME TRANSLATION OF ENGLISH

by

Francis Fan Lee

Submitted to the Department of Electrical Engineering on November 1, 1965 in partial fulfillment of the requirements for the degree of Doctor of Philosophy

ABSTRACT

The result of this thesis research is the identification and development of an efficient scheme for automatic translation of English text from letters to phonemes. The motivation arises from the specific desire for artificial-speech outputs from reading machines and also from the general desire to provide background for modelling the cognitive processes involved in human reading and speech.

In order to determine whether phonic rules can be generalized to the extent that an algorithmic approach of grapheme (primarily letter spellings) to phoneme translation can be implemented for a reading machine, a body of 17,777 most commonly used English words together with their pronunciation in General American was processed and placed in various forms so that graphemic context was plainly observable. It was found that while the consonant letter mapping relationship is more regular, vowel letter mapping is heavily dependent on the root word and suffixes. A detailed study of the cases of the paradigmatic suffixes -ed, -er, -ing revealed that the algorithmic approach, even when supplemented by large exception lists, not only leads to extreme complications, but leaves many serious problems unsolved.

The study led to the belief that phonic rules do not play a significant part in the mature reader's reading habit. His reading capability is based principally on the existence of the learned morpheme lexicon and the application of morphophonemic rules. Furthermore, it is believed that in reading unfamiliar words or nonsense words, morphophonemic rules are applied to the parts which agree with bound morphemes, if any, and phonic rules are then applied to the remaining unfamiliar or pseudo-morpheme. These phonic rules depend on personal experience and differ among individuals, thus accounting for the variation of responses to nonsense words.

Technological advance in low-cost high-density read-only storage has made it feasible now to consider the imitation of the human reading habit by machine. A lexicon containing in the order of 32,000 selected morphemes and words can be used together with algorithms to give phonemic translation for a vocabulary equivalent to what is contained in the Webster New Collegiate Dictionary. The algorithms make use of a search and compare procedure which provides the direct translation of simple words and decomposes in an orderly manner complex words into their constituent lexical entries. Considerations in the selection of morphemes and words for the storage are discussed in connection with the algorithms. It is shown that problems the phonic algorithmic approach cannot possibly solve, such as those involving compound words containing the medial mute grapheme [e], syntactical ambiguities, and semantic symbolisms, can now be handled.

Thesis Supervisors: Samuel J. Mason
Title: Professor of Electrical Engineering

Morris Halle
Title: Professor of Modern Languages

Acknowledgements

The author wishes to thank Professors S. J. Mason and M. Halle who maintained a high level of interest in the subject problem and gave him a steady flow of encouragement throughout the course of the research, and to thank Professor H. Teager for his timely suggestion in the use of optical storage.

Work reported herein was supported in part by Project MAC, an M. I. T. research program sponsored by the Advanced Research Projects Agency, Department of Defense, under Office of Naval Research Contract Number Nonr-4102(01). Reproduction in whole or in part is permitted for any purpose of the United States Government.

The author wishes to acknowledge the use of the facilities provided to him by the Research Laboratory of Electronics and the generous financial support from the Fannie and John Hertz Foundation.

TABLE OF CONTENTS

CHAPTER 1

Introduction

Most people desire to be independent, useful to society, and financially secure, whether handicapped or not. For a blind person, the quest for such common objectives is severely limited by restricted mobility and by the inaccessibility of much material that he would like to read. His ability to perform other tasks for which sight is not necessary is unimpaired. In fact, nature seems to have a way of compensating him with better memory and a more alert mind. Hence, helping him to get around and to read are the two main problems in sensory-aids research.

Let us restrict our attention now to reading.

At present, the most efficient way for a blind person to "read" is to be read to. Listening to a human reader is most efficient because of the relatively high information rate attainable, and no further mental translation is required for proper understanding. The information is produced in the same form he normally uses for maintaining communication with other human beings.

How does a human reader read? How does he recognize the alphabets when they may be printed in a variety of fonts, in different sizes, and located at different places? How does he convert the sequence of discrete symbols into a continuum of speech sound? What are the elements of speech sound? How are they related to the discrete alphabets? Research in speech production, perception, and linguistics over the past twenty years has given us a fairly good inside to some of these deep questions. With the invention of powerful high-speed logic machines, we are now beginning to be able to simulate some of the processes employed in reading.

In the next chapter, we shall review the reading machine development, and state, in reference to a high-performance and high-quality speech-output reading machine, the objective of this thesis research.

CHAPTER 2

A Review of Reading Machine Development

Braille has been in use by the blind for a little over a hundred years. The basic Braille symbols are embossed on stout paper so that the blind persons can read by "touch". Grade 1 Braille is a direct translation of the English text with each Braille symbol corresponding to an alphabet, a numeral or a special symbol. Grade 2 Braille makes use of contractions to enable the reading to be done at a higher speed, and such contraction also reduces the bulk of a Braille book. Most Braille books are coded in Grade 2. The rules for contraction depend not only on phonological considerations but also on syntax and semantics. Consequently, the process of printed English to Grade 2 Braille translation is a complex problem which until recently has been performed only by highly trained persons (1).

Braille books are bulky and cumbersome to handle, and slow in reading. Very few Braille readers can approach even the modest reading speed of 100 words per minute (wpm). In contrast, the speech rate is in the order of 180 wpm.

Statistics (2) indicate that 75% of the blind population become blind over the age of 45. These people, and many who became blind at somewhat younger ages, are less capable of learning Braille and, as a result, do not in general use it.

Devices which could convert print into sound and allow the blind reader direct access to the printed page have been the interest of a growing number of inventors for many years.

The most famous invention of early years is the Optophone (3). It is a machine which presents the listener with a series of sounds that are generated from, and vary in accordance with, the continuously changing contours of the printed text, much as a player piano plays the constellations of holes in a music roll. Its use requied considerable amount of training. The best reading rate achieved was in the neighborhood of 30 wpm. Other devices (4) constructed on the principle of a direct optical image to sound conversion, for the reasons mentioned, have neither yielded any greater reading speed nor have met with any better acceptance by the blind population. The importance of a simple, cheap and highly portable direct conversion device, however, must not be minimized. It would be very useful for incidental readings such as telephone directory, package labels, typed short notes, etc.

Let us take a look at what comes within view if we forego the personal and portable aspect of a reading machine.

With the advances made in electronic data processing, we now have machines which are capable of recognizing printed characters. All these machines have been designed for high speed reading of sheet documents printed in one or a small number of fonts, usually of a single size. Clemens (5) has recently demonstrated a technique of feature extraction which permits the recognition of a large number of type fonts. A program to reduce Clemens' idea to a low cost practical machine is now under active consideration by the Cognitive Information Processing Group in the Research Laboratory of Electronics here at M. I. T.

Once the characters of printed text have been recognized, we may present them in a number of ways through the auditory or tactile sensory channels. Rate of successful tactical communication depends on signal coding and so far has been woefully low (6,7). We shall restrict the following review to auditory presentation only.

The simplest such presentation is perhaps Morse Code. Thirty to forty words per minute is generally considered good rate even for experienced commercial operators. Metfessel's work (8) on spelled speech is an extension of the Morse Code idea. Spelled speech consists of very rapid spoken spelling in which the letter sounds are run closely

together. Using the same phonetic elements of the spoken language, it represents each word as a new "word" sound pattern which the reader himself can produce. Listening speed in the neighborhood of 100 words per minute has been reported, from specially-prepared prerecorded spelled speech.

A normal connected speech representation of the printed material is highly desirable because it requires no learning on the part of the listener. It is fast and with time compression a rate of 300 wpm can be realized without sacrifice of comprehension (9).

The generation or synthesis of speech has been attacked along two differnt routes, both involving the use of stored data of, or about, speech elements.

One approach, which has been explored by the Haskins Laboratories, employs a library of pre-recorded spoken words (10). The spelling of the word is used to generate the address of the word in the storage medium. The storage capacity required is proportional to the size of the vocabulary. Cooper estimated (10) that 400,000,000 bits of storage is needed for a vocabulary of 20,000 words. Since each word included in the spoken dictionary is to be stored as as a single entry, it must not only be "typical" of the word, but also must sound reasonable in combination with any other words likely to occur in its immediate environment (11). Although the machine has not been constructed,

simulated output from joined strips of such recorded words has been demonstrated. One may get some idea of the performance by reading to himself a sentence one word at a time with slight pauses between words at the same time eliminating the sentence intonation.

The other approach is aimed at the generation of speech with an unrestricted size of vocabulary from a small set of stored data of speech elements. Early attempts by Harris (12) in splicing together segments of audio recordings corresponding to what was thought to be phonemes led to very poor results. Phonemes, as we now know, are elements of language not on the acoustic level. Their production involves the changing of distinctive features (values along different dimensions) in an overlapping manner. When the overlap is large, phoneme segmentation on the acoustic level can not be obtained. In fact, experiments done at the Haskins Laboratories (13) with the Pattern Playback machine showed that segments of acoustically identical signals can be perceived as totally different phonemes depending on the context.

Peterson and Wang (14) cut audio recordings in such a way that each segment contained a transition from one phoneme to the next and the two ends of each segment were chosen at times when the acoustical signal was approximately at steady states. The speech quality of a few sentences synthsized by the concatenation of such segments by Peterson

and Wang was poor, but they were intelligible. The mismatch of level, pitch and formant frequencies across the segment boundary due to their crude instrumentation was plainly noticeable.

Estes, Kerby, Maxey and Walker of the IBM Research Laboratory at San Jose, California reported (15) on a speech synthesis scheme which used the same principle employed by Peterson and Wang. Instead of storing the acoustic segments, they digitized and stored the analog control signals which are necessary to generate these segments on a terminal analog type of speech synthesizer. With the equipment they constructed, it was possible to assure at the output across the segment boundaries smooth transitions in pitch, level and the formant frequencies. Recordings of sentences assembled from such stored data and generated by the speech synthesizer were quite intelligible even when heard for the first time.

More sophisticated phoneme-driven speech generators have been reported by Kelley, Gerstman and Lockbaum (16) of the Bell Telephone Laboratories and by Holmes, Mattingly and Shearme of the Joint Speech Research Unit in England (17). In each of these cases, instead of joining the control signal segments rigidly, as was done by the IBM group, transitions of each control signal from segment to segment were computed based on the properties of the segments involved. While the Bell Telephone Laboratories group used

a large scale general purpose computer to simulate the entire process, the English group employed a small computer together with a terminal analog speech synthesizer to produce the speech in real time. Speech produced in this manner was not only intelligible, it even had a touch of naturalness.

In terms of the concept of a print-to-voice converter using a character recognition unit and a phoneme-driven speech synthesizer, there are a number of functions yet to be worked out. One unsolved problem is the translation from the grapheme symbols used in the printing to the phoneme symbols. English spelling is not simply related to pronunciation. Can we devise an algorithmic approach for the translation, or must we use a large dictionary? How should we organize the dictionary if we have to use one? A study on this very subject is the objective of this thesis research.

CHAPTER 3

A Brief History of English

The original speakers of the tongue from which English was born were Germanic people on the continental North Sea Coast, from Denmark to Holland. They began moving to Britain in the fifth century. Prior to this time the Celts were the principal dwellers of the British isles. The Romans ruled over the Celts from the first century till 410 A.D. Neither the Celts nor the Romans of that era left any significant influence on the English language as we know it today. The first landing in force by the Germanic tribes on British shores was made in 449 by the Jutes, settling down in Kent. The Saxons didn't arrive until 477, settling down in Sussex and Wessex in 495; while the Angles did not reach Anglia until 547. The original Celtic people eventually retreated to the western mountain fastnesses of Wales and Cornwall.

The Angles, Saxons and Jutes spoke Low Germanic dialects which were very closely related. The mixture of these dialects which gradually emerged out of the invasions from the mainland has been called "Old English" by modern

linguists.

Old English, being a Germanic tongue, was marked by vowels that could be long or short, independently of the accent, which was regularly fixed on the initial syllable (Germanic stress rule), and by an abundance of inflectional endings. The grammatical forms were such that nouns had four cases, nominative, genitive, dative and accusative, with an occasional instrumental, and there were many different declensional schemes. Adjectives were similarly declined. The definite article itself was very strongly inflected. The verbs displayed the customary Germanic strong and weak classes, which have persisted into modern English.

By the time of the Danish invasions in the eighth and ninth centuries, the Jutes, Angles and Saxons were well settled and had become Christians. The Danish invasion was halted by King Alfred, who ceded nearly half of England to the Danes as a colony (the Danelagh).

The Danes eventually merged with the Anglo-Saxons, but their presence on the scene coincided with the beginning of the process of the inflectional decay of Old English.

Jespersen (18) wrote:

> "In order rightly to estimate the Scandinavian influence it s important to remember how great the similarity was between Old English and Old Norse,...

> An enormous number of words were then identical in the two languages,... The consequence was that an Englishman would have no great difficulty in understanding a Viking -- nay, we have positive evidence that Norse people looked upon the English language as one with their own. ...
>
> As the Scandinavians and the English could understand one another without much difficulty it was natural that many niceties of grammar should be sacrificed, the intelligibility of either tongue coming to depend mainly on its mere vocabulary..."

The implication is clear, and has led to the conjecture that the Danish settlement was the cause of the beginning of the Old English inflectional decay. Interesting and plausible as this conjecture may be, scholars of linguistics still consider the exact sequence of events leading to the beginning of the inflectional decay an unsettled issue.

This inflectional decay went on throughout the Norman period.

Although the Normans were too of Germanic origin, by the time of their invasion of England in 1066 they were already assimilated, at least in their language, by the French. Under the Norman rule, the court, clergy and nobility knew and spoke only French and Latin. English, being spoken by the subject population, went on in its merry

own way. English was not restored to an official status until the beginning of the fifteenth century, well after the loss of Normandy by King John in 1204. By then, a large number of French and Latin words had already been absorbed into the English language.

Many words lost their endings with the inflectional decay. For example, a verb like [drīfan] became [drīven] , then [drive] . In other cases, vowels of final syllables, a, o, u, e, once distinctly pronounced, began to merge into an indefinite weak [e], which later turned mute. Jespersen considered the loss of the weak [e] as the most important changes in the whole history of the English language. Indeed it is for the problem of grapheme to phoneme translation, as we shall see later in chapter 4, the interaction between this mute [e] and various suffixes has made it necessary to have extensive word lists for the purpose of resolving ambiguities.

With the loss of inflectional endings, words lost some of their outward characteristics which previously identified their parts-of-speech. This gives rise to many cases in which groups of related words of different parts-of-speech are spelled in the same way, such as [white] both as adjective and noun and [move] both as verb and noun. Many words ending in mute [e] can therefore take on a larger number of suffixes. This fact aggravated the difficulties created by the mute [e] in grapheme to phoneme translation.

When Caxton introduced the Gutenberg movable-type printing press to England in the fifteenth century, he found it necessary to standardize the spelling, which up to that time was subject to great variations and arbitrariness. There has been a continuing change in the English sound pattern from Caxton on, but as in most languages, the spelling, constrained by printing, has lagged behind these changes up to this present day.

Future students of the history of the English language undoubtedly will regard the twentieth century inventions of radio, television and sound recording as having exerted a further standardizing influence on the English sound patterns as Caxton's presses did on spelling. It is not inconceivable that dialectal differences in pronunciation will diminish with the passage of time. The vocabulary will probably be the most changeable element of the English language as it has been since the days of Shakespeare.

Chapter 4

PHONIC ALGORITHMIC ANALYSIS OF ENGLISH WORDS

4.1 Phonic Alorithmic Approach and List Look-Up

In spite of the lack of simple letter-to-sound correspondence, there exists much regularity between spelling and pronunciation of English words. In fact, it is because of this regularity we have the so-called phonic method of teaching English to grammer school children. As a simple example, the single isolated consonant letter [c] is pronounced as /s/ before vowel letters [e, i, y] and is pronounced as /k/ before vowel letters [a, o, u]. We shall come back to this in much more detail later. (Consonant and vowel letters are defined in Section 4.3.)

It is furthermore a common experience that there is a reasonable degree of agreement among people in their pronunciation of English-like nonsense words. The property of English-likeness of a nonsense word can only be attributed to the way the letters are arranged. The approximate agreement among people in their pronunciation of nonsense words further suggests the existence of some

loosely definable phonic rules.

It is of interest, therefore, to see whether we can formalize these relations and state them unambiguously. If it is possible to do so even at the expense of a large number of levels of logical decisions, we may be able to implement these relations as algorithms for phonemic translation by a logic machine.

A more straightforward method of deriving the pronunciation of words is by the use of a list look-up procedure. After all, we can do it as human beings. For machine handling, however, there are two strong objections to the use of such a dictionary. The first objection is that the list would have to be very large, consequently very expensive. The second objection is that there would be no way of handling words outside the list. New words are constantly created, and the compounding of words in English is so free that it is impractical to store all conceivable compound words even if we know how to generate them. We would have to store all the paradigmatic forms of each and every word, which would substantially increase the size of the list.

Since a phonic algorithmic approach holds a broad generative appeal, we shall proceed to examine it in greater detail.

4.2 Phonic Teaching of English:

People devoted to the teaching of English in primary schools have been interested for many years in the correlations between spelling and pronunciation of English words. There is the phonic school which advocates the use of phonic rules, and there is the look-and-say school which treats each word as unique visual pattern, ignoring whatever regularity there may be between spelling and pronunciation. There have been long and drawn-out disputes over which system is the better. The principal argument against the phonic method is that the rules have not been unambiguously stated.

Theodore Clymer, Professor of Elementary Education and Educational Psychology at the University of Minnesota, reported in 1961 at a joint meeting of the International Reading Association and the National Conference of Research in English (19) the result of his evaluation of forty-five phonic rules selected from four widely used sets of phonic readers. For testing he used a list of twenty-six hundred words made up from all the words introduced in the four basic series and the words from the Gates Reading Vocabulary for the Primary Grades. Defining utility as the percentage of words conforming to a rule when the conditions specified for its application are satisfied, he found the following distribution:

Utility	Number of Rules
0-14%	1
15-29%	2
30-44%	4
45-59%	6
60-74%	10
75-89%	6
90-100%	17

To be executable by a machine, a set of rules must be precise with all conceivable contingencies provided, and with all exceptions clearly listed. Unlike a human being, even a child, the machine cannot take advantage of other cues to supplement inadequate instruction.

4.3 Phonic Algorithmic Analysis: Past Work

Higginbottom at the University College, London, was the first who tried to establish a set of phonic rules for use by a machine. Unfortunately, her published result (20) was not sufficiently complete to permit programming for test by a computer. The small sample she used--30,000 words of running text--was too small for the results to be conclusive. For example, she had

a(ny) / /,

a(1C) / :/, etc.

Clearly, she had not encountered words such as miscellany, alleghany, canyon , and talcum, calculus, fallacy, .

She had separate rules for stressed and unstressed vowels without providing a means of deciding when a vowel is to be stressed and when it is not. She recognized the difficulties involved in handling derived words and compound words, but dismissed consideration on derived forms other than those formed with suffixes s, er, est, ing, ed, ly on the ground that they do not occur with sufficient frequency. It was interesting that in the paragraph she made the latter statement, seventeen words out of one hundred fall in the dismissed category.

A group of researchers at Cornell University performed a series of experiments around 1961 to test the hypothesis that the proper unit of the reading process is neither the single letter nor the whole word but a higher-order invariant derived from grapheme-phoneme correspondences. Their reported results (21,22) were limited exclusively to monosyllabic words.

More recently Bhimani, Dolby and Resnikoff announced at an Acoustic Society meeting (23) the result of their study on the functional relation which maps words of written English onto the corresponding words of spoken English. Their work was also confined to monosyllabic words.

Recognizing that the spelling to pronunciation translation has more irregularities near the end of words, Monroe (24) investigated the automatic recognition of word endings which he called post-base affixes. For example, he gave, as the result of the computer run,

systematic	as	system+ate+ic
solicitor	as	sol+ic+ite+or
applicable	as	appl+ic+able

It appears that the notion of suffix identification is a worthwhile one, but the particular approach taken by Monroe and the artifiality of the post-base affixes complicates rather than simplifies the correspondence problem.

The recent work by Weir and Venezky at Stanford University on "Rules to Aid in the Teaching of Reading" (25,26) marked a clear departure from either the phonic or look-and-say approaches. The hypotheses on which their research was based were that English spelling relates not only to phonology, but also to morphology and syntax. When viewed with this understanding, a much higher degree of regularity emerges than when the consideration is confined to a simple letter-to-sound relationship.

They modelled the mapping process as involving a structure of three levels: grapheme, morphophoneme, and phoneme. Polymorphemic words are first broken into their

constituent morphemic units and each of these is then mapped into "morphophonemic strings". Thus, they gave

$$\langle \text{climatic} \rangle \rightarrow \langle \text{climax} \rangle + \langle \text{-ic} \rangle$$
$$\rightarrow \{\text{klaɪmæks}\} + \{\text{-Ik}\}$$
$$\rightarrow \{\text{klaɪmæk} + \text{Ik}\}$$
$$\rightarrow /\text{klaɪmætɪk}/$$

Note: The symbols $\langle\ \rangle$ were used to enclose graphemes, $\{\ \}$ were used to enclose morphophonemes, and // were used to enclose phonemes.

It is worthwhile noting that in all the work described the grapheme-to-phoneme translation is performed on a word basis. Clearly there are many cases where the mapping relation is one-to-many with the choice depending on the syntax. There are familiar examples of:

[produce] → /prádjus/, noun,
→ /prədjús/, verb.
[refuse] → /rɛ́fjus/, noun,
→ /rɪfjúz/, verb.

For proper translation of connected text, ambiguities at this level can be resolved if the parts-of-speech are known.

Klein and Simon (27), in connection with the creation of a syntactic analysis program, developed a computational method for finding without a dictionary the parts-of-speech

information for each word in a running text. They used a few small lists (less than 1500 words) in conjunction with algorithms to perform suffix analysis. The result of the suffix analysis returns the parts-of-speech information, and in cases where ambiguities exist, a "context frame test" extending over three consecutive words is performed. The "context frame test" searches a stored list of syntactically permissible combinations to assist in the final choices.

Ambiguities in pronunciation due to semantics can arise, for example, the word [wind] in [It was a left wind] could be /wɪnd/ or /waɪnd/, both nouns. Fortunately, semantic ambiguities of this kind do not seem to occur often enough to warrant serious engineering consideration.

4.4 Phonic Algorithmic Analysis: Present Work

Instead of starting from a set of existing known rules which is not precise and incomplete, and proceeding to enlarge and modify it, the approach taken here is first to observe and then to deduce. A selected body of English words and their proper pronunciation are collectively treated as the experimental data. They were analyzed and manipulated into suitable forms so that the desired correspondences could be conveniently observed. Through these manipulations and observations, it was hoped that the phonic algorithms could be logically deduced.

For the source material "The Teacher's Word Book of 30,000 Words" (28), by Thorndike and Lorge, is used in the selection of the experimental data. Pronunciation of words are from Kenyon and Knott's "Pronouncing Dictionary of American English" (29). The present work included those words occurring at least once per million in the Thorndike General Count and also contained in the pronouncing dictionary. This body consists of a total of 17,777 words.

In compiling the Teacher's Word Book, Thorndike and Lorge lumped all the paradigmatic forms of a word together and only listed the basic entry. This fact was kept in mind and special attention was brought to it later because of the complications introduced by vocalic suffixes.

The pronouncing dictionary lists all the variants of pronunciation, whether the variation is due to different parts-of-speech or due to unrelated meanings, such as those examples given in the last section, or simply the various culturely accepted ways of pronouncing, such as:

[advertisement] → /ædvərtáɪzmənt, ədvə̀rtɪzmənt, ədvə̀rtɪsmənt/.

It was decided that in as much as possible these variations should be preserved in the data processing. Only regional pronunciations were not retained in the initial transcription.

Because of the limited number of available symbols in the data processing equipment used, it was necessary to use substitution for the phonemic symbols. The substitution list is included in Appendix A.

Since a one-one or many-one correspondence does not exist in going from grapheme letters to phoneme letters, we are forced to examine the correspondence at a larger sub-word level.

Phonemic consideration suggests that syllables should be the sub-word level at which our study could be carried out. However, it was found after a brief examination that nearly one-sixth of the 17,777 words taken are monosyllabic. We could not even achieve an order of magnitude of reduction in the number of distinct elements to be observed. In addition, many polysyllabic words can be segmented in more than one way. For example, if we define a graphemic syllable as a string of graphemes containing some vowel letter as a nucleus, we can segment, for example, the word [consonant] into the following alternate forms:

co nso nant
co nson ant
con so nant
con son ant
cons o nant
cons on ant

We may rule out the first two possibilites on the basis that [ns] is not an admissible initial consonant cluster in English. This additional type of constraint does not elliminate the remaining ambiguities. Similar ambiguities can arise with vowel letter clusters also, for example, with the vowel letter cluster [ai] we need for [Jamaica] a breakdown of [Ja mai ca] , but for [archaic] a breakdown of [ar cha ic] . We can of course go through a suffix identification procedure to determine that [ic] is a suffix and must be handled as such. But we still have to cope with the problem of handling words like [dais, naive] , [phaeton, Israel] , etc.

The ambiguity and complication involved in the construction of graphemic syllables led us to the consideration of the consonant and vowel letter clusters.

We may define grapheme letters [a, e, i, o, u] as vowel graphemes. With a relatively simple algorithm the graphemes[y, w] can be classified as either vowel grapheme or consonant grapheme. All the remaining grapheme symbols in the alphabet set can be defined to be consonant graphemes.

Having so defined the grapheme alphabets, we may scan each word from left to right and group consecutive vowel graphems together. A grouping of vowel graphemes is called a vowel grapheme cluster and a grouping of consonant graphemes is called a consonant grapheme cluster. We can

similarly perform the phoneme words cluster grouping, since there is no ambiguity in the identification of vowel or consonant phonemes. The stress marks, which represent a prosodic feature, are placed to precede the vowel phonemes they stress and are regarded as qualifiers of the vowel.

If we represent a consonant cluster by 'C' and a vowel cluster by 'V', for each grapheme or phoneme word we can derive a characteristic signature such as CVCVCVC. It was found that the signatures for a grapheme word and its corresponding phoneme word are identical for most entries. There were found 159 distinct vowel grapheme clusters and 833 distinct consonant grapheme letter clusters. (see Appendix A).

For the entries which have multiple pronunciations a method had to be developed to preserve the alternatives without hindering the cluster matching process. The "+" symbol was introduced to logically "or" the alternative phoneme clusters. An entry which has been merged in this manner may contain more than one such complex cluster if and only if all possible combinations exist. Most of the entries which cannot be merged to give single complexly represented phoneme words are words which receives different stress assignments for different parts of speech. (See Appendix B).

The entries which resulted in non-identical signatures between the grapheme word and the phoneme word were then

examined. With a few exceptions like [one, once] , the lack of correspondence was due to the existence of a mute grapheme cluster, such as the underlined parts in [honest, baseball, base, throughout, sleigh, anihilate, Judah, Salisbury, denominational, iron, apropos, bouquet, Roquefort, league, Sioux, Agassiz]. A null symbol /-/ was introduced artificially to bring about signature agreement. On the grapheme side, the symbol [-] was used to denote word boundary. Thus we have a facility to indicate whether a grapheme cluster is in word initial, medial, or final position.

At this point, we can present the correspondence relation in terms of the environmental conditions. We have, for instance,

[eou] → / ɪə / when it is proceded by [-instantan]
and followed by [s-].

There were over 76,000 such individual correspondences generated. The results were sorted in two different ways and printed. The first sort employed three fields, namely, in descending order: grapheme cluster, the precedent (in reverse spelling) and the antecedent. The second sort used four fields, namely, in descending order, the grapheme cluster, the phoneme cluster, the precedent (in reverse spelling) and the antecendent. Samples from the print out are shown in Appendix C.

We are now in a convenient position to examine the correlation between graphemic clusters and phonemic clusters. If graphemic environment has a strong influence on the mapping relation, then a pattern of regularity would show up in the sorted list, and the mapping would be governed by environmental conditions which are the common denominators of related clusters.

It was realized that the mute final grapheme letter [e] is easy to handle, but recognition of a mute [e] in paradigmatic forms might be more difficult. Furthermore, the appending of non-vocalic suffixes, like [ness, less, ment] would move a mute [e] to medial position, rendering it difficult to detect. Words ending in [ed, er, es, ly, less, ness, ful, fully, ment] were set aside for special examination. The sorted lists, as a result, did not reflect clusters which were contained in these words.

4.5 Result of Phonic Analysis:

After all the work of arranging the data finally into the desired forms, many isolated interesting features of English spelling and pronunciation appeared. For example, the final vowel letter [e] is always mute (2799 counts), except in words in which [e] is the only vowel letter, such as in [he, she, me, we, ye, be, the] , and in [anemone, phoebe, canape, posse, simile, recipe, circe, psyche, acme, acne, apostrophe, catastrophe, epitome, Comanche, Apache, Shoshone, Athene, Hebe, Ariadne, Daphne, Aphrodite, adobe,

alcalde, Niobe, Chile, Halle, ukulele, finale,....]. The consonant cluster [ct] in medial position is always pronounced as /kt/ except in [victual, Connecticut] (derivatives of [indict] may be considered to be in this group.). The only word in which a medial single consonant [s] can be pronounced as /s/, /ʃ/, /z/ or /ʒ/ is [nauseate].

But it was rather disappointing to find that the sought after neat relations do not exist. It is not practical to reproduce the fifteen hundred or so pages of the environmental printout to illustrate this point. A summary of the cluster correspondence without the environmental conditions is included here as Appendix A. It can be seen that the correspondence between the consonant clusters is substantially more regular than the vowel clusters.

The frustration of not being able to find the intended solution diverted the writer's attention to the examination of the mute e problem and its interaction with the various types of suffixes. As we shall see later, even if we could force a phonic algorithmic solution to handle the set of words included in the investigation, we would still have many serious problems in applying the solution to a real reading machine.

4.6 Paradigmatic Suffixes:

In compiling the "Teacher's Word Book of 30,000 Words", Thorndike and Lorge chose not to list the regular

paradigmatic forms of words. Since these forms can be readily derived from the main entries, their inclusion would contribute little to the significant vocabulary.

While the rules used to form the paradigmatic forms can be precisely stated, the inverse process of deriving the basic words from paradigmatic forms frequently involves ambiguities.

For example, the suffix [er] is used to form the agent nouns and comparatives of adjectives. The rules for suffixing [er] can be described as follows: (We shall ignore for the purpose here those agent nouns formed by suffixing [ar, or] such as in [beggar, operator]).

a. If the base word ends in a single consonant letter [c] , append [ker].

b. If the ending cluster is a single consonant letter but not [c] , and the last vowel letter cluster is stressed, append [$er] , where [$] represents the last consonant letter.

c. If in (b), the last vowel letter cluster is not stressed, append [er] . Exception: Some words may optionally take either [$er] or [er] , e.g. [traveller, traveler] .

d. If the ending consonant letter cluster contains two or more letters, append [er] .

e. If the ending is a single vowel cluster [e] , append [r] .

f. If the ending is a single vowel letter [y] , and the base word is polysyllabic, change [y] to [i] and append [er] . For monosyllabic words, [y] may be optionally changed to [i] and appended with [er] , e.g. [dry, dryer] or [drier] .

g. If the ending is a single vowel letter not [e, y], append [er] .

h. If the ending is a vowel letter cluster containing two or more letters, with last one being [e] , append [r] .

i. If in (h) the last letter is [y] , append [er] for verbs. If the vowel cluster is [ey] , change [y] to [i] and append [er] , otherwise append [er] .

In addition to the suffixal [er] , we have many base words normally ending in [er] , such as [never, sever, fever, October, ...] .

From the grapheme pattern alone, it is not possible to resolve ambiguities of the following kinds:

[faster] as [fast•er, faste•r] or [faster] ,
[paster] as [past•er, paste•r] or [paster] ,
[aster] as [ast•er, aste•r] or [aster] ,

[inviter] as [invit•er] (stress on first vowel),
[invite•r] (stress on second vowel), or
[inviter] ,

[profiter] as [profit•er] (stress on first vowel),
[profite•r] (stress on second vowel), or
[profiter].

The fact that we adult readers know [faster] is [fast•er], [inviter] is [invite•r], is simply due to our prior learning that [fast, invite] are the base words. From phonic rules alone, [fast] and [faste] or [invit] and [invite] would lead to very different assignment of vowel values. For the phonic rules to be useful, lists must be consulted to resolve these ambiguities. Such lists are the counterpart of the learned experience a person uses in dealing with the same situations. The fact that some words are sometimes mispronounced by some people, like [quadruped] pronounced as /kwadrúpt/ supports such a point of view.

In order to assess the extent of the complexity to which an algorithmic approach would lead in resolving ambiquities introduced by vocalic suffixing, the suffixes [er, ed, ing] were studied. The "environment printout" was found to be a great tool for this purpose. The study was done with the objective to minimize the total number of words in the combined exception lists. For simplicity, words which end in [er, ed, ing] in their base forms were treated as if these endings were suffixes attached to pseudo words. The placement of such pseudo words was guided by potential simplification at the output. For example [never] is considered as [nev•er], but [fever] is considered as

[feve•r] .

The algorithm for determining the base word (or pseudo word) from a word ending in [er, ed, ing] is depicted in the flow chart shown in Appendix D.

It is assumed that by a previous set of algorithms letters [y] and [w] have been determined to be vowel letters or consonant letters. The word is examined to determine whether there is an ending of the type [er, ed] or [ing] . The proper flag is set if a match is found, and the related exception list (list 1 or list 1') is searched. If the word is found in the list, the phonemic representation is copied and the problem is over. Words in the exception lists are chosen on the basis that they do not fit into a general pattern.

The next step involves the formation of the vowel and consonant letter cluster of the truncated word. The procedure leads to various branches depending on what the last cluster is. If the last cluster contains a single vowel letter (as denoted by V_1), depending on whether it is [a, e, i, o, u] or [y], different steps are taken. For example, if the letter is [o], we examine list 3 to see if the truncated word is contained among [ho, cano, to, tipto], for [hoe, canoe, toe, tiptoe] . If the word is contained in list 3, the base word ends in [e] , we have, for example, a decomposition such as [canoe•d, conoe•r] or [canoe•ing] , as the case may be. If the truncated word is not contained in

list 3, for example, [echo] , the decomposition would be [echo•ed, echo•er] or [echo•ing] . In this particular case of V = [o] , the counter list found was only slightly longer than list 3. It contains eleven words: [do, overdo, ditto, go, forego, embargo, undergo, echo, zero, veto, photo] . Whenever a list had to be constructed, the choice was taken to state the rule in such a way so that words in the list were fewer in number than words outside the list. For example, if a truncated word is found in list 3, a mute [e] is appended to reconstruct the base word, but if a truncated word is found in list 4, the base word is equal to the truncated word. List 4 contains only the word [tabu] , while the counter list contains nineteen words: [barbecue, rescue, subdue, undue, vague, argue, value, blue, glue, continue, accrue, true, construe, sue, ensue, pursue, issue, revue, beleague] .

The complete lists are offered in Appendix D. A total of 213 words are contained. The lists are necessarily imcomplete because only a small fraction (although the most frequently used fraction) of English words have been considered. The ad-hoc nature of the algorithms used is characteristic of the phonic approach. The algorithm can undoubtedly be improved, but the point should be clear that a phonic algorithmic approach to the grapheme-to-phoneme translation, if possible, would require a great many words to be contained in a great many different exception lists. Although we have only illustrated it for the case of [er,

ed, ing] suffixes, it can be shown readily that similar situations arise with all vocalic suffixes and [s] endings, and, of course, there are the various lists which contain the plain, familiar and often-quoted irregularities such as [indict, victual, facade, schism], and many others.

It is not possible to given an accurate count of the size of the combined exception lists, since it depends on the complexity of the rules. For the reasons considered so far, an estimate will put the size in excess of one thousand words. We have seen that we need for the phonic algorithm approach a number of lists to handle the irregularities which occur toward the end of the words. It may well be recalled that the good result reported with the phonic algorithm approach (23) has been restricted to monosyllabic words, which by their very definition do not involve any suffix problem.

4.7 Further Limitation of Phonic Algorithmic Approach:

The appeal of the generative power of a phonic algorithmic approach is so great that many of the intrinsic difficulties were often ignored by its promoters.

In addition to the complexity of the rules and the need for exception lists, which we have covered in the last section, there are three basic problems the phonic algorithmic approach can not solve.

a. The first question on hand is what to do with abbreviations and semantic symbols. Dewey (30) counted over 2500 numerals, abbreviations and special symbols (such as $, &, etc.) in 100,000 words analyzed. This amounts to 2.5%, a figure which cannot be ignored by serious reading machine designers.

b. The second problem concerns un-hyphenated compound words which contain a medial mute [e] . In English the formation of compound words is exceedingly free (31). There does not appear to be any rule in deciding when a compound word should or should not be hyphenated (33). We have, for example, [blackbird] and [blue-bird] , [redcoat] and [red-throat] . Short of the using of a list of all words ending in mute [e] , it is hard to see how the phonic algorithmic approach can possibly operate correctly in this regard. Of the 17,777 words transcribed and processed, 2799 or about 16% were found to end in a mute [e] . Over 100 pages among the 540 pages - 18% - of Walker's "The Rhyming Dictionary of the English Language" (32) contain words ending in [e] . A mute [e] word list amounts therefore to a significant part of any dictionary. It is interesting to note that among the 3942 inseparable compound words listed in (33), 733

contained medial mute [e] .

c. The third problem deals with ambiguities like /wɪnd/ and /waɪnd/ for [wind] . The pronunciation of many words differ in stress assignment depending on the parts-of-speech. The phonic algorithmic approach cannot resolve ambiguities of this kind. The reader is reminded of the work done by Klein and Simmons (27) mentioned earlier in this chapter.

The combined size of the word lists for handling spelling irregularities, vocalic suffixes and compound words for a total vocabulary of, say, 100,000 words will be in the "thousands". The phonic algorithmic approach is now taking on some of the characteristics of the list look-up approach. If the cost of a list is not sensitive to its size for the range of our interest, the list look-up approach may provide us a more satisfactory answer. Let us look into this next.

CHAPTER 5

LIST LOOK-UP SUPPLEMENTED BY ALGORITHM

5.1 Re-Examination of List Look-Up Approach:

The arguments against the use of a list look-up procedure were presented in the last chapter. The objection to the high cost of the storage for the list is examined first.

In recent years there has been considerable progress in high density information storage technique. The photographic storage has been slow in finding its way into data processing system application because a record, once created by a photographic process, cannot be altered. For our list storage, the read-only property is no drawback. The very low cost coupled with adequate performance makes such storage medium ideal for our purpose.

In a commercially available system (34), information is recorded photographically on discs. Such a disc is ten-inches in diameter and contains 3100 tracks of usable information recorded in the outer one inch of the radius. Each track contains 67,000 bits of data. The capacity per

disc is more than 200,000,000 bits. For reading, the disc is rotated under a reading head at 4600 revolutions per minute. The commercial system, being designed for archival applications, includes a disc library, accessing mechanism, the reader and writer and a control unit. An electromechanical positioner is used in connection with a flying-spot scanner type of electro-optical unit to select one track out of the 3100 after a disc has been accessed from the disc library. The service charge to record a full disc of information from suitably-prepared data has been quoted as approximately $150.00.

In Section 5.6 our storage need for a list look-up approach is estimated to be in the order of 12,000,000 bits. This can be stored in less than 200 tracks, or in one-fifteenth of an inch of the outer radius. With such a moderate amount of linear travel, an electro-optical flying spot track selector, free of moving parts, can be designed. The estimated material cost for the list storage, including the disc, the reader, and the processor interface is less than $1000.00. This is a figure which can no longer be considered objectionable, especially when it is viewed in relation to the cost of the character scanning equipment and the processing unit which are required by the complete reading system.

With a suitable processing unit, the speed of translation will be primarily limited by the disc latency time. If we use an estimate of two revolutions per word on

the average, a speed of 2300 words per minute, about 15 times the real time human speech rate can be achieved. By recording in each track of the disc one-fourth of the information and repeating it a total of four times around, the latency time can be reduced to one-fourth at the expense of using four times the number of tracks. A speed of close to 10,000 words per minute may be realized.

5.2 Algorithms for List Look-Up:

The algorithm to be used with a list look-up approach depends on the manner in which the list is setup and the organization of the processor which executes this algorithm.

The procedure of grapheme-to-phoneme translation as it is envisioned here involves a "search phase", which, when successfully terminated, returns for an incoming word the phonemic translations of each of the constituent morphs and their related parts-of-speech information, and leads to the "parts-of-speech phase" which makes use of the parts-of-speech information of adjacent running words for making proper selection among multiple choices. Certain operations, such as the execution of simple morphophonemic rules for appending the suffix [s, es] or [d, ed] or for the choice of /ðə/ or /ðɪ/ for [the], can be grouped together in the "parts-of-speech phase". If the "search phase" can not be successfully terminated, an approximate phonemic translation can be obtained by the application of phonic rules. The system is said to be in the "phonic mode" while

executing the phonic rules. Depending on the complexity of the programming for the phonic mode, parts-of-speech information may or may not be returned with the phonemic approximations. When all words in a sentence have been translated, an intonation profile can be generated, based on the nature of the sentence, whether it is declarative, interrogative or exclamatory. The pitch and amplitude information from the intonation profile, together with the phonemic translation, may then be applied to the phoneme-driven speech generator for the creation of the final synthetic speech output.

The work reported on the following pages is restricted to the description of a machine organization and of the algorithms used during the "search phase".

Let us call the basic entries in the list "morphs". For the present, we may regard a morph as a simple word or a simple affix. In Section 5.5 we shall give a full description of what is meant by a "morph".

During the "search phase" the incoming word is compared with the list. If the list contains a morph which is the word, the search phase terminates successfully with the desired information copied from the list. If only a partial match can be made for the leading characters, the list information corresponding to the matched part is temporarily stored away and the remainder treated as a new word. In this "partial mode", if the remainder can be fully matched,

the new list information, together with the stored partial word information are available to be joined, and the search phase terminates again successfully. If the remainder can only be partially matched, the new information can be added to the temporary storage. For example, for the word [bluebirds], the first partial match would be [blue], the second partial match would be [bird] and the final full match would be [s], giving a decomposition of [blue.bird.s]. The levels of partial storage can be arbitrarily extended to any number. If the remainder at the last level cannot be matched, the last partial match made must be scrapped and a new partial match attempted. For example, for the word [uninformed], the first partial match would be [uni], but for the remainder [nformed], no match, full or partial, is possible. Thus the partial match [uni] has to be scrapped. The next new partial match would be [un]. The final decomposition would be [un.inform.ed]. If an incoming word cannot be constructed from the list at all, it can be determined and the search phase would terminate unsuccessfully, with the processor entering into the phonic mode.

5.3 Outline of a Machine Organization for List Look-Up:

Let us assume we use a photographic disc memory for the storing of the list. The basic unit of information stored consists of characters, each represented as a binary-coded pattern. We may use seven bits to represent a character, thus giving a maximum number of distinguishable symbols of

128. Each entry in the list consists of a morph field, a phoneme field and a parts-of-speech field. For entries which have several different phonemic transcriptions depending on the parts-of-speech, the last two fields will be repeated. It is clear that a symbol may be used in different fields to represent different things. The fields are all variable in length. An eighth bit is used as a word mark to indicate the end of the field (typographically represented as an underline in this chapter). A unique symbol is used to indicate the beginning of each track and a second unique symbol is used to indicate the beginning of each entry. Each track of the disc will store to its capacity a number of entries. Since final doubleable consonant letters require some special attention, a ninth bit may be added in the morph field over these consonant letters to provide the needed indication.

The standard alphabetic collating sequence is used with the exception that letters [i] and [y] are interchanged in their positions and the letter [e] is placed at the beginning of the sequence. The reason will be made clear later. In fact, the collating sequence of the remaining alphabets in the morph field can be entirely arbitrary. The complete list is arranged according to the morphs in a reverse collating sequence. In this manner, with a sequential comparison, the longest match for any incoming word will be attempted before a shorter match is done. For example, an incoming word [university] will be matched with

the list morph [university] before partial matches with morphes [un] and [uni] would have been encountered. By arranging the list in the reverse collating order, such unnecessary excursions into the "partial mode" can be eliminated.

The processor uses a randomly accessible memory, which we may call the core memory, or the core. It is used for the storage of the program and all interim results. The size of the core memory is very small when compared with the disc capacity. The core is character organized. As before with the disc, each character contains eight bits including the bit for marking the end of each field. The ninth bit on the disc associated with the morph field marking a final doubleable consonant need not be carried here. In the core memory three areas are set aside for special purposes. An "input word area" serves to store the incoming word for which the translation is desired. The last character of the incoming word, as indicated by word boundary information, marks the eighth bit of the last character in the input word area. For the holding of partial results, we have an area called Stack A and another called Stack B. Stack A is used to hold the disc entries which have completely or partially matched the input word. Stack B holds address information needed for retrace purpose in the event a partial match resulted in an unmatchable remainder.

Three core memory address registers K, PA, PB, are used for various traffic control functions. Register K contains the address of the next character in core to be compared with the character from the disc. Register PA points to the next available address in Stack A, and Register PB serves a similar purpose for Stack B. For the purpose of illustraction, let us assume the input word area begins with address 000, Stack A starts from address 100, and Stack B starts from address 050. Initially we have:

K: 000

PA: 100

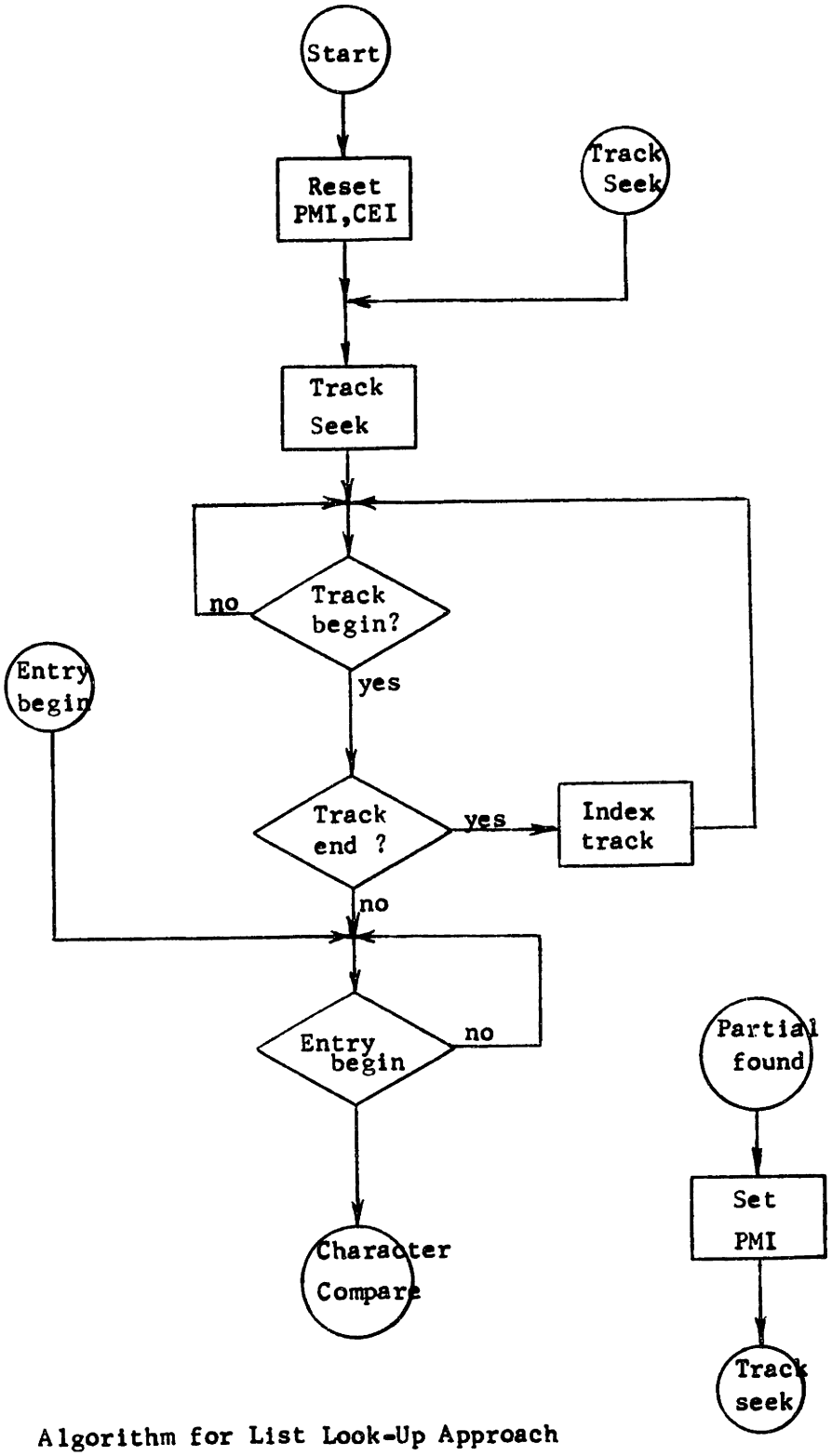
PB: 050

At the completion of each reading of the input word, PA and PB are reset to the above values. The values of K and PA are transferred into core beginning at the address initially contained in PB. Thus we have stored from address 050 through 055 the information 000100, and PB now has counted up to the address 056. Symbolically, we may represent this as

$$K, PA \rightarrow (PB).$$

We Shall refer to this later as "initialization".

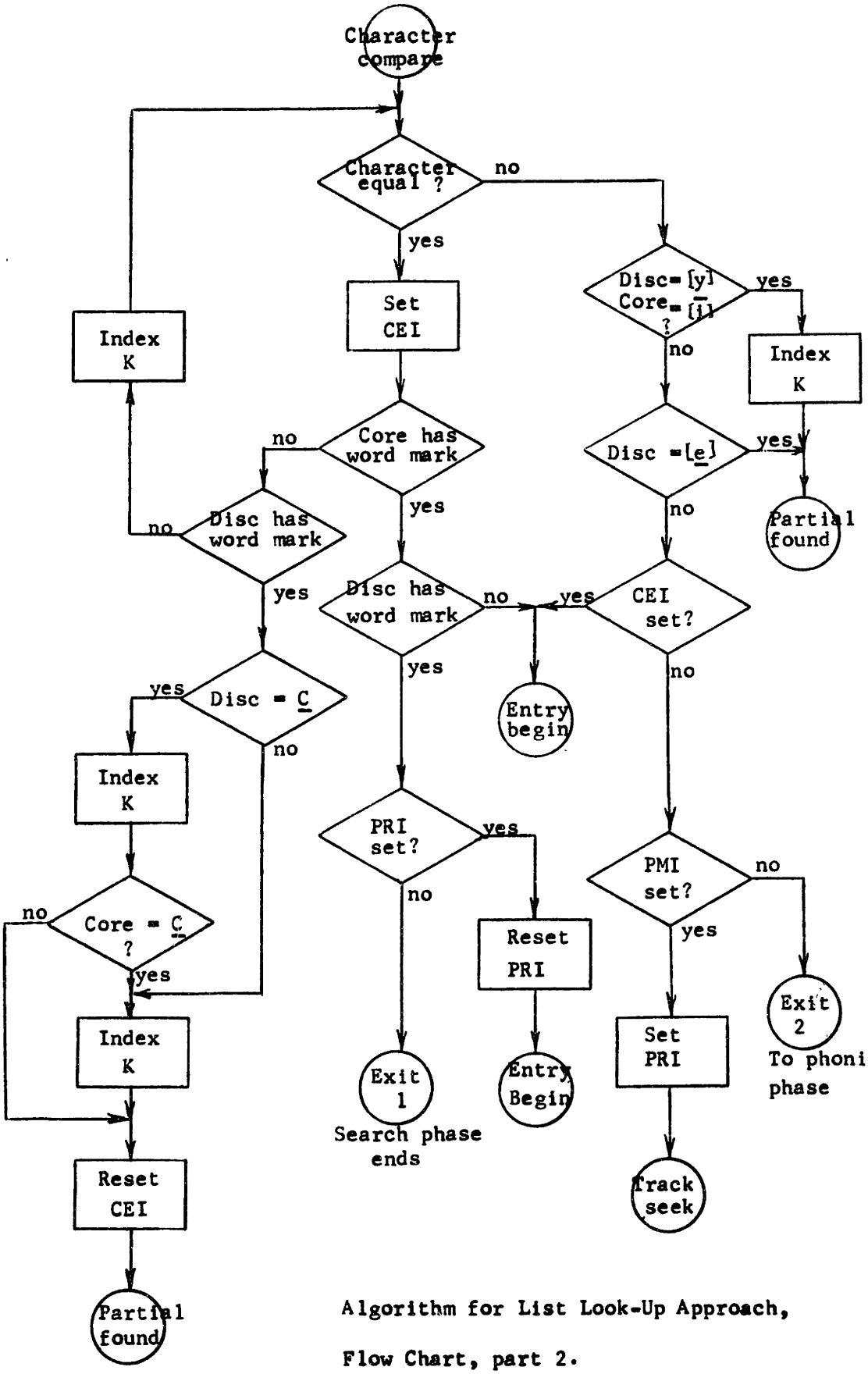
Now we may examine the flow chart shown on the following two pages for the operation of the search process.



Algorithm for List Look-Up Approach

Flow Chart

Part 1.



Algorithm for List Look-Up Approach,

Flow Chart, part 2.

Let us assume that the subroutine "track seek" takes the contents of K as an address parameter and determines according to the collating sequence and the word stored in core beginning at the specified address the disc track address which would contain the word.

After the input read and initialization, we enter into the "track seek" subroutine. The processor waits for the beginning-of-track symbol. When it is detected, the processor waits for the beginning-of-entry symbol. When the beginning-of-entry symbol has been detected, the processor is ready to compare the characters coming off the disc sequentially with the word stored in the input word area. Since K is initially 000, the first character of the input word is compared with the first character in the morph field of the current entry.

The action to be taken after each character comparison depends on whether the comparison results in equal or unequal comparison, the presence or absence of word marks and the ninth bit which is the doubleable final consonant indicator. When an equal comparison is made, the character equal indicator CEI is set. There are nine possible paths leading out from the comparison. The following lists the condition leading to each path and the actions to take place.

Path 1: Condition: An equal comparison has been made, neither the core nor the disc character has a word mark.

Action: The character is stored in Stack A, both K and PA are incremented by 1 and the next character is compared. (We assume that the core memory speed can keep up with the disc data rate. For the disc quoted in Section 5.1 the core memory needs to be 1.6 microsecond per character.)

Path 2: Condition: An equal comparison has been made, both the core and the disc character each have a word mark.

Action: If the processor is not in "partial retrace mode" (explained later), the search phase terminates with the transfer of the last character of the disc entry into Stack A. The description of action to take place when PMI, the "partial retrace mode" indicator, is on is deferred to description of Path 9.

Path 3: Condition: An equal comparison has been made, the core character has a word mark, but the disc character does not have a word mark. An example of the occurence is when the core word is [had] and the disc morph is [haddock]. Because of the reverse listing, [had] occurs later in the list than [haddock]. Such partial matches have to

ignored.

Action: PB is decremented by 6, and (PB), the contents of the core starting with the address given by the new value of PB, is set into K and PA. The character equal indicator, CEI, is reset. If no partial word has been formed this action amounts to the same as initialization. If partial words have been accumulated, this preserves all such accumulations.

Path 4: Condition: An equal comparison has been made, the core character has no word mark, the disc character is not a final doubleable consonant. For example, the core word may be [fastback] and the disc morph is [fast], assuming that [fastback] is not a morph.

Action: Since a partial match has been made, K is incremented by 1 to point to the beginning of the remainder. The remaining fields of the disc entry continue to be moved into Stack A. At the completion of the entry move, PA registers the next available space in Stack A. K and PA are moved into the core addressed by PB, or symbolically, K,PA → (PB). The character equal indicator, CEI, is reset. The PMI is set, and the processor goes into the "track seek" routine with the address parameter preset to the current content of K.

Path 5: Condition: An equal comparison has been made, the core character has no word mark, the disc character is a final doubleable consonant.

Action: K is incremented by 1, the core character is compared with the preceding character, if an equal comparison is made, K is again incremented by 1. The logic recognizes in this case the sequence [ck] as a doubled consonant. Other actions taken are identical to those in Path 4.

Path 6: Condition: An unequal comparison has been made, the core character is an [i] with no word mark, and the disc character a [y] with word mark. For example, the core word is [prettier] and the disc morph is [pretty].

Action: Identical to Path 4.

Note: Since [y] maybe changed into [i], [y] must be assigned an earlier position in the collating sequence, otherwise the identification of a normal [i] may be obstructed. For example, [companion] may be erroneously broken down into [company.on].

Path 7: Condition: An unequal comparison has been made, the disc character has a final [e] and the core character has no word mark.

Action: Identical to action for Path 4, except K is not incremented. For example, we have:

[bony] = [bone.y]

Note: The reason for placing [e] at the beginning of the collating sequence is similar to the explanation for [y] above. We have to prevent cases such as [probable] being erroneously broken down into [probe.able].

Path 8: Condition: An unequal comparison has been made, and the character equal indicator, "CEI", has been set by some previous comparison. For instance, the core word is [coaches] and the current disc morph is [cough].

Action: Identical to Path 3. We must look further in the list.

Path 9: Condition: An unequal comparison has been made on the first character, as indicated by the reset condition of CEI.

Action: If the processor is not in "partial mode", the condition indicates that the input word can neither be found among nor be constructed from the morphs stored in the list. The processor transfers control to the phonic phase.

If the processor is in the partial mode, the condition indicates that the last partial match has to be scrapped. PRI, the "partial retrace indicator", is set. PB is reduced by 9. The three core characters beginning at the address

given by PB are set into K. If K now contains 100, the PMI will be reset, and the "track seek" subroutine is re-entered. Since K now points to the beginning of the last entry in Stack A, which is the beginning of a morph, we will soon arrive at the condition for Path 2. With PRI on, the search phase does not terminate. The PRI is turned off. PB is reduced by 6, and (PB) is set into K, and PA, as in Path 3. The control of the process is now returned to seek the beginning-of-entry symbol, with the scrapped entry already past the disc reading head. It may seem extravagant to exit from Path 9 always at an unequal comparison of the very first character of the disc entry. This is clearly necessary for morphs [s], [d] and [y]. However, we must remember, with a properly selected morph list, the occurrance of an unsuccessful search should be a very rare event.

5.4 An Illustrative Example:

Let us now take a slightly involved example to illustrate the search process with some of the fine features. Let us assume the input word is [reoverthow].

The status of the machine immediately after the input word has been placed in the input word area and completion of initialization is as follows:

K: 000

PA: 100

PB: 056

PMI: Off

PRI: Off

Stack A: Empty

Stack B: 000100

The contents of K, now 000, is used as the address parameter for the "track seek" subroutine for locating the disc track on which the word [reoverthrow] would be contained in the collating sense. The result of comparison after two characters leads to Path 4. The partial match is the disc morph [re]. The status of the machine after the completion of the transfer of the disc entry is shown below:

K: 002

PA: 133 (assuming entry for [re] has 33

PB: 062 characters)

PMI: Set

PRI: Off

Stack A: beginning at 100, [re]..... ,
ending at 132.

Stack B: 000100,002133. (the punctuation marks are inserted here as aid for reading, and is actually not contained in Stack B.)

The processor goes once again into the "track seek" subroutine.

The next match found the disc morph [overt]. (We assume that [overthrow] is not a morph.) The status of the machine after the completion of the transfer of the disc entry becomes:

K: 007

PA: 182 (assuming entry for [overt] has 49 characters.)

PB: 068

PMI: Set

PRI: Off

Stack A: containing the entries for [re] from 100 to 132, and the entry for [overt] from 133 to 182.

Stack B: 000100,002133,007182.

The processor goes into "track seek" routine to seek the track for the remainder of the input word [hrow].

The result of character comparisons lead to Path 9. Since the PMI is set, the partial match overt has to be scrapped. PRI is set. PB is reduced by 9 to 059. The three core characters beginning with address 059 give 133, which is the beginning address of the morph [overt] in Stack A. 133 is set into K, and the "track seek" routine is re-entered. Since K ≠ 100, the PMI is not reset. The

machine status is now represented by the set:

K: 133

PA: 182

PB: 062

PMI: Set

PRI: Set

Stacks A, B: unchanged

When the disc entry containing [overt] is found, because PRI is set, the search phase does not terminte, and PRI is turned off. PB is reduced by 6 to 056, and the contents of the six locations in core beginning with address 056 are set into K and PA. The status of the machine, with the exception of the excess material in the stacks corresponding to the scrapped entry, is identical to the second set shown. The control of the process now looks for the entry beginning symbol, but the scrapped entry [overt] has already passed under the reading head.

The process will find a partial match [over] through Path 4, and a total match of the remainder [throw] through Path 2, thus completing the search phase successfully.

5.5 Selection of Morphs for the List

Up to this point we have not established the criteria for the selection of morphs for storing on the disc. Let us start by proposing a set of simple criteria and examine them in some detail.

1. All base words are morphs.

   A base word is not a compound word, and contains no prefix or suffix of any kind. For example, [bake] is a morph.

2. All prefixes and suffixes which do not reflect changes in the pronunciation of the base words to which they may be attached are morphs. For example, [un, ing] are morphs.

The question arises as to whether suffixes which do affect the pronunciation of the base words should be considered as morphs. The answer cannot be a clear-cut one. From an engineering point of view, it is a matter of trading disc storage space with complexity of the algorithms.

Between those suffixes which always mutuate the pronunciation of the base word, such as the suffix [ity], and those which never do, such as [ing], there are many which affect it to intermediate degrees. For example, the suffix [able] does not usually affect the pronunciation of the base word, such as in [attainable, removable, changeable, etc.], but it does affect some base words, such as in [inflammable, applicable, etc.]. In other cases the spelling of the base word itself is changed such as in [tolerable, navigable, etc.]. With our list approach, we have the freedom to include as morphs such partially mutating suffixes as well as those mutated words. For

example, we can list able as a morph to achieve economy and list words like [inflammable, applicable, tolerable, navigable] and [probable] as morphs as well. In general, whenever exceptions to a general case has to be made, we can avoid rule complication by the creation of new morph entries. We would want to store words such as [reappear, reallocate] as morphs to prevent incorrect decomposition into [reap.pear, real.locate]. It is obvious that a word like [unionized] is decomposable into [union.ize.d] as well as [un.ion.ize.d]. There is no way to resolve such ambiquity without a semantic analysis. Our algorithm which looks for the longer match would recognize the word as [union.ize.d].

There exists a resemblance between what is called a morph here and what the linguists call a morpheme. The difference is mainly operational. A morph is an engineering approximation of the morpheme. Modern linguists view a language as consisting of a lexicon of underlying morphemes operated together with a set of phonological, morphophonemic and syntactic rules. Undoubtedly future linguistic developments will provide continued guidance to many of the engineering realization of simulated human cognitive processes.

Concatentation of Suffixal Morphs

Suffixal morphs can be concatenated in various ways. For example, we have [loveliness] = [love.ly.ness],

[moonshiners] = [moon.shine.er.s] , etc. Since we are not concerned with the generation of words from stored morphs, for practical purpose we need to concern ourselves with a finite number of morphs in concatenation. It seems reasonable to limit this number to seven. Referring back to the machine organization proposed earlier in this chapter, we see that this limit places an upper bound on the size of Stack B.

5.6 An Estimate of the Size of the Morph List

From the criteria given in the preceding section, the following suffixes may be considered as morphs:

-able	-ible	-s	-ite
-age	-ing	-ship	
-al	-ish	-sman	
-ance	-ist	-some	
-dom	-ism	-ty	
-ed	-less	-ward	
-ence	-let	-way	
-er	-ly	-wise	
-est	-man	-y	
-ess	-ment	-d	
-ful	-ness	-'s	
-hood	-or	(Note: [-mental] always mutates the base word.)	

It appears to be a common property of English prefixes that they do not mutate the pronunciation of the base words to which they may be attached. Therefore, all prefixes are morphs. (Notable exceptions are: [infamous, extraordinary, antithesis, equivalent]).

Using the Seventh Edition of Webster's New Collegiate Dictionary as a reference, an estimate on the size of the morph list has been made. The ten pages with page numbers ending in even hundreds were examined. The number of dictionary bold-faced entries as well as the number of morphs are counted. The result is shown below.

Page Number	Dictionary Entry Count	Morph Count
100	92	18(17)
200	104	44(39)
300	87	22(18)
400	102	25(23)
500	96	45(44)
600	98	16(15)
700	78	32(32)
800	98	35(35)
900	80	38(36)
1000	94	34(32)
Total:	929	309(291)
Average per page:	92.9	30.9(29.1)

Multiplying the average number of morphs by the total page number of 1041, we arrive at an estimate of 32,000 morphs, which would generate all the words in the dictionary, plus all the regular paradigmatic forms which all dictionaries customarily omit. Since the average entry will be less than forty characters long, a storage capacity of 12,000,000 bits should be adequate.

It was further noticed that if all mutating suffixes were admitted among the suffixal morphs, the reduction in the average number of morphs per page is very small, as shown by the numbers in the parentheses in the above table. The morph list can at best be reduced by 5.5%.

5.7 Some General Remarks:

In principle, the need for entering into the phonic phase can arise. However, the probability of such occurrence with a morph list of the size considered will be very low, so that a spelled output may not be objectionable. The logic for the phonic phase may be eliminated for simplified machine design.

CHAPTER 6

Summary and Conclusions

6.1 The Reading Machine Problem:

In the last two chapters it was shown that the phonic algorithmic approach of grapheme-to-phoneme translation requires extensive use of exception lists. The algorithms, besides being ad hoc, are exceedingly complex, especially if we wish to reduce the size of the exception lists. In addition, there are problems which could simply not be solved at the phonic level.

Accepting the use of a list as unavoidable, we found that an efficient method of grapheme-to-phoneme translation can be realized by means of a list of moderate size, coupled with a set of simple algorithms. Ambiguities in pronunciation due to parts-of-speech differences can be reduced by a method which has been proved effective. Although there still remains the need for a set of phonic rules to handle the rare occurance of unrecognizables (non-sense words, newly coined words), these rules can be very simple and relatively crude since all the exceptions and complicating elements of the conventional phonic rules

have now been removed. Or, as remarked in Section 5.7, we may use a spelled output.

While the work reported here has brought us one step closer to a reading machine with speech output, it has also provided greater incentive to look into a few areas of research to which, perhaps because of the overshadowing difficulty in grapheme-to-phoneme translation, we have not paid sufficient attention. These areas include the study of features of speech above the segmental phoneme level, such as sentence stress and intonation. There is the study of the timing of phoneme production. More work on speech synthesis by rule is needed.

It is now possible to begin the design of a machine which scans the printed English text and produces an intelligible speech output. As a reading machine for the blind, we shall be able to explore the trade-off between the quality of output or user acceptance and engineering economy which may be achieved by a reduction of the size of the morph list or a simplification of the algorithms. From the experience of blind college students who often have to have highly specialized text read to them by volunteer readers, we know that speech output produced by persons with no understanding of what they are reading is often acceptable. With this machine we shall be able to examine the extent to which we may further back off from a perfect intelligible speech output.

6.2 Inference about the Human Reading Process:

It would be naive for anyone to say that an adult reader reads by phonic rules. But the desire for a simple machine has led many people, including the present writer at early phase of this work, to believe that a reasonable approximation could be made. Now that the notion has been clarified, we can perhaps make some more positive hypotheses about the human reading process.

The writer would like to theorize that when an adult reader reads an unfamiliar text aloud, he makes use of this learned lexicon in his memory. What he probably stores is a mixture of basic words, affixes and some frequently encountered compounds and inflected forms. He employs morphophonemic rules in joining lexicon entries together not unlike the algorithms presented in Chapter 5. When he encounters unfamiliar words, he attempts to "peel off" the affixes and uses a set of phonic rules on the remaining part. These phonic rules reflect his personal experience and differ from person to person, and they operate at the lowest level of all processes he uses in reading.

APPENDIX A

Grapheme Cluster to Phoneme Cluster Mapping Summary

Legend:

Column 1: Grapheme Clusters

Column 2: Phoneme Clusters

Column 3: Examples and Total Word Count of Each Mapping

PHONEME SYMBOL SUBSTITUTION CHART:

Phonemes	Printed As	Phonemes	Printed As
i (bee)	I	p (pity)	P
ɪ (pity)	4	b (bee)	B
e (rate)	E	t (tooth)	T
ɛ (yet)	2	d (dish)	D
æ (sang)	9	k (custom)	K
ɑ (bath)	A	g (go)	G
ɑ (far)	1	f (far)	F
ɒ (watch)	$	v (vision)	V
ɔ (jaw)	C	θ (tooth)	Q
o (go)	O	ð (bathe)	X
ʊ (full)	8	s (sang)	S
u (tooth)	U	z (using)	Z
ɜ (further)	3	ʃ (dish)	Y
ə (above)	6	ʒ (vision)	5
ʌ (above)	7	h (how)	H
aɪ (while)	A4	tʃ (watch)	TY
aʊ (how)	A8	dʒ (jaw)	D5
ɔɪ (toy)	C4	m (mom)	M
ju (use)	JU	n (not)	N
ɪu (fuse)	4U	ŋ (angry)	0
		l (full)	L
Monosyllable stress	=	w (watch)	W
Primary stress	*	hw (while)	HW
Secondary stress	'	j (yet)	J
Logical "or"	+	r (rate)	R
Null symbol	-		

-A	*C	ALBAN ALBANY ALCOTT 7
	*E	ABRAM ABLE ACORN 21
	*1	ALMSHOUSE ARBITRARY ARBITRATE 45
	*1+*2+*9	ARYAN 1
	*1+*9	ALLAH ALMOND 2
	*2	ANY ANYBODY ANYHOW 6
	*2+*E	AREA 1
	*2+*9+*E	ARIEL 1
	*9	ABBEY ABBOT ABDICATE 1
	*9+*C	ALTERNATE 1
	*9+*E	APRICOT AGLEOUS AVIATOR
	=C	ALL 1
	=E	ACE ACHE AGE 6
	=1	ARC ARCH ARK 5
	=1+=2+=9	ARE 1
	=6	AN 1
	=2+=6+=9	AND 1
	=9	ACT AC ACC 13
	'C	ALTERATION 1
	'E	ADRIATIC ALIENATION ASIATIC 3
	'1	ARBITRATION ARCHAEOLOGICAL ARCHIPELAGO 7
	'1+'9	AVOCADO 1
	'9	ABDICATION ABERDEEN ABOLITION 90
	'9+'C	ALTERCATION ALTERNATION 2
	'9+'E	AVIATION 1
	C	ALBEIT ALMIGHTY ALREADY 3
	1	ARCADE ARCADIA ARCADIAN 12
	1+6+*1	AHA 1
	4+6+9	ACCEPT ACCEPTABLE ACCEPTANCE 3
	6	ABACK ABANDON ABASE 370
	6+9	ABDOMINAL ABHOR ABHORRENCE 42
	9	ACCELERATOR ACTIVITY ALBINO 34
	9+C	ALTERNATIVE 1
-A-	=6+=E	A 1
-AA	*2+*9+*E	AARON 1
-AE	*2+*9	AEROPLANE 1
	*2+*9+E*4	AERIAL 1
	I	AEGEAN 1
	2	AESTHETIC 1
	4+I	AENEAS 1
-AI	*2+*9	AIRCRAFT AIREDALE AIRPLANE 7
	=E	AID AIDE AIL 5
	=2+=9	AIR 1
-AU	*C	AUBURN AUCTION AUDIBLE 21
	=C	AUGHT AULD 2
	=9	AUNT 1
	'C	AUDITORIUM AUSTRALASIA AUTHENTICITY 7
	C	AUDACIOUS AUDACITY AUGUST 15
	6	AUTHORITATIVE AUTHORITY 2
	6+C	AUGUSTA AUGUSTUS 2
-AW	*C	AWKWARD AWNING 2
-AWE-	=C	AWE 1

-AY-	=E	AY 1
-AYE-	=A4	AYE 1
-E	*1	EDEN EDICT EDITH 17
	*1	ENCORE ENTREE 2
	*2	EBON EBONY ECHO 141
	*2+*1	EGOTISM EGRET EGLANTI
	*2+*4+*1	EROS 1
	*3	ERMINE ERNEST ERSTWHILE 3
	*4	ENGLAND ENGLISH ENGLISHMAN 5
	*4+*1	ERA 1
	=1	EKE EVE EVE 3
	=2	EBB EDGE EFT 13
	=2+=E	EH 1
	=2+=9	ERE 1
	=3	ERR 1
	'1	EQUALIZATION EQUANIMITY EQUILIBRIUM 4
	'1	ENTREPRENEUR 1
	'2	EBULLITION ECCENTRICITY EDITORIAL 48
	'2+'1	ECONOMIC ECONOMICAL ENIGMATIC 5
	1	ENSEMBLE ENTENTE 2
	2	EMBATTLE EMBLAZON EMBRASURE 15
	2+4	ECCENTRIC ECSTATIC EFFACE 6
	2+4+6	EFFECT EFFUSION ESCAPE 3
	2+6	ERRONEOUS 1
	4	ECCLESIASTIC ECCLESIASTICAL ECLIPSE 234
	4+1	ECONOMIST ECONOMIZE ECONOMY 7
	4+6	EFFECTIVE EFFECTUAL EFFEMINATE 36
	6	EMIR EPHEMERAL ERRATIC 11
-EA	*1	EAGLE EASEL EASTERN 8
	*3	EARLDOM EARNEST EARTHEN 6
	*4	EARDRUM EARRING EARSHOT 3
	=1	EACH EASE EAST 4
	=3	EARL EARN EARTH 3
	=4	EAR 1
-EE	=1	EEL 1
-EI	*A4	EINSTEIN 1
	*E	EIGHTY 1
	=E	EIGHT EIGHTH 2
	E+*E	EIGHTEEN 1
-EU	J*U	EUCLID EULOGY EUNUCH 3
	J*8	EUROPE 1
	J'8	EUROPEAN 1
	JU	EUBOEA 1
	J8	EUGENE EURASIA EUROPA 3
-EWE-	J=C+J=U	EWE 1
-EYE	*A4	EYELASH EYELID EYESIGHT 3
-EYE-	=A4	EYE 1
-I	*A4	ICEBERG ICEBOAT ICEBOX 22
	*A46	IRON IRONCLAD 2
	*3	IRKSOME IRVING 2
	*4	IDIOM IDIOT IGNEOUS 100
	*4+*A4	IBID ISOLATE 2

```
        =A4             I'D  I'LL  I'M      6
        =3              IRK      1
        =4              IF  ILL  IMP      10
        =4+=A4          IND      1
        '4              IDIOSYNCRASY  IDIOTIC  IGNOMINIOUS    167
        '4+'A4          ISOLATION      1
        A4              IDEAL  IDEALIST  IDEALISM      13
        4               IGNITE  IGNITION  IGNOBLE    359
        4+*4            INSIDE      1
        4+A4            ITINERANT  ITINERARY      2
        4+6+A4          ITALIAN      1
-I-     =A4             I      1
-IO     *A41+*A46+*A4$
                        ION      1
        *A46            IODINE  IOWA      2
        A4*C            IONIAN      1
        A4*1+A4*$       IONIC      1
-O      *C              ORBIT  ORCHARD  ORCHESTRA      18
        *C+*$           OFFHAND  OFFSHOOT  OFFSPRING      4
        *C+*C           ORAL  ORIENT  ORIOLE      3
        *C              OBOE  OCEAN  ODIN      46
        *1              ORDURATE  OBELISK  OBLIGATE      42
        *1+*$           ODDITY      1
        *1+*C+*$        OFFAL  OFFERING  OFFICE      18
        *1+*C           ONYX      1
        *7              ONION  OTHERWISE  OVEN      3
        =C              OR  ORB      2
        =C+=$           OFF  OFT      2
        =C+=C           ORE      1
        =C              ODE  OF  OLD      4
        =1              OX      1
        =1+=$           ODD      1
        =1+=C+=$        ON      1
        =6+=7+=1+=$     OF      1
        'C              ORGANIZATION  ORNAMENTAL      2
        'C+'C           ORIENTAL  ORINOCO      2
        'C              ODORIFEROUS  OKLAHOMA  OVERAGE      22
        'C+*C           OVERTHREW  OVERTHROWN      2
        '1              OBLIGATION  OBSERVATION  OCCIDENTAL      14
        '1+'C+'$        ORATORIC      1
        C               ORCHESTRAL  ORDAIN  ORGANIC      5
        C+C             ORATION      1
        C               O'NEILL  OBEISANCE  OBESITY      15
        C+$+1+C         ORACULAR      1
        1               OCTAGONAL  OCTAVIA  OLFACTORY      7
        1+6             OBNOXIOUS  OBSCENE      2
        6               O'CLOCK  OBEDIENCE  OBEDIENT      48
        6+C             OBEY  OMIT  OPAQUE      4
-C-     =C              C      1
-C'-    =6              C'      1
-CA     *C+*C           CARSMAN      1
        *C              OAKEN  OAKLAND  OAKUM      5
        =C+=C           OAR      1
```

	=C	CAK CAT CATF 3
	C*F+*C6	CASIS 1
-CI	*C4	CILCICIF CILSKIN 2
	=C4	CIL 1
-CC	=L	COZE 1
-CL	*A8	CUTBUILDING CUTCAST CUTCOME 21
	=A8	CUNCF CUST CUT 3
	=C	CUCFT 1
	=1+=A8	OUR 1
	A8	CUTCC CUTCONE CUTGOING 16
	A8+*A8	CUTSIDE 1
	1+A8	CURSELF 1
-CW	*A8	CWLET 1
	*C	CWNERSHIP 1
	=A8	CWL 1
	=C	CWN 1
-CWE	*C4+*C6	OWEN 1
-CWE-	=C	CWE 1
-CWI	*C4	CWING 1
-L	*3	URBAN URCHIN URGENCY 4
	*7	ULTIMATE ULTRA UMBRIA 31
	=L	UGF 1
	=3	URGE URN 2
	=7	UP US 2
	*7	ULTIMATUM ULTRAVIOLET UNACCOUNTABLE 55
	J*U	UNIFORM UNIFY UNION 13
	J*8	URANUS URINE URUGUAY 3
	J*U	UKULELE UNANIMITY UNIFICATION 9
	JU	UBIQUITOUS UNIQUE UTENSIL 6
	J8	UNITE URANIA USURP 3
	J8+JU	UNANIMOUS 1
	6	UNTIL UPON 2
	6+7	UMBRELLA 1
	7	ULTERIOR UNABLE UNALTERABLE 135
	7+*7	UPSTREAM 1

```
A       *C              WABASH  BENGAL  WITHAL     62
        *C+*$           WALNUT      1
        *E              LABEL  MABEL  ARABIA    743
        *1              PUNJAB  MUSTACHIO  GRANADA    194
        *1+*$           WADDLE  SWADDLE  WALLOP      9
        *1+*C           NICARAGUA  FURRAH      2
        *1+*C+*$        WAFFLE  CHICAGO  WALLACE     16
        *1+*E           CICADA  ARMADA  ACCOLADE      6
        *1+*2+*E        SAHARA      1
        *1+*2+*9        SCENARIO      1
        *1+*7+*$        WASN'T      1
        *1+*9           NEVADA  COLORADO  FAHRENHEIT     22
        *1+*9+*A        DRAMA      1
        *1+*9+*E        DAHLIA  PASTY  DATA      4
        *2              MANY  SANITARIUM  MARYLAND      3
        *2+*E           PHARAOH  BULGARIA  SAMARIA     15
        *2+*9           CLARA  SCARCITY  DECLARE     23
        *2+*9+*E        HAREM  PARENT  PARENTAGE     27
        *9              CABBAGE  SCABBARD  SABBATH  1233
        *9+*A+*1+*E     TOMATO      1
        *9+*E           BABEL  IMPLACABLE  PLACATE     20
        =C              BALD  SCALD  BALK     34
        =E              BABE  FACE  LACE    158
        =1              BACH  YACHT  SHAH     77
        =1+=$           SWAB  WAD  WAN      7
        =1+=C+=$        SWAMP  SWAN  WANT      7
        =1+=E           PRAGUE      1
        =1+=7+=$        WHAT  'TWAS       2
        =1+=9           CHAD  JAM  KHAN      5
        =1+=9+=A        WAFT  BAH      2
        =1+=9+=C        GALL      1
        =2+=E           PLAGUE      1
        =2+=9           SCARCE  BARE  CARE     22
        =9              CAB  SCAB  DAB    304
        =9+=C           SAC  MALL      2
        =9+=E           GAPE  NAPE  SATE      3
        'C              WHEREWITHAL  ARCHIBALD  SIDEWALK     16
        'C+*C           BASEBALL  WHITEHALL      2
        'E              ASTROLABE  STABILIZATION  PALEFACE    222
        'E+*E           ARCHANGEL      1
        '1              REICHSTAG  CAMOUFLAGE  NEANDERTHAL     26
        '1+*1           CORNSTARCH  OVERCHARGE      2
        '1+'C+'$        WHITEWASH      1
        '1+'9           HALLOWEEN  MELODRAMA      2
        '2              APOTHECARY  LEGENDARY  SECONDARY     52
        '2+*9           ROSEMARY      1
        '2+'E           MARIETTA      1
        '2+'9           TABERNACLE  THREADBARE  THOROUGHFARE     13
        '2+'9+*2+*9     FAREWELL      1
        '2+'9+'E        GRANDPARENT  VARIATION      2
        '9              TAXICAB  HABITATION · ELABORATION    193
        '9+*9           SECONDHAND      1
```

A		SALCN 1
C		JACKAL COBALT EXALTATION 3
E		GRADATION FEMALE MUNDANE 25
J9		COGNAC 1
1		FRANCESCA CUNBAR RHUBARB 38
1+C+$		WIGWAM 1
1+6		CLAF OMAR LOMBARD 13
1+9		CZECHOSLOVAK 1
4		DESPICABLE NECKLACE WALLACE 127
4+'E		SYNDICATE CERTIFICATE IMPLICATE 50
4+'9		ALMANAC 1
4+E		MANDATE IMPREGNATE PINNATE 7
4+6		ITHACA PREFACE SURFACE 32
4+6+'E		PREDICATE 1
4+6+'4		SPECTACLE 1
4+6+E		VACATION FATALITY 2
4+9		COMRADE 1
6		ARAB CABAL ALABAMA 1714
6+-		ROSALIND SCANDALOUS RAGAMUFFIN 26
6+'C		REARWARD 1
6+'C+'1+'$		SASKATCHEWAN 1
6+'E		REMUNERATIVE 1
6+'1		RESTAURANT 1
6+'1+'$		SOMEWHAT 1
6+'2		PRIMARY 1
6+'9		CATALAN MADMAN HORSEMAN 22
6+C		CORNWALL 1
6+E		STABILITY SAGACIOUS VAGARY 6
6+J6		SURVEILLANCE POIGNANCY POIGNANT 3
6+9		TABCO BABCON TABU 21
9		RACCOON ADIRONDACK RANSACK 121
9+C		ASPHALT 1
A'A	*16+*96+=1+=9	MA'AM 1
AA	*1	BAZAAR 1
	=E+*E6	BAAL 1
	6	ISAAC BALAAM CANAAN 3
AF	*A4	MAESTRO 1
	*E	DISRAELI 1
	*E6	PHAETON 1
	*I	CAESAR PRAETOR 2
	*2	DAEDALUS 1
	=1+*12	STAEL 1
	4	LACEDAEMONIAN 1
	46	RAPHAEL ISHMAEL ISRAEL 4
	6	MICHAEL MICHAELMAS ANAESTHETIC 3
AEA	*I6	PAEAN 1
AEC	46	ARCHAEOLOGICAL 1
AI	*E	JAMAICA INLAID OVERLAID 109
	*E4	ARCHAIC MOSAIC PRCSAIC 3
	*E4+*E6	LAITY 1
	*2	AGAIN AGAINST 2
	*2+*E	PRAIRIE DAIRY 2

	*2+*E+*A4	CAIRO 1
	*2+*9	AFFAIR UNFAIR REPAIR 16
	=E	LAIC MAIC PAIC 65
	=E+*E4	CAIS 1
	=2	SAITH 1
	=2+=6	SAIC 1
	=2+=9	FAIR HAIR CHAIR 8
	=2+=9+=E	LAIRD BAIRN 2
	=9	PLAID 1
	'E	HANDMAID HOUSEMAID MILKMAID 13
	'2	AFORESAID 1
	'2+'9	ARMCHAIR HORSEHAIR MOHAIR 3
	E	GAINSAY 1
	1*I	NAIVE 1
	2+9	CORSAIR 1
	4	BARGAIN CHAPLAIN CHIEFTAIN 6
	4+E	PORTRAIT 1
	4+6	FOUNTAIN MOUNTAIN CAPTAIN 9
	4'4	JUDAISM 1
	46	EPHRAIM 1
	6	VILLAIN BRITAIN VILLAINOUS 5
	6+'E	MAINSAIL TOPSAIL 2
	6+E	MAINTAIN 1
AIA	*E6+*A46	ISAIAH 1
	*E9+*A49+*A46	NAIAD 1
AIE	*E6	GAIETY 1
AC	*E1	CHACS 1
	=E	GACL 1
	E*1	CHACTIC 1
	C+4'C	PHARACH 1
AL	*C	BAUBLE CALCASUS SAUCEPAN 49
	*C+*C	VAUDEVILLE 1
	*1+*C+*$	JAUNDICE LAUNDRY GAUNTLET 6
	*1+*9+*C	FAUCET 1
	*7+*C+*$	BECAUSE 1
	*9	LAUGHABLE LAUGHINGSTOCK 2
	=A8	FAUST 1
	=C	DAUB SAUCE LAUD 21
	=E	GAUGE 1
	=C	MAUVE 1
	=1+=C+=$	HAUNCH LAUNCH PAUNCH 11
	=9	LAUGH DRAUGHT 2
	'A8	SAUERKRAUT 1
	'C	APPLESAUCE CNSLAUGHT INAUGURATION 6
	C	CAUCASIAN CONNAUGHT PAULINE 4
	C	SAUTE 1
	46	CAPERNAUM 1
	6	RESTAURANT CHAUTAUQUA 2
ALE	*A8	SAUERKRAUT 1
AW	*C	CATAWBA STRAWBERRY DRAWBRIDGE 12
	=C	HAWK BAWL SHAWL 17
	'C	TOMAHAWK 1

	C	MOHAWK 1
AWA	*C+*C6	WITHDRAWAL 1
AY	*E	DAYBREAK HAYCOCK DAYDREAM 20
	=E	WAYNE MAYST 2
	'E	WAYLAY 1
AYA	*E6	BETRAYAL 1
AYE	*E6	GAYETY 1
	E*2	LAYETTE 1
	E*2+A4*2	CAYENNE 1
AYC	*E1+*E$	RAYCN 1
	*E6	CRAYON BAYCNET 2
	=2+*E6	MAYCR 1
	'E6	MAYONNAISE 1
AYCU	*E'A8	LAYCUT 1
E	*E	CARNEGIE UKULELE VENIZELOS 6
	*E+*I	PEDRC VEGA ZENC 4
	*I	SHEBA THEBAN HEBE 191
	*1	ENSEMBLE GENDARME GENRE 4
	*1+*2	RENDEZVOUS 1
	*2	SUBDEB LEBANON PEBBLE 1325
	*2+*E	CORTEGE MENU 2
	*2+*I	CECIL PEDAL HELCT 14
	*2+*3	UNERRING 1
	*2+*4	HYSTERIA STEROTYPE 2
	*2+*4+*E	BERING 1
	*2+*9	THEREFORE WHEREFORE WHEREWITHAL 3
	*3	SUPERB VERBAL REVERBERATE 202
	*4	PERSEVERANCE SINCERE BELVEDERE 56
	*4+*I	HERA PERIOD HERO 6
	-	HORSEBACK BASEBALL ICEBERG 197
	=E	CREPE FETE 2
	=I	HE'D SHE'D WE'D 16
	=2	NEB WEB DEBT 193
	=2+=3+=9	WERE 1
	=2+=6+=9	THERE 1
	=2+=9	WHERE 1
	=2+=9+=E	KEG 1
	=3	VERB PERCH HERO 25
	=4	HERE SPHERE MERE 3
	=4+=I	WE'RE 1
	'E	SENORITA 1
	'I	RECAPITULATE DEPRECIATION APPRECIATION 32
	'2	COBWEB NEBUCHADNEZZAR TECHNICALITY 202
	'2+*2	HEARTFELT SEVENTEEN SEVENTEENTH 3
	'2+'I	RECOLLECT RECOLLECTION RECOMMEND 9
	'2+'6	BLACKBERRY 1
	'2+'9	SOMEWHERE ELSEWHERE NOWHERE 8
	'3	PERADVENTURE REVERBERATION TUBERCULOSIS 30
	'4	HEMISPHERE ATMOSPHERE HERETOFORE 6
	'4+'I	PERIODIC PERIODICAL 2
	E	SENOR SENORA 2
	I	REBUILD REBUILT RECAPTURE 21

2	AZTEC TECHNICIAN TECHNIQUE 62
2+4	AFFECTATION EGRET SUSSEX 3
2+4+6	PROBLEM HERCIC HEROICAL 3
2+6	CROMWELL BOSWELL ITEM 20
2+6+9	THERECF 1
2+9	WHEREAS THEREAT WHEREAT 15
3	MERCURIAL SPITSBERGEN LINDBERGH 4
3+6	PROVERB COMMERCE VERMONT 4
4	DEBAR DEBASE SEBASTIAN 725
4+'I	RECEDE RECESSION RECESSIVE 16
4+'2	BARONET PARAPET SOMERSET 4
4+E	REGIME 1
4+I	PRECEDE SECEDE SECESSION 4
4+6	CALEB BECAUSE MEDALLION 51
4+6+*I	FERCCICUS 1
4+6+-	BARREL 1
6	SADDLEBAG BUMBLEBEE HUCKLEBERRY 1303
6+-	QUARREL CHANCELLOR BACHELOR 160
6+'2	ISABEL CITADEL LIONEL 12
6+J6	SINEWY 1
EA *E	BREAKAGE BREAKDOWN 2
*I	SEABOARD PEABODY PEACEABLE 98
*I+*I6	FEALTY 1
*I+*46+*I6	IDEAL UNREAL IDEALIST 4
*I6	AEGEAN EUROPEAN KOREAN 6
*1	HEARKEN HEARKENING HEARTACHE 9
*2	TREACHEROUS TREACHERY AHEAD 67
*2+*I	HEAVY 1
*2+*4	INSTEAD 1
*2+*9	OVERBEAR UNBEARABLE FORBEARANCE 5
*3	SEARCHLIGHT UNHEARD REHEARSAL 5
*4	ENDEAR OVERHEAR APPEAR 16
*4+*I	DREARY WEARY 2
*46+*IC+=I+*I6	REAL 1
*46+*I6	REALIST REALISM IDEALIZE 4
*9	WHEREAS THEREAT WHEREAT 3
=E	BREAK STEAK GREAT 3
=E+=I	JEAN 1
=I	PEACE BEACH LEACH 92
=1	HEART HEARTH 2
=2	DEAD HEAD BREAD 21
=2+=I	LEAD LEAPT 2
=2+=4+=9	TEAR WEAR 2
=2+=9	BEAR PEAR SWEAR 3
=3	SEARCH HEARD PEARL 8
=4	DEAR FEAR GEAR 15
'E	HEARTBREAK DAYBREAK BEEFSTEAK 3
'I	PIECEMEAL OATMEAL MOONBEAM 6
'I6	READJUST NEAPOLITAN REAPPEAR 8
'1	FIREARM FOREARM SWEETHEART 3
'2	ROUNDHEAD FIGUREHEAD BLOCKHEAD 13
'2+*2	OVERHEAD COMMONWEALTH 2

	'2+'9	BUGBEAR UNDERWEAR 2
	'4	HEADGEAR SHAKESPEARE 2
	'46+'16	REALISTIC REALIZATION 2
	'9	PINEAPPLE 1
	1*9+*19	SEATTLE 1
	2	GODHEAD 1
	2+4	VOLSTEAD 1
	4	MILEAGE ACREAGE 2
	4+'2	BEDSTEAD HOMESTEAD 2
	4+6	ELEANOR 1
	4*C	MONTREAL 1
	4*E	CREATE DELINEATION CREATION 7
	4*9	REACTIONARY REALITY UNREALITY 6
	4*9+*19	PREAMBLE 1
	4*9+'1*9	REACT REACTION 2
	4'E	PERMEATE NAUSEATE 2
	44	ROSEATE 1
	44+4'E	LAUREATE 1
	46	MALLEABLE LINEAL CEREAL 15
	6	PEACEABLE TRACEABLE NOTICEABLE 14
	6+45	ELEANORA 1
EAU	*C	BEAUFORT BEAUMONT BEAUREGARD 4
	*1	BUREAUCRACY 1
	=C	BEAUX 1
	J*U+*4U	BEAUTEOUS BEAUTIFY BEAUTY 3
EE	*E	BEETHOVEN 1
	*1	FEEBLE ENFEEBLE BEECH 69
	*2+*1	KEELSON 1
	*2+*4	GREENWICH 1
	*4	POUGHKEEPSIE PEERAGE STEERSMAN 3
	=1	FLEECE GREECE SPEECH 64
	=2+=4+=1	BEEN 1
	=4+=1	BREECH CREEK 2
	'1	NEWSREEL EVERGREEN 2
EEA	*16	AGREEABLE DISAGREEABLE 2
EI	*A4	LEIBNITZ REICHSTAG HEIDELBERG 7
	*E	OUTWEIGH NEIGHBOR NEIGHBORHOOD 8
	*E+*1	INVEIGLE OBEISANCE 2
	*1	CEILING O'NEILL BEING 15
	*1+*A4	ONEIDA 1
	*14	ALBEIT HOWBEIT 2
	*16	DEIFY DEITY SPONTANEITY 3
	*2+*1	LEISURE 1
	*2+*9	HEIRLOOM 1
	*4	HEREIN THEREIN WHEREIN 4
	=A4	REICH HEIGHT STEIN 3
	=E	BEIGE SLEIGH NEIGH 15
	=1	REID LEIGH SEIZE 3
	=2+=9	HEIR 1
	=2+=9+=E	THEIR 1
	=4	WEIR WEIRD 2
	'A4	FAHRENHEIT 1

	'E+*E	OVERWEIGHT 1
	'I4	REINFORCE REINSTATE 2
	A4	EINSTEIN 1
	I+A4	FOLSTEIN 1
	I*4	REITERATE 1
	I4	PROTEIN 1
	4	RALEIGH VILLEIN COUNTERFEIT 6
	4+6	SOVEREIGN FOREIGN SOVEREIGNTY 3
	4'4	ATHEISM 1
	44	ATHEIST 1
EIA	*I6	PLEBEIAN 1
	*I6+*A46	PLEIAD 1
EO	*C	GEORGIA GEORGIAN 2
	*I	PEOPLE 1
	*IC	CREOLE 1
	*I6	THEODORE THEOREM THEORIST 3
	*C	YEOMAN YEOMANRY 2
	1+$	THEREOF WHEREOF 2
	*1+*C+*$	THEREON WHEREON 2
	*2	GEOFFREY LEONARD LEOPARD 5
	*46+*I6	THEORY 1
	=C	GEORGE 1
	'I	TOWNSPEOPLE 1
	'IC	REORGANIZATION 1
	'I1+I'1	PREOCCUPATION 1
	'I6	THEODOSIUS GEOGRAPHIC GEOGRAPHICAL 10
	C	GEORGETTE 1
	E*C+*I6	LEON 1
	I*C	REORGANIZE 1
	I*C	REOPEN 1
	I*1	PREOCCUPY THEODORIC GEOLOGIST 6
	I*1+I*$	GEOGRAPHY 1
	4+6	PIGEON PIGEONHOLE 2
	4*C+4*C	PEORIA 1
	4*1	PHRASEOLOGY NAPOLEONIC 2
	4*1+4*C+4*$	METEORIC 1
	4'1+4'$+46+4'C	METEOROLOGICAL 1
	46	GIDEON SIMEON METEOR 4
	46+J6	CHAMELEON GALLEON NAPOLEON 3
	6	DUNGEON SURGEON LUNCHEON 6
	6+'7	SOMEONE 1
EOI	1	BOURGEOISIE 1
EOU	46	HIDEOUS CONTEMPORANEOUS INSTANTANEOUS 15
	46+J6	MISCELLANEOUS SIMULTANEOUS GASEOUS 3
	6	CRETACEOUS OUTRAGEOUS COURAGEOUS 7
EU	*I6	MAUSOLEUM COLOSSEUM 2
	*U+*4U	REUBEN RHEUMATISM 2
	*U+J*U+*4U	PSEUDO TEUTON NEUTRAL 4
	*3	ENTREPRENEUR CONNOISSEUR PASTEUR 3
	=U+=4U+J=U	DEUCE ZEUS 2
	=4U+J=U	FEUD 1
	'IJ8	REUNITE 1

	IJ*U	REUNION 1
	J*U+*4U	FEUDAL FEUDALISM THERAPEUTIC 3
	U+4U	RHEUMATIC 1
	U+4U+JU	STEUBEN DEUCALION PNEUMATIC 6
	U+46+JU	THESEUS 1
	46	PETROLEUM NUCLEUS 2
	46+JU	ORPHEUS PERSEUS ODYSSEUS 4
	46+J6	LINCLEUM 1
	46+J6+JU	PROMETHEUS 1
	6	HEREUPON THEREUPON WHEREUPON 4
	6+8	GRANDEUR 1
	8+48+J8	NEUROTIC 1
EW	*U+J*U+*4U	NEWBORN NEWCASTLE DEWDROP 8
	=C+=U+=4U	SHREWD 1
	=U+=4U	LEWD STREWN 2
	=U+=4U+J=U	NEWT 1
	=4U+J=U	HEWN 1
EWA	*U4+J*U4+*4U4	SEWAGE 1
	*U6+J*U6+*4U6	NEWARK STEWART 2
EWE	*U6+*4U6	JEWEL JEWELRY 2
	*2	FAREWELL 1
	*4U+*U6	BREWERY 1
EY	*A4	LEYDEN 1
	*E	HEYDAY GREYHOUND HEYWOOD 3
	*I	KEYBOARD KEYHOLE SEYMOUR 5
	*2+*E	REYNARD 1
	=E	THEY'D THEY'LL THEY'VE 3
	=2+=E	THEY'RE 1
	4	HONEYBEE HONEYCOMB BARLEYCORN 7
EYA	*E6	ABEYANCE 1
EYC	*E6	PURVEYOR SURVEYOR 2
I	*A4	INDESCRIBABLE TRIBAL IMBIBE 335
	*I	POLICE CAPRICE POLICEMAN 38
	*I+*A4	CASTILE LIMA 2
	*2+*3+*4	STIRRUP 1
	*2+*4	MIRIAM 1
	*3	ASTIR BESTIR CIRCA 42
	*3+*4	CHIRRUP SIRUP 2
	*4	RIBALD GIBBET RIBBON 1155
	*4+*A4	WINDY SINECURE VIRILE 4
	*4+*I	PHOENICIAN CAPRICIOUS 2
	*9	ROBIN LINGERIE MERINGUE 3
	-	BUSINESSLIKE BUSINESSMAN SALISBURY 3
	=A4	GIBE BRIBE SCRIBE 162
	=I	LILLE HIM 2
	=2+=3	GIRL 1
	=3	FIR WHIR SIR 29
	=4	BIB FIB JIB 288
	=4+=A4	WIND LIVE 2
	=4+=I	MIL CLIQUE 2
	=4+=6	TILL 1
	'A4	HIBERNATION SACRIFICE MICROSCOPIC 181

'∆4+*∆4	BROADSIDE UPSIDE OVERNIGHT	5
'∆4+'∆46	GRIDIRON ANDIRON FLATIRON	3
'I	SIGNORINA JOSEPHINE PHILIPPINE	5
'I+'∆4	EGLANTINE CONSTANTINE ARGENTINE	4
'3	CIRCULATION CIRCUMNAVIGATE CIRCUMSCRIBE	16
'4	LIBERALITY LIBERATION DELIBERATION	278
'4+*4	HEARTSICK 1	
'4+'∆4	MICHELANGELO SIMULTANEOUS 2	
∆4	LIBATION TIBERIUS LIBRARIAN	43
∆4+*∆4	NINETEEN 1	
I	SIGNORA MORPHINE 2	
3	THIRTEEN 1	
4	SAHIB INHIBITION LIBRETTO	1440
4+*4	FIFTEEN FIFTEENTH SIXTEEN	4
4+-	IMAGINABLE PROFITABLE UNPROFITABLE	3
4+'∆4	CYANIDE MERCANTILE ALKALINE	10
4+'I	PARAFFINE ANILINE CRINOLINE	4
4+'I+'∆4	IODINE EVANGELINE 2	
4+'4	ICIKLE DISCIPLINE HOSPITAL	3
4+∆4	TRIBUNAL SULPHIDE BROMIDE	14
4+I	STALIN CHLORINE BENEDICTINE	3
4+I+∆4	ADAMANTINE 1	
4+6	AMERICA CHICAGO AMERICAN	63
4+6+'∆4	JUVENILE INFANTILE 2	
4+6+∆4	FORTNIGHT HILARIOUS HILARITY	4
6	CANNIBAL HANNIBAL ARCHIBALD	1082
6+-	PRESIDENCY PRESIDENT PRIVILEGE	12
6+'4	IMBECILE LANCASHIRE LINCOLNSHIRE	4
6+∆4	SIBERIA SIBERIAN FIDELITY	36
IA *∆4+*∆46	DENIAL DIAMOND 2	
*∆4'9	TRIANGLE 1	
*∆46	LIABLE RELIABLE UNRELIABLE	29
∆46+∆49	FIAT 1	
*9+4*9	IMPARTIALITY 1	
=∆4+*∆46	DIAL PHIAL TRIAL	5
'∆4+'∆46	SUNDIAL 1	
'∆46	LIABILITY RELIABILITY DIABOLICAL	7
∆4*9	NIAGARA DIAGONAL MIAMI	5
∆4*9+*∆49	SIAM 1	
J6	CONGENIAL WILLIAM WILLIAMSBURG	18
4	CARRIAGE MARRIAGE REMARRIAGE	3
4+44	COLLEGIATE 1	
4+46	MINIATURE 1	
4*E	DEPRECIATION APPRECIATION ENUNCIATION	22
4*1	PATRIARCHAL 1	
4*1+∆4*2+∆4*E	TIARA 1	
4*1+4*E	SANTIAGO 1	
4*9	ARIADNE POTENTIALITY TRIVIALITY	10
4*9+*I6	PIANIST 1	
4*9+J*9+J4*9	FAMILIARITY PECULIARITY 2	
4'E	EMACIATE DEPRECIATE APPRECIATE	28
4'1	PATRIARCH 1	

	4'2	SUBSIDIARY INCENDIARY PECUNIARY 3
	4'9	ZODIAC PONTIAC ENTHUSIAST 4
	44	FOLIAGE INAPPROPRIATE 2
	44+J6	IMMEDIATE 1
	44+4'E	ASSOCIATE INTERMEDIATE AFFILIATE 8
	46	JUSTICIABLE AMIABLE VARIABLE 98
	46+J6	PAROCHIAL FILIAL MENIAL 36
	46+4'E	INITIATIVE 1
	46+4'9	LARIAT 1
	6	SOCIABILITY SOCIABLE FACIAL 73
	6+J6	GEORGIAN 1
	6+J6+4'2	AUXILIARY 1
	6+4'2	JUDICIARY BENEFICIARY FIDUCIARY 5
	6+46	APPRECIABLE INSATIABLE GLACIAL 11
AI	'IE	LIAISON 1
IE	*A4+*A46	FIERY 1
	*A46	SCIENCE CLIENT SCIENTIST 17
	*I	APIECE PIECEMEAL PIEDMONT 26
	*2	BEFRIEND FRIENDSHIP 2
	*4+4*2	SIERRA 1
	=I	NIECE PIECE FIEF 21
	=I+*I6	LIEN 1
	=2	FRIEND 1
	=4	FIERCE PIERCE PIERRE 4
	'A4+'A46	HIEROGLYPHIC 1
	'A46	DIELECTRIC CLIENTELE SCIENTIFIC 3
	'I	TIMEPIECE MOUTHPIECE MANTELPIECE 9
	'I6	VIENNESE 1
	A4*2	BIENNIAL 1
	I	SHEFFIELD GARFIELD 2
	I+4'I	HYGIENE 1
	J*I	UNYIELDING 1
	J6	NATHANIEL SPANIEL INCONVENIENCE 5
	4	KERCHIEF MISCHIEF MISCHIEVOUS 3
	4+'I	HANDKERCHIEF 1
	4*I	MEDIEVAL 1
	4*2	SIENA HYGIENIC VIENNA 10
	4*2+J*2	MOLIERE 1
	4*2+4*E	LIEGE 1
	44	FIFTIETH TWENTIETH THIRTIETH 3
	44+46	HARRIET 1
	46	ARIEL GABRIEL OBEDIENCE 15
	46+J6	ALIEN INALIENABLE ALIENATE 8
	46+4'2	ORIENT 1
	6	CONSCIENCE PATIENCE IMPATIENCE 22
	6+-	HOSIERY 1
	6+J6	DANIEL 1
IEU	J*3	MONSIEUR 1
	L+4U	LIEUTENANT 1
IEW	J*U+*4U	VIEWPOINT 1
IL	*A46	NIOBE DIOCESE INVIOLABLE 18
	*C+*C	MAGGIORE 1

```
        *1+*$           GICTTC      1
        -               CENCMINATICNAL      1
        =A4+*A46        VIOL      1
        'A46            BICGRAPHICAL  VIOLATICN  VICLIN      7
        A4*1            BIOLOGIST  BICLCGY  DIOXIDE      3
        A4*1+A4*C+A4*$
                        PRICRITY      1
        J=C+J=C         FIORD      1
        J4+J6           CNICN      1
        J6              BATTALICN  VERMILICN  PAVILICN      26
        4+6             CUSHICN  PINCUSHICN      2
        4*C             TAPICCA  ETHICPIAN      2
        4*C+A4*C+*A46   VICLA      1
        4*1             MEDIOCRITY  PERIODIC  PERIODICAL      12
IC      4*1+A4*1+*A4*$
                        BICGRAPHY      1
        4*1+A4*1+4*$+A4*$
                        AUTOBICGRAPHY      1
        4*1+4*$         BIBLICGRAPHY      1
        4*1+4*C+4*$     SUPERICRITY      1
        4'C             CRICLE  PETICLE  GRANDICSE      3
        4'1             ANTIOCH  HELICS      2
        44+46           PERIOD      1
        46              HESIOD  VITRIOL  SOCIOLOGICAL      35
        46+J6           BALLIOL  ALBION  DELCALION      7
        46+4'1          PATRICT      1
        6               SUSPICION  COERCION  CONTAGION      761
        6+-             FASHIONABLE  OBJECTIONABLE  OCCASIONAL      18
ICU     *A46            PICUS      1
        =U              SIOUX      1
        J6              BILIOUS  REBELLIOUS  INGENIOUS      3
        46              AMPHIBIOUS  DUBIOUS  PERFIDIOUS      41
        46+J6           FASTIDIOUS  PUNCTILIOUS  VICTORIOUS      5
        6               EFFICACIOUS  AUDACIOUS  SAGACIOUS      57
IU      *A46            TRIUMPH  CARIUS      2
        A4*3            DIURNAL      1
        A4*7            TRIUMPHAL  TRIUMPHANT      2
        J6              CORNELIUS  JULIUS      2
        46              CALCIUM  PALLADIUM  RADIUM      27
        46+J6           GERANIUM  OPIUM  GYMNASIUM      5
        6               NASTURTIUM  CONFUCIUS      2
        6+46            BELGIUM  LUCIUS  CASSIUS      5
O       *A8             COWHIDE      1
        *C              LIAISON  THEREFOR  ABHOR      144
        *C+*$           COFFIN  ALOFT  SOFTEN      23
        *C+*O           CORA  PANCORA  FLORA      121
        *C              COBALT  ADOBE  HYDROPHOBIA      353
        *C+*$+*1+*C     PHOSPHORIC  FLORIN      2
        *C+*C4          BOULOGNE      1
        *U              TWOFOLD  ENTOMB  TOMBSTONE      16
        *1              PROBABLE  IMPROBABLE  ROBBERY      573
        *1+*$           WOBBLE  GODHEAD  GODLIKE      37
        *1+*$+*C+*O     FLORIST      1
        *1+*C+*$        MOCKERY  CHOCOLATE  COFFEE      62
        *1+*C+*C        COLBERT      1
```

```
*1+*C          COGNAC  PCLISF  DOLCRCUS      8
*1+*7          LOMBARC  LCMBARCY  COMBATANT      10
*1+*7+*$       SOVEREIGN  SOVEREIGNTY      2
*3             WORDSWORTF  OVERWORK  WORKHOUSE      18
*4             WOMEN      1
*7             COLOR  DISCOLOR  STOMACF      63
*7+*C+*1+*$    CONKEY      1
*7+*C          CONEY  COZEN      2
*8             WOLFISF      1
*8+*U          WOMAN  WOMANHOOC  WOMANKINC      4
-              IRON  GRICIRON  ANCIRON      5
=C             COMTE  FOR  THOR      28
=C+=$          SCOFF  LOFT  SOFT      20
=C+=C          FORCE  PORCF  FORC      35
=C+=C+=$       SLOTH  TROTF      2
=C+=C+=1+=$    SOL      1
=C             LOBE  GLOBE  ROBE      123
=C+=$          SHONE      1
=C+=U          POLE      1
=U             TOMB  WOMB  LOSE      5
=1             COC  FCC  SFCC      96
=1+=$          COG  JOFN  SOLVE      7
=1+=C+=$       MOCK  GOC  COFF      17
=1+=C          JOB  POLL      2
=1+=7+=$       FROM  WON      2
=1+=7+=$+=C+=O
               WONT      1
=3             WORC  WORK  WHORL      8
=6             NOR      1
=7             COME  SOME  SON      14
=7+=C          NONE  COVE  SHOVE      3
=7+=C+=U       WON'T      1
=8             WOLF  WOLFE      2
=8+=C          COKE  WHOLE      2
=8+=U          WHOM  WHOSE      2
'$+*$+'C+*C    HEADLONG      1
'C             LABRADOR  ECUADOR  HARPSICHORD      24
'C+'$          CASTOFF  WATCHDOG  BULLDOG      15
'C+'C          STEVEDORE  THEODORE  COMMODORE      49
'C             WARDROBE  MOBILIZATION  SOCIABILITY      101
'C+*C          BACKBONE  CHEEKBONE  KEYNOTE      3
'1             PROBABILITY  PROBLEMATICAL  HOBGOBLIN      151
'1+'$          LOCHINVAR  DEMIGOD  PROTOCOL      6
'1+'C          HOLLYHOCK      1
'1+'C+'$       HEDGEHOG  BULLFROG  SYNAGOGUE      12
'1+'O          MOLESTATION  HOMOGENEOUS      2
'1+'6          MYRMIDON  HEXAGON      2
'1+'7          MONTREAL      1
'3             WATCHWORD  CROSSWORD  WOODWORK      21
'7             TRICOLOR  COLORATION  INCOME      8
'7+*7          SHORTCOMING      1
'8             WASHERWOMAN      1
'8+'U          NEEDLEWOMAN  GENTLEWOMAN  ENGLISHWOMAN      3
```

	C	CONCORD BCRDEALX INCRGANIC 16
	C+$	OBLONG FURLONG ARMSTRONG 5
	C+C	SPORADIC ENCORE FILLMORE 28
	J*C	SENOR 1
	J*C+J*C	SENORA 1
	J*C	SIGNORA 1
	JC+JC	SIGNOR 1
	J6	CANYON KENYON MICNONETTE 5
	C	PROBATION MICROBE NOBEL 80
	1	WEDLOCK HEMLOCK SHYLOCK 39
	1+$	RANDOLPH VOLTAIRE YUKON 8
	1+C+$	DOGMATIC 1
	1+C	DOCILITY 1
	1+6	CARBON ARCHON PYTHON 15
	1+6+$	KELLOGG MACON JARGON 5
	1+6+C	MONGOL 1
	4+6	PIVOT 1
	46	STEROTYPE 1
	6	JACOB TOBACCO ACROBAT 1268
	6+-	NICOLAS NICHOLAS CHOCOLATE 58
	6+'C	BEARBORN 1
	6+'C	MENDELSSOHN GLADSTONE INMOST 8
	6+'1	PEABODY ARAGON PARAGON 8
	6+'1+'$	MARATHON 1
	6+'1+'C	WAINSCOT 1
	6+'1+'7	SOMEBODY NOBODY ANYBODY 4
	6+'3	LEAVENWORTH 1
	6+C	BANGOR FORBEARANCE ACORN 6
	6+C+C	MORALE UNFORESEEN 2
	6+C+C+1+$	MORALITY 1
	6+C	SOBRIETY VOCABULARY AVOCATION 18
	6+8	COCOON 1
OA	*C	ABROAD BROADBRIM BROADCAST 7
	*C+*C	ABOARD BOARDINGHOUSE HOARFROST 5
	*C	ENCROACH REPROACH APPROACH 15
	*C6	SHENANDOAH NOAH SAMOAN 3
	*C9	MOAB 1
	=C	BROAD 1
	=C+=C	BOAR HOAR ROAR 8
	=C	COACH POACH RCACH 40
	=C+C*1	LOAN 1
	=C+C*9+*C6	JOAN 1
	'C+'C	UPROAR SEABOARD CARDBOARD 14
	'C	STAGECOACH COCKROACH RAILROAD 16
	'C+*C	HIGHROAD 1
	'C6	COALITION 1
	C*E	CROATIA 1
	C*9	COAGULATE JOANNA 2
	6	CUPBOARD 1
OE	*I	PHOEBE PHOEBUS PHOENIX 4
	*C	ROEBUCK FOEMAN 2
	*C4+*C6	POEM POET POETRY 3

	*C6	JOEL NOEL	2
	*U+*4U	SHOESTRING	1
	*7	DOESN'T	1
	'C4+'C6	COEFFICIENT	1
	C*2	POETIC POETICAL	2
	C*3	COERCE COERCION	2
	6	PHOENICIA PHOENICIAN	2
C1	*C4	FOIBLE REJOICE AVOID	29
	*C4+*C4	TROILUS	1
	*C4	HEROIC STOIC MESOZOIC	11
	*1+*C	BOUDOIR	1
	=A4	CHOIR	1
	=C4	CHOICE VOICE VOID	21
	=1	LOIRE	1
	'C4	ALKALOID CELLULOID ADENOID	8
	'C4	COINCIDE SEAGOING	2
	'1+'C	REPERTOIRE	1
	C4	INVOICE NEGROID TURMOIL	5
	C*4	COINCIDENCE COINCIDENT	2
	C'4	HEROISM	1
	C4	HEROINE	1
	1	ANTOINETTE	1
	1+C	MEMOIR	1
	4+6	TORTOISE	1
	6	PORPOISE MADEMOISELLE CONNOISSEUR	3
	9	POINCARE	1
CC	*C+*C	DOORYARD	1
	*C	DOORMAN	1
	*U	BOOBY FOODSTUFF MOODY	53
	*7	BLOODHOUND BLOODSHOT BLOODTHIRSTY	3
	*7+*8+*U	SOOTY	1
	*8	UNDERSTOOD MISUNDERSTOOD WOODBINE	38
	*8+*U	ROOFTREE ROOMMATE BROOMSTICK	4
	=C+=C	DOOR FLOOR	2
	=C+=U	BROOCH	1
	=U	BOOB FOOD MOOD	54
	=U+*8	WOOF	1
	=7	BLOOD FLOOD	2
	=7+=8+=U	SOOT	1
	=8	GOOD HOOD STOOD	18
	=8+=C+=C	MOORE	1
	=8+=U	HOOF ROOF POOH	10
	'C+'C	INDOOR OUTDOOR	2
	'C6	ZOOLOGICAL	1
	'U	WHIRLPOOL LIVERPOOL TOADSTOOL	6
	'U+*U	FIREPROOF WATERPROOF HEIRLOOM	3
	'6+'8+'U	BEDROOM	1
	'8	CHILDHOOD HARDIHOOD LIKELIHOOD	26
	'8+*8	BACKWOODSMAN	1
	'8+'U	STOREROOM STATEROOM ANTEROOM	12
	C*1	ZOOLOGIST ZOOLOGY	2
	6	WHIPPOORWILL	1

	8	FALSEHOOD GIRLHOOD MANHOOD 7
OU	*A4	ACCOUNTANT 1
	*A8	REDOUBT REDOUBTABLE AVOLCH 70
	*C	BETHOUGHT METHOUGHT OVERWROUGHT 5
	*C+*O	COURTHOUSE COURTROOM COURTSHIP 4
	*C	DOUGHBOY MOULDY POULTICE 4
	*U	TROUBADOUR COULEE UNCOUTH 3
	*U+J*U+*4U	COUPON 1
	*3	COURAGE ENCOURAGE DISCOURAGE 14
	*3+*8	BOURBON TOURNEY 2
	*7	TROUBLESOME DOUBLET TROUBLOUS 16
	*8	COULDN'T SHOULDN'T WOULDN'T 6
	=A8	DOUBT COUCH SLOUCH 62
	=C	BOUGHT FOUGHT THOUGHT 7
	=C+=$	COUGH TROUGH 2
	=C+=O	FOUR SOURCE MOURN 5
	=C	THOUGH SOUL MOULD 3
	=C+=U	COUP 1
	=U	YOU'D YOU'LL YOU'VE 9
	=U+=A8	WOUND ROUTE 2
	=U+=4U	THROUGH 1
	=3	SCOURGE 1
	=7	TOUCH ROUGH TOUGH 4
	=7+=A8	JOUST 1
	=8	COULD SHOULD WOULD 8
	=8+=C+=C	POUR COURD COURSE 3
	=8+=U	YOU'RE 1
	'A8	THUNDERCLOUD SPELLBOUND BLOODHOUND 33
	'A8+*A8	ROUNDABOUT 1
	'C	FORETHOUGHT AFTERTHOUGHT 2
	'C+'C	WATERCOURSE INTERCOURSE 2
	'L	RENDEZVOUS 1
	'3	JOURNALISTIC 1
	'8	PARAMOUR BOURGEOISIE 2
	'8+'C+'C	TROUBADOUR DOWNPOUR 2
	A8	VOUCHSAFE PRONOUN FOUNDATION 6
	C+O	CONCOURSE FOURTEEN FOURTEENTH 3
	J*U+*4U	HOUSTON 1
	C+U	BOUQUET 1
	U	BOUDOIR ROULETTE ROUMANIA 6
	U+4U	THROUGHOUT 1
	6	POUGHKEEPSIE COURAGEOUS RAUCOUS 121
	6+C+O	SEYMOUR HARCOURT 2
	6+O	BOROUGH THOROUGH THOROUGHFARE 4
	6+8	CAMOUFLAGE BOULOGNE YOURSELF 3
	8	BALFOUR CONTOUR CHERBOURG 3
OUI	*84+*484	LOUISVILLE 1
	8*I	LOUISA LOUISE 2
	84	BEDOUIN 1
OW	*A8	COWBOY ADOWN RENOWN 15
	*C	SNOWBALL CROWBAR ROWBOAT 16
	*C+*AU	JOWL 1

	*C+*A8	BOWMAN BOWSPRIT 2
	*I	KNOWLEDGE 1
	=A8	CROWD COWL SCOWL 17
	=C	BOWL SHOWN FLOWN 8
	'A8	WATERFOWL THISTLEDOWN SOUTHDOWN 5
	'C	UNDERGROWTH OUTGROWTH 2
	'I	FOREKNOWLEDGE 1
	A8	HOWBEIT 1
	A8+*A8	DOWNSTREAM 1
	6+0	WINDOWPANE FELLOWSHIP YELLOWSTONE 3
OWA	*A86	ALLOWABLE AVOWAL ALLOWANCE 6
	*C+*C	UNTOWARD 1
	*C6	STOWAWAY 1
OWE	*A8	FLOWERET FLOWERPOT 2
	*A8+*A86	FLOWERY 1
	*A8+*C6+*A86	BOWERY 1
	*A86	COWEL 1
	*C4+*C6	LOWELL 1
	=A8+*A84+*A86	VOWEL 1
	=A8+*A86	BOWEL TROWEL TOWEL 3
OWEE	C*I	HALLOWEEN 1
OY	*C4	BOYCOTT BURGOYNE 2
	=C4	BOYLE 1
OYA	*C44+*CJ4	VOYAGE 1
	*C46	ANNOYANCE 1
OYOU	*C46	JOYOUS 1
U	*U	JUGOSLAVIA YUKON HONOLULU 9
	*U+*4U	RHUBARB SCHUBERT RUBICON 111
	*U+J*U+*4U	EXUBERANCE EXUBERANT TUBERCLE 82
	*2	BURIAL BURY 2
	*3	OCCUR RECUR INCUR 116
	*3+*8	TURRET BURRO 2
	*4	BUSINESSLIKE BUSINESSMAN BUSY 4
	*7	SHRUBBERY RUBBISH STUBBORN 458
	*7+*U	TURBULENT 1
	*7+*8	PUSSY 1
	*8	BUDDHA BUDDHIST SUGAR 31
	*8+*48	PLURAL RURAL ADJURE 10
	*8+J*8+*48	DURABLE UNENDURABLE ENDURANCE 15
	=U	CHUTE 1
	=U+=4U	BRUCE SPRUCE TRUCE 18
	=U+=4U+J=U	TUBE DUDE NUDE 7
	=2+=6+=7	JUST 1
	=3	CUR FUR BLUR 38
	=3+=8	KURD 1
	=4U+J=U	CUBE HUGE MULE 10
	=6+=7	SUCH 1
	=7	CUB DUB HUB 226
	=7+=U	RUM 1
	=7+=8	SUNG BRUSQUE PUT 3
	=8	RUHR BULL FULL 7
	=8+=48	LURE 1

'0	RUDIMENTARY SUPERCILIOUS PARACHUTE	3
'0+'40	CRUCIFIXION HALLUCINATION INTERLUDE	4
'0+'40+J'0	BUDAPEST QUIETUDE SOLICITUDE	42
'2	CANTERBURY	1
'3	LARKSPUR OVERBURDEN MAGDEBURG	14
'40+J'0	REPUDIATION SUBTERFUGE VESTIBULE	16
'48+J'8	SINECURE MANICURE EPICURE	5
'7	SUBDIVIDE SUBJUGATION PUBLICATION	53
'8	PINCUSHION OUTPUT	2
'8+'0	MUSSOLINI	1
'8+'48	JURISDICTION	1
'8+'48+J'8	DURABILITY	1
J*0	NONUNION DISUSE MISUSE	4
J*0+*40	CUBA CUBAN HUBERT	90
J*0+*48	AMUSE	1
J*8	INURE	1
J*8+*48	INCURABLE MURAL CURATE	29
J0	REFUGE DELUGE OVULE	4
J6	INCUBATOR SOLUBLE INSOLUBLE	124
J6+J8	IMPUDENCE IMPUDENT ACCUSATION	7
J8	CENTRIFUGAL REFUGEE GLOBULE	13
J8+J0	CANUBE	1
0	TUCSON SUCAN NODULE	6
0+40	LUCRETIUS JUDAEA JUDICIAL	8
0+40+J0	NUMERICAL TUMULTUOUS STUPENDOUS	7
3	SUBURB HAMBURG STRASBURG	6
3+6	BURLESQUE CURTAIL	2
4+6	LETTUCE	1
40+J0	HUMANITY HUMIDITY HUMILIATE	12
48+J8	EPICUREAN BUREAUCRACY	2
48+6+8++J8	SUPERB SUPERLATIVE SUPREMACY	4
6	CHERUB SUBDUE SUBJECTION	354
6+-	PLEASURABLE MEASURABLE IMMEASURABLE	12
6+'2+-	SALISBURY	1
6+'7	DIFFICULT DIFFICULTY OMNIBUS	8
6+'8	CARICATURE EXPENDITURE OVERTURE	3
6+J6	NEBUCHADNEZZAR MANUFACTURE CONSULAR	15
6+J6+-	MERCURY	1
6+J6+J8	OBDURATE	1
6+J8	CHERUBIM INSULAR INSULATE	6
6+0+40+J0	TUBERCULOSIS	1
6+40+J0	BUCHANAN	1
6+7	PUBLICITY PRODUCT GUFFAW	8
6+8	EDUCATE EDUCATION EDUCATIONAL	11
6+8+J6	VIRULENCE VIRULENT QUERULOUS	3
7	HUBBUB SUBCONSCIOUS SUBDEB	29
7+8	BULGARIA BULGARIAN	2
8	GERTRUDE CONJUGAL CONJUGATE	9
8+J8	ERUDITION	1
8+48	PLURALITY JURASSIC	2
8+48+J8	DURATION	1
*C	QUARTERBACK QUARTERSTAFF QUARTZITE	3

UA

	*E	PERSUADE DISSUADE ASSUAGE	7
	*U6+*4U6	JUAN TRUANT	2
	*U6+J*U6+*4U6	DUAL DUALISM PURSUANCE	4
	*1	GUARDHOUSE GUARDIAN GUARDSMAN	3
	1+$	SQUABBLE QUADRANGLE QUADRANT	11
	*1+*C+*$	GUARANTINE GUARREL GUARRY	3
	*1+*E+*$	SQUALOR	1
	*1+*9+*$	AQUATIC	1
	*2+*E	ANTIQUARIAN AQUARIUM	2
	*9	GUARANTY	1
	=C	SQUALL QUART QUARTZ	3
	=C+=$+=1+=9	QUAFF	1
	=E	QUAKE	1
	=1	GUARD	1
	=1+=$	SQUAB SQUAD SQUASH	4
	=1+=C+=$	QUALM	1
	=1+=E	SUAVE	1
	=2+=9	SQUARE	1
	=9	QUACK	1
	'E	EARTHQUAKE	1
	'1	SAFEGUARD VANGUARD BODYGUARD	3
	'1+'$	QUALIFICATION	1
	'2	ANTIQUARY	1
	'9	GUARANTEE	1
	J6+J86	VALUABLE INVALUABLE	2
	J8+J86	ANNUAL	1
	J8*E	EVACUATION VALUATION INSINUATION	4
	J8'E	EVACUATE EVALUATE EXTENUATE	4
	J86	MANUAL CONTINUAL CONTINUANCE	3
	J86+J8'2	JANUARY	1
	1+6	BLACKGUARD	1
	4	LANGUAGE ADEQUATE INADEQUATE	3
	6	EQUABLE INADEQUACY ECUADOR	11
	6+8+86	USUAL UNUSUAL SPIRITUAL	4
	8+86	GRADUAL INDIVIDUAL CASUAL	11
	8*E	GRADUATION INFATUATION FLUCTUATION	3
	8*9	INDIVIDUALITY ACTUALITY SPIRITUALITY	3
	8'E	INFATUATE ACTUATE PUNCTUATE	7
	8'2	STATUARY SANCTUARY ESTUARY	3
	84+8'E	GRADUATE UNDERGRADUATE SITUATE	3
	86	VISUAL SENSUAL CONTRACTUAL	11
UAI	*E	ACQUAINT ACQUAINTANCE	2
	=E	QUAIL QUAINT	2
UAh	=C	SQUAWK	1
UE	*E	CROQUET BOUQUET	2
	*I	VENEZUELA VENEZUELAN	2
	*U+*4U	BLUEBELL BLUEBERRY BLUEBIRD	5
	*U+J*U+*4U	TUESDAY	1
	*U2+*4U2+J*U2+J8*2	SUEZ	1
	*U4+J*U4+*4U4	SUET	1
	*U6+*4U6	CRUEL GRUEL CRUELTY	4
	*U6+J*U6+*4U6	DUEL	1

	*2	UNQUENCHABLE QUERULOUS BEQUEST	9
	*3	QUERDON QUERNSEY	2
	*4	QUERY	1
	-	ROQUEFORT	1
	=E	SUEDE	1
	=2	QUELL QUENCH QUEST	4
	'I	PORTUGUESE	1
	'2	CONSEQUENCE CONSEQUENT QUESTIONNAIRE	4
	J*U6+*4U6	FUEL	1
	J6+J8+J86	SAMUEL	1
	J8*2	INNUENDO MINUET	2
	J86	EMMANUEL	1
	J86+J8'2	MANUEL	1
	U*2+4U*2+JU*2	DUET	1
	2	INQUEST CONQUEST	2
	4	QUEBEC AQUEDUCT SUSQUEHANNA	4
	6	SEQUEL SEQUENCE ELOQUENCE	12
	6+-	UNCONQUERABLE	1
	6+'2	SUBSEQUENT	1
	8*2	STATUETTE	1
	8*2+48*2	INFLUENTIAL INFLUENZA	2
	86	CONSTITUENCY CONSTITUENT	2
	86+486	AFFLUENCE INFLUENCE CONFLUENCE	4
UEA	*I	SQUEAMISH BEQUEATH	2
	=I	SQUEAK SQUEAL	2
UEE	*I	QUEENSLAND	1
	=I	QUEEN SQUEEZE	2
UECU	46	AQUEOUS	1
UI	*A4	GUIDANCE MISGUIDE BEGUILE	11
	*I	MOSQUITO	1
	*U+*4U	JUICY RECRUIT	2
	*U+J*U+*4U	NUISANCE PURSUIT SUITABLE	6
	*U4+*4U4	FLUID DRUID RUIN	7
	*U4+J*U4+*4U4	INTUITIVE	1
	*U6+*4U6	INCONGRUITY	1
	*U6+J*U6+*4U6	GRATUITOUS FORTUITOUS INGENUITY	5
	*4	QUIBBLE QUICKEN QUICKSAND	20
	=A4	GUIDE GUILE GUIRE	6
	=U+=4U	JUICE SLUICE BRUISE	5
	=U+=4U+J=U	SUIT	1
	=3	QUIRK SQUIRM QUIRT	4
	=4	QUICK QUID BUILD	11
	=4U+J=8	MUIR	1
	'U+'4U	GRAPEFRUIT	1
	'U+'4U+J'U	LAWSUIT	1
	'4	OUTBUILDING	1
	J*U+*4U+*U6	SUICIDE	1
	J*U4+*4U4	CIRCUITOUS	1
	J*U6+*4U6	AMBIGUITY	1
	J84	GENUINE	1
	U*4+4U*4	FRUITION	1
	U*4+4U*4+JU*4	TUITION	1

	4	LANGUID LIQUID LIQUIDATE	28
	4+84	CONDUIT	1
	6	EQUILIBRIUM AQUILINE EQUINOX	13
	8*4	ALTRUISTIC	1
	8*4+48*4+J8*4	INTUITION	1
UIA	4*1+4*9	GUIANA	1
	46	CCLLOQUIAL	1
UIE	*A46	QUIET UNQUIET DISQUIET	4
	4*2	ACQUIESCE	1
	46	REQUIEM	1
UICU	46	OBSEQUICUS	1
UC	*C	QUOTA QUOTIENT	2
	=C	QUOTE QUOTH	2
	C	QUOTATION	1
	6	LANGUOR LIQUOR	2
UCI	=C4	QUOIT	1
	C4	TURQUOISE	1
UCU	J86	CONSPICUOUS INCONSPICUOUS INNOCUOUS	10
	86	DECIDUOUS ASSIDUOUS ARDUOUS	15
UL	J86	VACUUM	1
UY	*U	SCHUYLKILL	1
Y	*A4	HYBRID PSYCHE PSYCHIC	34
	*3	MYRMIDON SMYRNA MYRTLE	3
	*3+*4	SYRUP	1
	*4	CHARYBDIS SYCAMORE GLYCERIN	93
	*4+*A4	ENCYCLICAL	1
	=A4	BRYCE CLYDE DYKE	11
	=3	BYRD MYRRH	2
	=4	HYMN LYMPH NYMPH	11
	=4+=A4	TRYST	1
	'A4	PSYCHOLOGICAL HYDROCHLORIC HYDROPHOBIA	11
	'4	SYNONYM SYMPATHETIC HYPOCRITICAL	12
	A4	PSYCHIATRIST PSYCHOLOGY PSYCHOSIS	10
	4	LADYBIRD ANYBODY EVERYBODY	53
	4+'4	BICYCLE	1
	4+A4	TYRANNICAL	1
	4+6	OXYGEN SIBYL ETHYL	6
	6	THERMOPYLAE COTYLEDON ETHYLENE	26
	6+A4	MYSELF	1
YA	*A46	HYACINTH BRYAN CYANIDE	5
	*A46+*A49	DRYAD	1
	46	LIBYAN	1
	46+J6	ARYAN	1
YE	A4*I	HYENA	1
YI	*A44	DYING UNDYING LYING	4
	'A44	OUTLYING	1
	44	UNVARYING LOBBYIST	2
YC	*A46	LYCN	1
	A4*C+*A46	WYOMING	1
YCU	*A4'A8	TRYOUT	1

A-	*1	AHA FUZZA 2
	=1	FA FRA 2
	=1+=C	LA 1
	'1+'C	OMAHA 1
	J6	BOLOGNA 1
	4+6	EXTRA 1
	6	SHEBA CUBA CATAWBA 211
	6+'E	IOWA 1
	6+'1+'$	OTTAWA 1
AA-	=1+=9+=A	BAA 1
AE-	'I	THERMOPYLAE VERTEBRAE 2
	I	ALGAE LARVAE 2
AEA-	*I6	JUDAEA 1
AI-	A4+*A4	SHANGHAI 1
	A4+4'A4	SINAI 1
AL-	C	BRESLAU NASSAU 2
Aw-	*C	GUFFAW WITHDRAW 2
	=C	CAW DAW HAW 17
	'C	JACKDAW OUTLAW BYLAW 6
	C	WARSAW 1
AwE-	*C	OVERAWE 1
AY-	*E	BOMBAY DECAY TODAY 23
	=E	BAY DAY FAY 28
	'E	BIRTHDAY HOLIDAY NOONDAY 31
	'E+*E	MIDDAY MIDWAY 2
	E	CHAMBRAY FORAY NORWAY 3
	4	FRIDAY MONDAY SUNDAY 10
	4+'E	YESTERDAY 1
AYC-	*EC	MAYO 1
E-	*E	CAFE POINCARE PASSE 4
	-	BABE ASTROLABE IMBIBE 2799
	=I	HE SHE ME 4
	=4+*I	YE 1
	=4+=I	BE 1
	=6	THE 1
	'I	ANEMONE 1
	E	LIRE 1
	I	COMANCHE ATHENE 2
	4	HEBE PHOEBE ADOBE 24
	4+'I	NIOBE SIMILE RECIPE 3
	4+I	CIRCE ACME 2
	6	GENRE 1
EA-	*I6	MEDEA CHALDEA ~~CORCHEA~~ 5
	*46+*I6	PANACEA 1
	=E	YEA 1
	=I	LEA FLEA PLEA 6
	4	GUINEA 1
	46	AREA 1
EAU-	*C	ROUSSEAU CHATEAU PLATEAU 3
	=C	BEAU 1
	C	PORTMANTEAU 1
	6+C	BUREAU 1

EE-	*E	NEGLIGEE MATINEE 2
	*I	GRANDEE DUNDEE REFUGEE 18
	=I	BEE FEE GEE 14
	=4+=I	THEE 1
	'I	BUMBLEBEE HONEYBEE JUBILEE 9
	E	ENTREE 1
	4	COFFEE PRITHEE YANKEE 7
EC-	*IC	LEO GALILEO 2
	JC+4'C	CAMEO ROMEO 2
	4'C	BORNEO 1
EW-	*U+*4U	ESCHEW WITHDREW OUTGREW 4
	*U+J*U+*4U	ANEW RENEW 2
	=C	SHEW SEW 2
	=C+=U+=4U	SHREW 1
	=U+=4U	CHEW JEW BLEW 14
	=U+=4U+J=U	DEW NEW KNEW 4
	=4U+J=U	FEW HEW WHEW 5
	'U+'4U+J'U	MILDEW 1
	'4U+J'U	BARTHOLOMEW 1
	JU	MATTHEW 1
	U+4U	HEBREW 1
	U+4U+JU	CURLEW SINEW 2
	4U+JU	CURFEW 1
	4U+J8+JU	NEPHEW 1
EWEY-	*U4+J*U4+*4U4	DEWEY 1
EWY-	*U4+J*U4+*4U4	DEWY 1
EY-	*E	OBEY DISOBEY 2
	=E	BEY HEY THEY 6
	=I	KEY 1
	'I	TURNKEY 1
	4	ABBEY LACKEY HOCKEY 54
I-	=I	SKI 1
	'A4	ALIBI ALKALI 2
	'I	MEDICI 1
	A4	RABBI FUNGI DELPHI 6
	I	YOGI 1
	4	GARIBALDI KHAKI DISRAELI 12
	4+A4	ANTI 1
	4+I	GANDHI 1
	4+6	MIAMI MISSOURI CINCINNATI 3
IA-	*A46	SOPHIA VIA 2
	*I6+*A46	MARIA 1
	J6	AUSTRALIA AMELIA CORNELIA 5
	46	HYDROPHOBIA SERBIA NUBIA 43
	46+J6	ARABIA COLUMBIA INDIA 29
	6	ACACIA ASIA AUSTRALASIA 12
	6+J6	GEORGIA 1
	6+46	CILICIA PHOENICIA LUCIA 8
IE-	*A4	BELIE UNTIE 2
	*I	BOURGEOISIE 1
	=A4	DIE FIE HIE 7
	'A4	MAGPIE NECKTIE 2

	'I	LINGERIE	1
	4	LACCIE BIRDIE CARNEGIE	23
IEU-	*U+*4U	RICHELIEU	1
	*U+J*U+*4U	ADIEU	1
	=U+=4U	LIEU	1
IEW-	=4U+J=U	VIEW	1
	'4U+J'U	INTERVIEW	1
	J*U+*4U	REVIEW	1
IC-	*A4C	OHIC	1
	*IC+*A4C	TRIC	1
	JC+4'C	FOLIC PORTFOLIC ANTONIO	3
	C	MUSTACHIO RATIC	2
	C+4C	FORATIC	1
	4'C	NUNCIC RADIC STUDIO	8
	4C	CRATERIC	1
O-	*C	AGO FOREGO UNDERGO	4
	*U	ADO UNDO OVERDO	6
	=C	GO HO LO	8
	=U	DO TO TWO	3
	=8+=U	WHO	1
	'C	CALICO PORTICO MEXICO	14
	C	LIMBO FOBO MOROCCO	92
	6+C	TOBACCO TOLEDO CHICAGO	9
	6+8	INTO	1
	6+8+U	ONTO	1
	8	UNTO	1
O'-	=C	THO'	1
OA-	*C6	BALBOA SAMOA	2
	6+O	COCOA	1
OE-	*C	DEFOE MONROE	2
	*U	CANOE	1
	=C	DOE FOE FOE	3
	=U+=4U	SHOE	1
	'C	MISTLETOE TIPTOE	2
	'U	SNOWSHOE	1
	'U+'4U	HORSESHOE OVERSHOE	2
	C	CRUSOE	1
	C+C4	OBOE	1
OEA-	*I6	EUBOEA	1
OO-	*U	TABOO BAMBOO FALLOO	8
	=U	BOO TOO ZOO	4
OU-	=A8	THOU	1
	=U	SOU YOU	2
	'U	CARIBOU	1
	U	ANJOU	1
OW-	*A8	ENDOW ALLOW AVOW	3
	*C	BELOW AGLOW OUTGROW	4
	=A8	COW SCOW HOW	10
	=C	SHOW BLOW FLOW	12
	=C+=A8	BOW MOW ROW	4
	'A8	SOMEHOW ANYHOW	2
	'C	ELBOW RAINBOW CROSSBOW	6

	C	MOSCOW GLASGOW LONGFELLOW	3
	6+C	MEADOW SHADOW FORESHADOW	40
CY-	*C4	ENJCY CVERJOY EMPLCY	6
	=C4	BOY COY JCY	7
	'C4	COUGHBOY SCHCCLBOY NEWSBOY	4
	C4	VICERCY ENVOY	2
U-	*U	TABU MANCHU	2
	*U+*4U	PERU	1
	U	ZULU	1
	U+*U	HINDU	1
	U+JU	MENU	1
	U+4U+JU	IMPROMPTU	1
	4U+JU	JEHU	1
	6+U	HONCLULU	1
UA-	6	NICARAGUA CHAUTAUQUA	2
UAW-	=C	SQUAW	1
UAY-	=I	QUAY	1
	'E+'A4	PARAGUAY URUGUAY	2
UE-	*U+*4U	ACCRUE UNTRUE CONSTRUE	3
	*U+J*U+*4U	SUBCUE ENDUE UNCUE	5
	-	LEAGUE HAGUE PLAGUE	29
	=U+=4U	BLUE CLUE FLUE	6
	=U+=4U+J=U	CUE SUE	2
	=4U+J=U	CUE HUE	2
	'U+'4U+J'U	RESIDUE AVENUE REVENUE	4
	'4U+J'U	BARBECUE	1
	J*U+*4U	IMBUE REVUE	2
	JU	AGUE	1
	J8	RESCUE ARGUE VALUE	5
	8	TISSUE STATUE VIRTUE	3
	8+J8	ISSUE	1
UY-	=A4	BUY GUY	2
	4	SOLILOQUY COLLOQUY	2
Y-	*A4	HEREBY THEREBY WHEREBY	8
	=A4	BY SHY THY	14
	'A4	LULLABY STUPEFY PACIFY	51
	4	BABY SHABBY FLABBY	1078
YA-	46	LIBYA	1
YE-	=A4	BYE DYE LYE	4
YC-	4'C	EMBRYO	1

-'T	T	'TIS 1
-'TW	TW	'TWAS 'TWERE 'TWILL 5
-B	B	BAA BAAL BABBLE 581
-BL	BL	BLAB BLACK BLACKBERRY 64
-BR	BR	BRACE BRACELET BRACING 136
-C	K	CAB CABAL CABBAGE 816
	KW	CUISINE 1
	S	CAESAR CEASE CECIL 102
-CH	K	CHALDEA CHAMELEON CHAOS 17
	KW	CHOIR 1
	TY	CHAD CHAFE CHAFF 116
	Y	CHAGRIN CHAISE CHAMBRAY 15
	Y+TY	CHIVALRY 1
-CHL	KL	CHLORIDE CHLORINE CHLOROFORM 3
-CHR	KR	CHRIST CHRISTEN CHRISTENDOM 15
-CL	KL	CLACK CLAD CLAIM 96
-CR	KR	CRAB CRACK CRACKLE 129
-CZ	TY	CZECH CZECHOSLOVAK CZECHOSLOVAKIA 3
	Z	CZAR 1
-D	D	DAB DABBLE DAD 787
-DR	DR	DRAB DRACHM DRAFT 64
-DW	DW	DWARF DWELL DWELLING 6
-F	F	FABRIC FABRICATE FABRICATION 414
-FL	FL	FLABBY FLAG FLAGON 94
-FR	FR	FRA FRACTION FRACTIONAL 89
-G	DZ	GAOL GEE GEM 65
	G	GABBLE GABRIEL GABLE 182
	G+DZ	GILL GIN 2
	Z	GENDARME GENRE 2
-GH	G	GHOST 1
	G+DZ	GHENT 1
-GL	GL	GLACIAL GLAD GLADDEN 39
-GN	N	GNASH GNAT GNAW 4
-GR	GR	GRAB GRACE GRACIOUS 128
-H	-	HEIR HEIRLOOM HONEST 8
	H	HA HABIT HABITABLE 498
-J	DZ	JAB JACK JACKAL 156
	J	JUGOSLAVIA 1
-K	K	KALAMAZOO KALE KALEIDOSCOPE 70
-KH	K	KHAKI KHAN KHEDIVE 3
-KN	N	KNACK KNAPSACK KNAVE 26
-L	L	LA LABEL LABOR 448
	LW	LOIRE 1
-LL	L	LLAMA 1
-M	M	MA'AM MABEL MACADAM 737
-N	N	NAG NAIAD NAIL 279
-P	P	PACE PACIFIC PACIFIST 683
	PW	POINCARE 1
-PH	F	PHAETON PHALANX PHANTOM 48
-PHL	FL	PHLEGMATIC 1
-PHR	FR	PHRASE PHRASEOLOGY PHRYGIA 4
-PL	PL	PLACATE PLACE PLACID 79

-PN	N	PNEUMATIC PNEUMONIA 2
-PR	P+PR	PROPRIETOR 1
	PR	PRACTICABLE PRACTICAL PRACTICE 281
-PS	S	PSALM PSALMIST PSEUDO 10
-PSH	Y	PSHAW 1
-PT	T	PTOLEMY 1
-Q	K	QUAY 1
	K+KW	QUOTATION QUOTE 2
	KW	QUACK QUADRANGLE QUADRANT 53
-R	R	RABBI RABBIT RABBLE 683
-RH	R	RHAPSODIC RHAPSODICAL RHAPSODY 15
-S	S	SABBATH SABLE SAC 712
	S+Z	SYNE 1
	SW	SUAVE SUEDE 2
	Y	SUGAR SURE SURETY 3
-SC	S	SCENARIO SCENE SCENERY 12
	SK	SCAB SCABBARD SCAFFOLD 57
-SCH	S	SCHISM 1
	SK	SCHEDULE SCHEME SCHOLAR 14
	Y	SCHUBERT 1
-SCR	SKR	SCRAMBLE SCRAP SCRAPBOOK 24
-SH	Y	SHABBY SHACK SHACKLE 122
-SHR	YR	SHRANK SHRAPNEL SHREVEPORT 19
-SK	SK	SKATE SKEIN SKELETAL 25
-SL	SL	SLAB SLACK SLACKEN 59
-SM	SM	SMACK SMALL SMALLPOX 26
-SN	SN	SNACK SNAG SNAIL 30
-SP	SP	SPACE SPACIOUS SPADE 99
-SPH	SF	SPHERE SPHERICAL SPHINX 3
-SPL	SPL	SPLASH SPLEEN SPLENDID 7
-SPR	SPR	SPRAIN SPRANG SPRAWL 18
-SQ	SKW	SQUAB SQUABBLE SQUAD 20
-ST	ST	STAB STABILITY STABILIZATION 199
-STR	STR	STRADDLE STRAGGLE STRAIGHT 59
-SW	S	SWORD 1
	SW	SWAB SWADDLE SWAIN 46
-T	T	TAB TABBY TABERNACLE 385
-TH	0	THACKERAY THANE THANK 62
	0+X	THENCE THENCEFORTH THENCEFORWARD 4
	T	THOMAS THOMPSON THOMSON 4
	X	THAN THAT THE 35
-THR	0R	THRACE THRACIAN THRALL 32
-THW	0W	THWACK THWART 2
-TR	TR	TRACE TRACEABLE TRACERY 172
-TS	TS	TSAR 1
-TW	T	TWO TWOFOLD TWOPENCE 3
	TW	TWAIN TWANG TWELFTH 18
-V	V	VACANCY VACANT VACATE 263
-X	Z	XENOPHON 1
-Z	Z	ZEAL ZEALAND ZEALOT 22
-Y	J	YACHT YALE YAM 47
-W	W	WABASH WAD WADDLE 289

-WH	H	WHO WHOLE WHOLESALE	8
	H+HW	WHOOP 1	
	HW	WHACK WHALE WHALEBONE	62
-WR	R	WRACK WRANGLE WRATH	28

'CL	KL	C'CLOCK 1
'N	N	O'NEILL 1
'R	R	WE'RE YOU'RE THEY'RE 3
'V	V	WE'VE I'VE YOU'VE 4
B	B	SHEBA CUBA CATAWBA 668
BB	B	CABBAGE SCABBARD SABBATH 41
BBL	B	COBBLESTONE 1
BBR	BR	ABBREVIATE ABBREVIATION 2
BC	BK	BOBCAT SUBCONSCIOUS 2
BD	BD	SUBDEB ABDICATE ABDICATION 8
BG	BG	HOBGOBLIN 1
BH	BH	ABHOR ABHORRENCE ABHORRENT 3
BJ	BDZ	OBJECTION SUBJECTION OBJECTIONABLE 7
BL	BL	ABLAZE PROBLEM PROBLEMATICAL 34
BM	BM	CABMAN SUBMERGE SUBMISSION 5
BN	BN	LEIBNITZ ABNORMAL OBNOXIOUS 3
BR	BR	ALGEBRA VERTEBRA ZEBRA 41
BS	BS	ABSALOM ABSENCE ABSENT 25
	BZ	OBSERVABLE OBSERVANCE OBSERVANT 6
BSB	PSB	HABSBURG 1
BSC	BS	OBSCENE 1
	BSK	OBSCURE OBSCURITY 2
BSCR	BSKR	SUBSCRIBE SUBSCRIPTION 2
BST	BST	ABSTAIN OBSTAKLE SUBSTANCE 10
BSTR	BSTR	ABSTRACT ABSTRACTION OBSTRUCT 4
BT	BT	OBTAIN OBTAINABLE SUBTERFUGE 5
	T	REDOUBTABLE DEBTOR SUBTLE 3
BTL	T	SUBTLETY 1
BTR	PTR	SUBTRACT SUBTRACTION SUBTROPICAL 6
BV	BV	OBVIATE OBVIOUS 2
BW	BW	SUBWAY COBWEB 2
BWH	BHW	BOBWHITE 1
C	K	ITHACA SENECA JAMAICA 419
	KW	ECUADOR 1
	S	FACADE ACE PEACE 353
	S+Y	ASSOCIATION SOCIOLOGICAL SOCIOLOGIST 4
	S+Z	SUFFICE SACRIFICE 2
	TY	MEDICI 1
	Y	CRUSTACEAN OCEAN CRETACEOUS 101
CB	KB	MACBETH 1
CC	K	MECCA IMPECCABLE MOCCASIN 47
	KS	ACCEDE ACCELERATE ACCELERATOR 22
CCH	K	BACCHUS 1
CCL	KL	ACCLAIM ACCLAMATION ECCLESIASTIC 4
CCR	KR	ACCREDIT ACCRUE 2
CD	KD	ANECDOTE 1
CH	K	NEBUCHADNEZZAR MICHAEL MICHAELMAS 30
	K+X	LOCHINVAR 1
	TY	IRREPROACHABLE UNAPPROACHABLE RICHARD 14
	Y	CACHE RICHELIEU MICHIGAN 8
CHL	KL	HYDROCHLORIC 1
CHM	TYM	COACHMAN RICHMOND 2

CFN	KN	TECFNIC TECFNICAL TECFNICALITY	7
CFS	TYS	VOUCHSAFE	1
CFST	KST	REICHSTAG	1
CK	K	COCKADE BLOCKADE STOCKADE	79
CKB	KB	BLACKBERRY BLACKBIRD BLACKBOARD	4
CKCL	KKL	SACKCLOTH	1
CKD	KD	JACKDAW	1
CKG	G	BLACKGUARD	1
CKGR	KGR	BACKGROUND	1
CKF	KF	BLOCKHEAD BLOCKHOUSE	2
CKL	KL	NECKLACE SUCKLING TICKLISH	3
CKM	KM	BLACKMAIL	1
CKN	KN	NICKNAME HACKNEY	2
CKP	KP	COCKPIT PICKPOCKET	2
CKR	KR	COCKROACH	1
CKS	KS	QUICKSAND JACKSON	2
CKSB	KSB	FREDERICKSBURG VICKSBURG	2
CKSK	KSK	BUCKSKIN	1
CKSM	KSM	BLACKSMITH	1
CKT	KT	COCKTAIL NECKTIE STOCKTON	3
CKY	K	DOCKYARD	1
CKW	KW	BACKWARD BACKWOODSMAN CLOCKWORK	3
CKWH	KHW	BUCKWHEAT	1
CL	KL	DECLAIM RECLAIM PROCLAIM	26
CM	KM	ACME	1
CN	KN	PICNIC	1
CQ	KW	ACQUAINT ACQUAINTANCE ACQUIESCE	7
CR	K+KR	SECRETARY	1
	KR	DEMOCRACY TECHNOCRACY ARISTOCRACY	47
CS	KS	FROLICSOME	1
	S	TUCSON	1
CST	KST	ECSTASY ECSTATIC	2
CT	KT	RESPECTABILITY TRACTABLE DELECTABLE	123
	KTY	ACTUAL CONTRACTUAL EFFECTUAL	20
	KY	ACTION REACTION FACTION	85
	T	CONNECTICUT VICTUAL	2
CTM	KTM	SELECTMAN	1
CTR	KTR	SPECTRAL ELECTRIC DIELECTRIC	14
D	D	CICADA ARMADA CANADA	714
	DW	BOUDOIR	1
	DS	GRADUAL INDIVIDUAL INDIVIDUALISM	22
DB	DB	THREADBARE WOODBINE TIDBIT	4
DBR	DBR	REDBREAST BROADBRIM	2
DC	DK	BROADCAST WOODCOCK WOODCUT	3
DCH	DTY	WOODCHUCK	1
DCL	DKL	BROADCLOTH	1
DCR	DKR	WOODCRAFT	1
DD	D	RIDDANCE GLADDEN MADDEN	53
	DD	MIDDAY	1
DDH	D	BUDDHA BUDDHIST	2
DF	DF	STEADFAST CODFISH BRADFORD	4
DG	DG	EDGAR HEADGEAR	2

	D5	BADGE EDGE HEDGE	45
DH	DH	GODHEAD ADHERE ADHERENCE	7
DJ	D5	ADJACENT ADJECTIVE ADJOIN	9
DL	DL	BEDLAM HEADLAND MIDLAND	15
DM	DM	HEADMAN MADMAN GOODMAN	20
DN	DN	EDNA KIDNAP ARIADNE	8
	N	WEDNESDAY	1
DP	DP	TADPOLE	1
DR	DR	HYDRA BEDRAGGLE CATHEDRAL	22
DS	DS	BROADSIDE BEDSIDE HUDSON	3
DSH	DY	MIDSHIPMAN BLOODSHOT	2
DSK	DSK	REDSKIN	1
DSM	DZM	WOODSMAN BACKWOODSMAN	2
DSPR	DSPR	BEDSPREAD	1
DST	DST	ROADSTEAD BEDSTEAD GLADSTONE	5
DSTR	DSTR	HEADSTRONG	1
DT	DT	BEDTIME	1
DTH	DG	BLOODTHIRSTY	1
DV	DV	ADVANCE ADVANTAGE DISADVANTAGE	17
DW	DW	EDWARD HEADWAY ROADWAY	10
F	F	SOFA DEFACE PALEFACE	222
FF	F	AFFABILITY AFFABLE INEFFABLE	102
FFB	FB	SNUFFBOX	1
FFH	FH	OFFHAND	1
FFL	FL	AFFLICT AFFLICTION AFFLUENCE	4
FFR	FR	SUFFRAGE AFFRAY GEOFFREY	6
FFSH	FY	OFFSHOOT	1
FFSPR	FSPR	OFFSPRING	1
FL	FL	CAMOUFLAGE SNOWFLAKE AFLAME	13
FR	FR	REFRACTION REFRACTIVE REFRACTORY	19
FST	FST	BEEFSTEAK	1
FT	F	SOFTEN	1
	F+FT	OFTEN	1
	FT	CHIEFTAIN FIFTEEN FIFTEENTH	12
FTR	FTR	ROOFTREE	1
FTSM	FTSM	CRAFTSMAN DRAFTSMAN	2
FTW	FTW	DRIFTWOOD	1
G	D5	AGE CABBAGE GARBAGE	293
	G	SAGA VEGA CHATTANOOGA	221
	G+D5	INTELLIGENTSIA	1
	GW	NICARAGUA PARAGUAY URUGUAY	3
	5	CAMOUFLAGE MIRAGE MASSAGE	9
	5+D5	MENAGERIE	1
GB	GB	BUGBEAR RUGBY	2
GL	GD	MAGDEBURG OGDEN	2
GG	D5	EXAGGERATE EXAGGERATION MAGGIORE	3
	D5+GD5	SUGGEST SUGGESTION SUGGESTIVE	3
	G	BAGGAGE LUGGAGE TOBOGGAN	33
GGPL	GPL	EGGPLANT	1
GGR	GR	AGGRAVATE AGGREGATE AGGREGATION	7
GGSH	GY	EGGSHELL	1
GH	-	THROUGHOUT	1

	F	LAUGHABLE ROUGHEN LAUGHINGSTOCK 3
	G	ALLEGHANY AGHAST SPAGHETTI 3
GHB	B	NEIGHBOR NEIGHBORHOOD NEIGHBORING 4
GHF	F	THOROUGHFARE 1
GHG	G	THOROUGHGOING 1
GHK	K	POUGHKEEPSIE 1
GHL	L	HIGHLAND 1
GHR	R	HIGHROAD 1
GHSH	Y	PLOUGHSHARE 1
GHT	T	EIGHTEEN STRAIGHTEN HEIGHTEN 16
	TY	RIGHTEOUS UNRIGHTEOUS 2
GHTC	TK	NIGHTCAP 1
GHTF	TF	NIGHTFALL STRAIGHTFORWARD 2
GHTG	TG	NIGHTGOWN 1
GHTH	TH	KNIGHTHOOD LIGHTHOUSE 2
GHTM	TM	NIGHTMARE 1
GHTN	TN	LIGHTNING 1
GHTT	TT	NIGHTTIME 1
GHTW	TW	STRAIGHTWAY LIGHTWEIGHT 2
GHW	W	HIGHWAY 1
GL	GL	EGLANTINE NEGLECT NEGLIGEE 8
GM	GM	ENIGMA STIGMA DOGMA 9
GN	GN	IMPREGNABLE PUGNACIOUS SIGNAL 59
	N	BOLOGNA COGNAC POIGNANCY 13
	N+GN	COGNIZANCE PHYSIOGNOMY 2
GNB	NB	SIGNBOARD 1
GNT	NT	SOVEREIGNTY 1
GP	CP	MAGPIE BAGPIPE 2
GR	GR	PETROGRAD DEGRADATION DEGRADE 69
GSB	GZB	AUGSBURG 1
GSH	GY	FLAGSHIP 1
GSK	GSK	PIGSKIN 1
GST	GST	FLAGSTAFF FLAGSTONE 2
GT	GT	PIGTAIL 1
GZ	GZ	ZIGZAG 1
GY	G	MAGYAR 1
GW	GW	WIGWAG WIGWAM DOGWOOD 3
H	-	GRAHAM PROHIBITION ANNIHILATE 4
	H	AHA OMAHA CALAHAD 68
	H+-	REHABILITATE REHABILITATION SAHIB 5
HL	L	DAHLIA 1
HNS	NS	JOHNSON 1
HNST	NST	JOHNSTON 1
HR	R	FAHRENHEIT 1
J	D5	ELIJAH PAJAMA TROJAN 17
K	K	TOPEKA UNSPEAKABLE UNMISTAKABLE 160
KB	KB	CHEEKBONE 1
KC	KK	BOOKCASE 1
KD	KD	BREAKDOWN 1
KF	KF	BREAKFAST 1
KL	KL	OKLAHOMA OAKLAND WEAKLING 3
KN	N	FOREKNOWLEDGE 1

KW	KW	AWKWARD 1
L	L	GALA VENEZUELA PARABOLA 1184
LB	LB	ALBAN ALBANY WHEELBARROW 19
LC	K+LK	FALCON 1
	LK	CAVALCADE ALCALDE VULCAN 20
	LS	ALCESTIS CALCITE RECALCITRANT 4
LCH	LK	ALCHEMIST COLCHIS 2
LCHR	LKR	SEPULCHRAL 1
LCL	LKL	OILCLOTH 1
LD	D	COULDN'T SHOULDN'T WOULDN'T 3
	LD	MOLDAVIA MOLDAVIAN ALCALDE 23
	LDS	SOLDIERY 1
LDB	LDB	CHILDBIRTH 1
LDC	LK+LDK	WILDCAT 1
LDF	LDF	COLDFINCH WILDFIRE GOLDFISH 3
LDH	LDH	CHILDHOOD 1
LDL	LDL	CHILDLIKE 1
LDR	LDR	GRANDCHILDREN CALDRON CAULDRON 3
LDSM	LDSM	GOLDSMITH 1
LDSP	LSP+LDSP	FELDSPAR 1
LDW	LD+LDW	BALDWIN 1
LF	LF	ALFALFA CLFACTORY ALFALFA 10
	LF+LV	WOLFISH 1
LFR	LFR	PALFREY BELFRY 2
LFS	LFS	SELFSAME 1
LFW	FW	HALFWAY 1
LG	LDS	ALGAE BULGE INDULGE 13
	LG	VOLGA AMALGAMATE TRAFALGAR 10
LGR	LGR	PILGRIM PILGRIMAGE 2
LH	L	PELHAM 1
	LH	VALHALLA FOOLHARDY SCHOOLHOUSE 3
LK	K	TALKATIVE TALKIE 2
	K+LK	POLKA 1
	LK	ALKALI ALKALINE ALKALOID 9
LKH	LKH	BULKHEAD 1
LKL	KL	FOLKLORE 1
	KL+LKL	HALKLAND 1
LKM	LKM	MILKMAID MILKMAN 2
LKW	LKW	SILKWORM 1
LL	L	VALHALLA ELLA ARABELLA 269
	L+LL	ILLEGAL ILLEGITIMATE ILLICIT 7
LLB	LB	BILLBOARD SPELLBOUND 2
LLD	LD	BULLDOG 1
LLF	LF	SHELLFISH 1
LLFR	LFR	BULLFROG 1
LLM	LM	PULLMAN FILLMORE 2
LLP	LP	SMALLPOX 1
LLR	LR	BALLROOM 1
LLS	LS	HILLSIDE 1
LLST	LST	MILLSTONE 1
LLT	LT	TELLTALE 1
LLW	LW	HALLWAY SPILLWAY 2

LM	LM	ALMA PATRCLMAN MUSSULMAN 12
	M	PSALMIST SALMON ALMOND 5
LMSH	MZH	ALMSHOUSE 1
LMSM	LMZM	HELMSMAN 1
LN	LN	VULNERABLE INVULNERABLE WALNUT 3
LNSH	NY	LINCOLNSHIRE 1
LP	LP	PALPABLE CULPABLE MANTELPIECE 7
LPH	LF	ALPHA ALPHABET ALPHABETICAL 11
LPR	LPR	CULPRIT 1
LPT	LPT	SCULPTOR 1
	LPTY	SCULPTURE 1
LR	LR	ALREADY RAILROAD SCHOOLROOM 12
LS	LS	ELSA BALSAM FALSE 18
	LY	EMULSION REPULSION COMPULSION 6
	LZ	PALSY 1
LSH	LY	BOLSHEVIK BOLSHEVISM 2
LSHM	LYM+LTYM	WELSHMAN 1
LSK	LSK	OILSKIN 1
LSP	LSP	FELSPAR 1
LSS	LS	MENDELSSOHN 1
LST	LST	FALSTAFF VOLSTEAD HOLSTEIN 5
LT	LT	MALTA DELTA VOLTAIRE 58
	LTY	TUMULTUOUS CULTURAL AGRICULTURAL 6
LTH	LG	MALTHUS HEALTHY UNHEALTHY 5
LTR	LTR	ULTRA ULTRAVIOLET ALTRUISTIC 5
LV	LV	ALVA SALVAGE SYLVAN 30
	V	CALVE HALVE 2
LW	LW	BULWARK STALWART MILWAUKEE 4
M	M	ALABAMA YOKOHAMA PAJAMA 737
	M+MP	SOMETHING 1
	MW	SOMEONE MEMOIR 2
MB	MB	CYMBAL TIMBALE EMBALM 75
MBB	MB	DUMBBELL 1
MBK	MK	LAMBKIN 1
MBL	MBL	ASSEMBLAGE SEMBLANCE RESEMBLANCE 5
MBR	MBR	EMBRACE REMEMBRANCE REMBRANDT 19
MBST	MST	TOMBSTONE 1
MC	MC	CAMDEN 1
MCR	MCR	HUMCRUM 1
MF	MF	CIRCUMFERENCE DISCOMFIT DISCOMFITURE 8
MH	MH	CUSTOMHOUSE 1
ML	ML	DREAMLAND HAMLET HEMLOCK 3
MM	M	EMMA DILEMMA COMMA 101
	M+MM	IMMEASURABLE IMMEMORIAL IMMOBILITY 6
	MM	ROOMMATE 1
MMS	MS+MZ	MONMSEN 1
MN	M+MN	COLUMNIST 1
	MN	DAMNABLE ALTUMNAL REMNANT 19
MP	MP	TAMPA CHAMPAGNE CAMPAIGN 157
MPB	M+MB	CAMPBELL 1
MPBL	MPBL	LAMPBLACK 1
MPC	MC+MPC	HAMPDEN 1

MPF	MF	EMPHASIS EMPHASIZE EMPHATIC 8
	MF+MPF	TRIUMPHAL TRIUMPHANT CAMPHOR 3
MPHL	MFL+MPFL	PAMPHLET 1
MPK	OK+MPK	PUMPKIN 1
MPL	MP	SIMPLETON 1
	MPL	IMPLACABLE COMPLACENCY COMPLACENT 33
MPR	MP+MPR	IMPROPRIETY 1
	MPR	IMPRACTICABLE IMPRACTICAL IMPRECATION 20
MPS	MPS	GLIMPSE SAMPSON 2
	MS+MPS	THOMPSON 1
MPSH	MPY	HAMPSHIRE 1
MPT	MPT	TEMPTATION CONTEMPTIBLE SYMPTOM 7
	MPTY	CONTEMPTUOUS SUMPTUOUS PRESUMPTUOUS 3
	MPY	REDEMPTION EXEMPTION RESUMPTION 6
MR	MR	COMRADE RAMROD PRIMROSE 3
MS	MS	HIMSELF SAMSON 2
	MS+MPS	THOMSON 1
	MZ	DAMSEL WHIMSICAL CRIMSON 5
MSB	MZB	WILLIAMSBURG 1
MSCR	MSKR	CIRCUMSCRIBE 1
MSH	MY	STEAMSHIP 1
MSP	MSP	CIRCUMSPECT CIRCUMSPECTION 2
MST	MST	CIRCUMSTANCE CIRCUMSTANTIAL AMSTERDAM
MT	NT	COMTE 1
MV	MV	CIRCUMVENT 1
Mh	Mh	CROMWELL TEAMWORK 2
N	N	INDIANA DANA DIANA 1289
NB	NB	GREENBACK DUNBAR MOONBEAM 22
NBR	NBR	UNBRIDLE UNBROKEN 2
NC	K	POINCARE 1
	NK	INCALCULABLE ENCAMP INCANDESCENT 59
	NS	DISTURBANCE SIGNIFICANCE DANCE 346
	NS+NY	ENUNCIATE ENUNCIATION DENUNCIATION 4
	NS+NZ	QUINCY 1
	NTY	CONCERTO FRANCESCA 2
	NY	FINANCIAL PROVINCIAL ANCIENT 4
	OK	DUNCAN LANCASHIRE LINCOLN 5
	OK+NK	SALAMANCA PANCAKE INCOME 7
NCH	NTY	UNQUENCHABLE UNCHANGEABLE ENCHANT 15
	NY+NTY	STANCHION 1
	OK	ANCHOR ANCHORAGE 2
	OK+NK	BRONCHITIS 1
NCHB	NTYB	HUNCHBACK 1
NCHM	NTYM	RANCHMAN FENCHMAN FRENCHMAN 3
NCHR	OKR+NKR	SYNCHRONIZE 1
NCL	NKL	IRONCLAD UNCLASP NOMENCLATURE 15
	OKL+NKL	CONCLAVE 1
NCR	NKR	INCREDIBLE INCREDULITY INCREDULOUS 5
	OKR+NKR	IDIOSYNCRASY PANCREAS 2
NCT	OKT	SANCTIFY PUNCTILIOUS SANCTITY 7
	OKTY	PUNCTUAL SANCTUARY PUNCTUATE 7
	OKY	SANCTION DISTINCTION EXTINCTION 11

NC	MC+NC	PERPENDICULAR	1
	NC	PROPAGANDA VERANDA ROUNDABOUT	289
	NC5	GRANDEUR GLANDULAR	2
NCB	NB+NDB	HANDBAG LINDBERGH HANDBOOK	3
NCC	NK+NCK	HANDCUFF	1
NCCH	NTY+NCTY	GRANDCHILDREN	1
	TY+NCTY	GRANDCHILD	1
NCF	NF+NCF	WINDFALL BLINDFOLD	2
NCH	NC	GANCHI	1
	NCH	ROUNDHEAD	1
	NCH+NTH	SECONDHAND	1
NCK	OK	HANDKERCHIEF	1
NCL	NCL	KINCLING	1
	NL+NCL	LANCLADY LANCLORD	2
NCM	NCM	BONDMAN	1
	NM+NCM	HANDMADE HANDMAID HANDMAIDEN	7
NCP	NP+NCP	GRANDPARENT WINDPIPE STANDPOINT	3
NCR	NCR	PENDRAGON HINDRANCE ANDREAS	13
NCS	NS	HANDSOME UNHANDSOME	2
	NS+NCS	GRANDSIRE GRANDSON	2
	NZ	WINDSOR	1
NCSC	NSK+NCSK	LANDSCAPE	1
NCSH	NY+NCY	WINDSHIELD FRIENDSHIP	2
NCST	NCST	SANDSTONE	1
	NST+NCST	STANDSTILL GRINDSTONE	2
NCTHR	NGR+NCGR	SPENDTHRIFT	1
NCW	NCW	LANDWARD WINDWARD SANDWICH	3
NCWR	NCR	HANDWRITING	1
NF	NF	UNFAILING UNFAIR RAINFALL	80
NFL	NFL	CONFLAGRATION INFLAME INFLAMMABLE	16
NFR	NFR	ENFRANCHISE INFREQUENT UNFREQUENT	5
NG	NC5	CHANGE EXCHANGE FLANGE	62
	NG	ENGAGE DISENGAGE HUNGARY	6
	N5	LINGERIE	1
	G	HANGING HARANGUE MERINGUE	6
	G+NC5	STINGY	1
	G+QG	SINGAPORE	1
	GG	BUNGALOW HUNGARIAN KANGAROO	43
	GG+NC5	DINGY	1
	GG+NG	BENGAL MONGOLIAN	2
	GGW	LANGUAGE LANGUID SANGUINARY	11
	GGW+NGW	PENGUIN	1
NGB	GB	KINGBIRD HUMMINGBIRD	2
NGC	GC	KINGDOM HUNTINGDON DINGDONG	3
NGF	GF	LONGFELLOW SPRINGFIELD	2
NGH	GH	DUNGHILL GINGHAM BUCKINGHAM	6
	G	GINGHAM	1
NGL	NGL	SHANGLAI INGLORIOUS	1
	GGL	ENGLAND ANGLICAN ANGLING	7
	GL	LANGLAND RINGLET	2
NGM	GM	HANGMAN WORKINGMAN	2
NGPL	GPL	GANGPLANK	1

NGR	NGR	UNGRACIOUS INGRATIATE INGRATITUDE 8
	GGR	CONGREGATE CONGREGATION CONGREGATIONAL
	GGR+NGR	INCONGRUITY 1
NGS	GS	ALONGSIDE SINGSONG LONGSUFFERING 3
NGSH	GY	KINGSHIP 1
NGST	GST	TUNGSTEN LAUGHINGSTOCK STEPPINGSTONE 3
NGT	GT	SPRINGTIME WASHINGTON WELLINGTON 10
NGTH	GG+GKG	LENGTHEN STRENGTHEN LENGTHY 3
NGTHW	GGW+GKGW	LENGTHWISE 1
NGW	GW	GANGWAY 1
NH	N+NH	INHIBITION 1
	NH	INHABIT INHABITANT INHALE 24
NJ	ND5	PUNJAB BENJAMIN INJECT 19
NK	NK	UNKEMPT MANKIND WOMANKIND 5
	GK	UNTHINKABLE SHRINKAGE TANKARD 24
NKF	GKF	FRANKFORT 1
NKL	GKL	FRANKLIN INKLING 2
NKN	NN	UNKNOWN 1
NKR	GKR	BANKRUPT BANKRUPTCY 2
NKSG	GKSG	THANKSGIVING 1
NL	NL	UNLACE INLAID GREENLAND 21
NM	NM	GUNMAN UNMANAGEABLE DENMARK 10
NN	N	ANNA BANDANNA SUSQUEHANNA 115
	N+NN	INNATE INNUMERABLE 2
	NN	UNNATURAL UNNECESSARY UNNERVE 3
NNS	NS	PENNSYLVANIA 1
NP	MP+NP	DAVENPORT 1
	NP	UNPACK UNPAID UNPOPULAR 4
NPL	NPL	COMMONPLACE UNPLEASANT 2
NPR	NPR	UNPRODUCTIVE UNPROFITABLE 2
NQ	NKW	UNQUENCHABLE INQUEST UNQUESTIONABLE 9
	GK	UNCONQUERABLE 1
	GK+GKW	ALGONQUIN 1
	GKW	DELINQUENCY DELINQUENT RELINQUISH 3
	GKW+NKW	CONQUEST BANQUET TRANQUIL 5
NR	NR	CONRAD ENRAGE ENRAPTURE 24
NS	NS	INDISPENSABLE RANSACK UNSAFE 173
	NS+NY	COMMENSURATE 1
	NS+NZ	TRANSACT TRANSACTION KANSAS 7
	NY	TRANSIENT MANSION EXPANSION 19
	NZ	CLEANSE KENSINGTON PANSY 3
	S	MONSIEUR 1
NSC	NS	TRANSCEND TRANSCENDENT 2
	NS+NY	CONSCIENTIOUS 1
	NSK	ENSCONCE TRANSCONTINENTAL WAINSCOT 3
	NY	CONSCIENCE CONSCIOUS SUBCONSCIOUS 4
NSCR	NSKR	TRANSCRIBE INSCRIBE TRANSCRIPT 7
NSF	NSF	TRANSFERENCE TRANSFIGURE TRANSFIX 6
	NSF+NZF	MANSFIELD 1
	NZF	KINSFOLK 1
NSGR	NSGR+NZGR	TRANSGRESSION 1
NSH	NY	UNSHAKEN UNSHEATHE MOONSHINE 14

NSHR	NYR	ENSHRINE	1
NSL	NSL	CNSLAUGHT ENSLAVE	2
	NSL+NZL	TRANSLATE TRANSLATICN TRANSLUCENT	3
	NZL	QUEENSLAND	1
NSM	NSM+NZM	TRANSMISSICN TRANSMIT TRANSMUTE	3
	NZM	KINSMAN	1
NSN	NSN	ENSNARE	1
NSP	NSP	TRANSPARENCY TRANSPARENT UNSPEAKABLE	18
	NZP	TOWNSPEOPLE	1
NSPL	NSPL	TRANSPLANT	1
NST	NST	INSTABILITY CONSTABLE UNSTABLE	34
	NZT	PAINSTAKING	1
NSTR	NSTR	CONSTRAIN CONSTRAINT REMONSTRANCE	23
NSV	NSV+NZV	TRANSVERSE	1
NSW	NS	ANSWERABLE UNANSWERABLE	2
	NSW	GREENSWARD	1
	NZ+NZW	BRUNSWICK	1
NT	MT+NT	TURPENTINE	1
	NT	ATLANTA LAMENTABLE PRESENTABLE	382
	NTW	ANTOINETTE	1
	NTY	EVENTUAL ACCENTUATE INDENTURE	10
	NY	SUBSTANTIAL CIRCUMSTANTIAL CREDENTIAL	35
	NY+NTY	PENITENTIARY	1
NTG	NTG	MONTGOMERY	1
NTH	NG	ANTHEM CHRYSANTHEMUM SYNTHESIS	11
	NG+NT	ANTHONY	1
	NTH	ANTHILL PENTHOUSE	2
NTHR	NGR	ANTHRACITE ENTHRONE WINTHROP	8
NTL	NT	GENTLEFOLK GENTLEMAN GENTLEWOMAN	3
	NTL	GAUNTLET	1
NTR	NTR	CONTRABAND CONTRACTION CONTRACTUAL	59
NTS	NTS	INTELLIGENTSIA	1
NTSM	NTSM	HUNTSMAN	1
NTW	NTW	ANTWERP ENTWINE	2
NV	NV	INVADE INVALUABLE LOCHINVAR	45
NX	CY+CKY	ANXIOUS	1
	CZ+CGZ	ANXIETY	1
NZ	NZ	STANZA INFLUENZA PENZANCE	6
NY	N	UNYIELDING CANYON KENYON	3
NW	MW+NW	HEAVENWARD	1
	N	GUNWALE GREENWICH	2
	NW	INWARD ONWARD COWNWARD	15
NWH	NH	UNWHOLESOME	1
	NHW	MEANWHILE	1
NWR	NR	UNWRAP UNWRITTEN	2
P	P	EUROPA PUPA CAPABILITY	416
PB	B	CUPBOARD	1
	PB	SHIPBOARD SCRAPBOOK UPBUILD	3
PBR	PBR	UPBRAID	1
PC	PK	POPCORN	1
PH	F	RAPHAEL ELEPHANT CALIPHATE	51
	F+V	NEPHEW	1

	P	SHEPHERD 1
	PH	HAPHAZARD UPHELD UPHOLD 5
	V	STEPHEN STEPHENSON 2
PHN	FN	CAPHNE 1
PHR	FR	DIAPHRAGM EPHRAIM APHRODITE 3
PHTH	FG+PG	NAPHTHA DIPHTHERIA 2
PK	PK	NAPKIN 1
PL	P+PL	MULTIPLICATION 1
	PL	REPLACE FIREPLACE CHAPLAIN 34
PM	PM	CHAPMAN MIDSHIPMAN TOPMAST 6
PN	PN	SHRAPNEL HYPNOTIC HYPNOTIZE 3
PP	P	STOPPAGE FLIPPANT APPARATUS 63
PPH	F	SAPPHIRE 1
PPL	PL	SUPPLANT APPLAUD APPLAUSE 10
PPR	PR	APPRAISAL APPRAISE APPRECIABLE 29
PR	PR	UPRAISE SOPRANO DEPRAVITY 56
PS	PS	KNAPSACK TOPSAIL LAPSE 23
	PY	DYSPEPSIA 1
PSH	PY	SNAPSHOT UPSHOT 2
PSK	PSK	SHEEPSKIN 1
PST	PST	LIPSTICK 1
PSTR	PSTR	UPSTREAM 1
PT	PT	ADAPTABILITY ADAPTABLE ACCEPTABLE 36
	PTY	VOLUPTUOUS SCRIPTURAL CAPTURE 9
	PY	EGYPTIAN CAPTION DECEPTION 23
	PY+PTY	NUPTIAL 1
PTC	PS+PTS	BANKRUPTCY 1
PZ	PS	LEIPZIG 1
PY	P	SHIPYARD 1
PW	PW	UPWARD 1
PWR	PR	SHIPWRECK 1
Q	K	PIQUANT CRAGGLE OBLIQUE 16
	K+KW	HARLEQUIN 1
	KW	CHAUTAUQUA EQUABLE INADEQUACY 62
R	R	BARBARA NIAGARA SAHARA 1648
	RW	FAREWELL 1
	W	EVERYONE 1
RB	B+RB	CANTERBURY 1
	RB	IMPERTURBABLE QUARTERBACK HORRIBLE 70
RBR	RBR	GINGERBREAD UNDERBRUSH 2
RC	K+RK	CIRCUMFERENCE 1
	RK	CIRCA ARCADE ARCADIA 45
	RS	SCARCE FARCE FIERCE 38
	RY	COMMERCIAL COERCION 2
RCH	RK	ARCHAEOLOGICAL ARCHAIC PATRIARCHAL 18
	RTY	PERCHANCE MERCHANDISE INTERCHANGEABLE 12
RCHB	RTYB	ARCHBISHOP 1
RCHD	RTYD	ARCHDUKE 1
RCHL	RTYL	SEARCHLIGHT 1
RCHY	RTY	CHURCHYARD 1
RCHW	RTYW	ARCHWAY 1
RCL	RKL	CIRCLET THUNDERCLOUD 2

RCR	RKR	AIRCRAFT	1
RCT	RKT	ARCTIC ANTARCTIC	2
RC	RC	ORDAIN AMSTERDAM JORDAN	59
	RC5	ARDUOUS VERDURE	2
RCB	RCB	CARDBOARD	1
RCF	RCF	GUARDHOUSE	1
RCN	RCN	ORDNANCE	1
RCR	RCR	WARDROBE EARDRUM	2
RCS	RCS	RICHARDSON	1
RCSH	RCY	HARDSHIP LORDSHIP	2
RCSM	RCZM	GUARDSMAN HERDSMAN	2
RCSW	RCZW	WORDSWORTH	1
RCW	RCW	HARDWARE HARDWOOD	2
RF	RF	SURFACE WATERFALL WARFARE	29
RFL	RFL	SUPERFLUOUS	1
RFR	RFR	HOARFROST	1
RG	RC5	BARGE CHARGE OVERCHARGE	56
	RG	BARGAIN ORGAN MORGAN	44
	R5W	BOURGEOISIE	1
RGL	RGL	BURGLAR BURGLARY	2
RGR	RGR	UNDERGRADUATE EVERGREEN UNDERGROUND	5
RH	R	DURHAM	1
	RH	LETTERHEAD OVERHEAD OVERHEAR	6
RJ	RC5	OVERJOY PERJURE PERJURY	3
RK	RK	REMARKABLE BURKE BERKELEY	19
RKH	RK	MARKHAM	1
	RKH	WORKHOUSE	1
RKM	RKM	WORKMAN WORKMANSHIP WORKMEN	3
RKN	RKN	ORKNEY	1
RKR	RKR	SAUERKRAUT	1
RKS	RKS	IRKSOME	1
RKSH	RKY	BERKSHIRE YORKSHIRE WORKSHOP	3
RKSM	RKSM	MARKSMAN	1
RKSP	RKSP	LARKSPUR	1
RKT	RKT	YORKTOWN	1
RKWR	RKR	ARKWRIGHT	1
RL	RL	INTERLACE OVERLAID PARLANCE	53
RLD	RLD	EARLDOM	1
RLF	RLF	GIRLHOOD	1
RLP	RLP	WHIRLPOOL	1
RLW	RLW	WHIRLWIND	1
RM	M+RM	FURTHERMORE	1
	RM	BURMA PHARMACY ARMADA	122
RMCH	RMTY	ARMCHAIR	1
RMH	RMH	ARMHOLE FARMHOUSE	2
RMP	RMP	ARMPIT	1
RMST	RMST	FARMSTEAD	1
RMSTR	RMSTR	ARMSTRONG	1
RMY	RM	FARMYARD	1
RMW	RMW	WORMWOOD	1
RN	N+RN	PARAPHERNALIA	1
	RN	SMYRNA BARNABAS UNGOVERNABLE	88

RNBL	RNBL	HORNBLENDE 1
RNK	RNK	TURNKEY 1
RNL	RNL	CARNLEY 1
RNP	RNP	TURNPIKE 1
RNS	RNZ	GUERNSEY 1
RNST	RNST	CORNSTARCH 1
RNY	RN	BARNYARD 1
RNW	RNW	CORNWALL CORNWALLIS 2
RP	P+RP	CATERPILLAR 1
	RP	COUNTERPANE COUNTERPART USURPATION 32
RPH	RF	ORPHAN ORPHANAGE ORPHEUS 9
RPL	RPL	AIRPLANE PERPLEX PERPLEXITY 6
RPR	PR+RPR	ENTERPRISE SURPRISE 2
	RPR	INTERPRET INTERPRETATION FINGERPRINT 5
RPS	RPS	CORPSE HARPSICHORD 2
RPT	RPY	ABSORPTION 1
RQ	RK+RKW	TURQUOISE 1
RR	R	SIERRA TERRACE BARRACK 171
	R+RR	IRRATIONAL IRRECONCILABLE IRREGULAR 13
	RR	OVERRATE COUNTERREVOLUTION OVERRIDE 5
RRH	R	PYRRHUS 1
RS	RS	CORSAIR FORSAKE FORSAKEN 111
	RS+RZ	PERSIST PERSISTENCE PERSISTENT 3
	RSW	PERSUADE PERSUASION PERSUASIVE 4
	RY	IMMERSION 1
	RZ	JERSEY 1
	RS+RY	PERSIA PERSIAN ASPERSION 11
RSB	RZB	PETERSBURG 1
RSD	RZD	THURSDAY 1
RSH	RY	OVERSHADOW MARSHAL PERSHING 15
RSHM	RYM	MARSHMALLOW 1
RSK	RSK	BEARSKIN 1
RSL	RSL	PARSLEY 1
RSM	RZM	CARSMAN STEERSMAN 2
RSN	RSN	PARSNIP 1
RSP	RSP	PERSPECTIVE INTERSPERSE PERSPIRATION 4
RSPR	RSPR	OVERSPREAD 1
RST	RST	QUARTERSTAFF UNDERSTAND MISUNDERSTAND 14
RSTR	RSTR	SUPERSTRUCTURE 1
RSTWH	RSTW	ERSTWHILE 1
RT	RT	SPARTA COMFORTABLE UNCOMFORTABLE 150
	RTW	REPERTOIRE 1
	RTY	VIRTUAL VIRTUE PORTUGAL 16
	RY	INERTIA MARTIAL PARTIAL 23
RTBR	RTBR	HEARTBREAK 1
RTC	RTK	SHORTCAKE SHORTCOMING PORTCULLIS 3
RTF	RTF	HEARTFELT PORTFOLIO HARTFORD 3
RTG	RG	MORTGAGE 1
RTH	RG	BERTHA CARTHAGE CARTHAGINIAN 16
	RG+RX	SWARTHY 1
	RT	NEANDERTHAL 1
	RTH	SHORTHAND PORTHOLE COURTHOUSE 3

	RX	BURTHEN FURTHERMORE NORTHERN 11
RTHC	RGK	FORTHCOMING 1
RTHD	RGD	BIRTHDAY 1
RTHL	RGL	NORTHLAND 1
RTHM	RGM	NORTHMAN 1
RTHPL	RGPL	BIRTHPLACE 1
RTHQ	RGKW	EARTHQUAKE 1
RTHR	RGR	OVERTHREW BIRTHRIGHT OVERTHROWN 3
RTHST	RGST	HEARTHSTONE 1
RTHW	RGW	NORTHWARD NORTHWEST NORTHWESTERN 5
RTL	RTL	PORTLAND STARTLING 2
RTM	RTM	PORTMANTEAU DARTMOUTH 2
RTN	RTN	FORTNIGHT 1
RTR	RTR	PORTRAIT PORTRAITURE BERTRAND 8
RTS	RTS	HEARTSICK 1
RTSH	RTY	COURTSHIP 1
RTSM	RTSM	SPORTSMAN PORTSMOUTH 2
RTZ	RTS	QUARTZITE 1
RTY	RT	COURTYARD 1
RV	RV	LARVA MINERVA OBSERVABLE 65
	V+RV	SURVEYOR 1
RY	R	OCCRYARD 1
RW	RW	REARWARD HITHERWARD THITHERWARD 26
RWH	RHW	OVERWHELM 1
RWR	RR	OVERWROUGHT 1
S	S	MESA FORMOSA DISABILITY 249
	S+Y+5+Z	NAUSEATE 1
	S+Z	MIMOSA MEDUSA DISABLE 38
	Y	THEODOSIUS 1
	Z	PISA LOUISA ROSA 391
	Z5	DISCLOSURE 1
	5	AMBROSIA AMBROSIAL EPHESIAN 68
	5+Y	ASIA AUSTRALASIA EURASIA 10
	5+Z	ELYSIUM 1
SB	SB	DISBAND DISBELIEF DISBELIEVE 5
	ZB	HUSBAND HUSBANDMAN HUSBANDRY 8
SC	K	VISCOUNT 1
	S	ACQUIESCE MISCELLANEOUS MISCELLANY 35
	S+Z	DISCERN DISCERNIBLE 2
	SK	FRANCESCA CASCADE AMBUSCADE 53
	Y	LUSCICUS FASCISM 2
SCH	SK	MARASCHINO 1
	STY	MISCHANCE DISCHARGE ESCHEW 5
	Y	SENESCHAL 1
SCL	SKL	DISCLAIM DISCLOSE DISCLOSURE 3
SCR	SKR	MISCREANT DISCREDIT DISCREET 21
SC	SC	MISDEMEANOR JURISDICTION 2
	SC+ZC	DISCAIN 1
	ZC	WEDNESDAY TUESDAY DRESDEN 4
SF	SF	SATISFACTION DISSATISFACTION SATISFACTORY 9
SG	SG	MISGIVING DISGORGE MISGUIDE 4
	SG+SK+ZG	GLASGOW 1

	SG+ZG	ASGARD DISGUST 2
SGR	SGR	DISGRACE 1
SH	S+Y	GRESHAM 1
	S+Z	DISHONEST DISHONESTY DISHONOR 4
	SH	DISHEARTEN 1
	Y	ELISHA WASHABLE PUNISHABLE 36
	Y+YH	THRESHOLD 1
SHL	YL	FLASHLIGHT 1
SHM	YM	ISHMAEL FRESHMAN ENGLISHMAN 4
SHV	YV	NASHVILLE 1
SHW	YW	ENGLISHWOMAN BRUSHWOOD 2
SJ	SDZ	MISJUDGE 1
SK	SK	ALASKA NEBRASKA ALASKAN 15
SKR	SKR	MUSKRAT 1
SL	L	ISLAND ISLET 2
	SL	ASLANT LEGISLATE LEGISLATION 18
	SL+ZL	MOSLEM 1
	ZL	WELLESLEY MUSLIN 2
SM	SM	SPOKESMAN STATESMAN STATESMANSHIP 6
	SM+ZM	TALISMAN DISMAY OSMOSIS 3
	ZM	PLASMA BRIDESMAID DISMAL 16
SN	ZN	BOSNIA 1
SP	SP	DESPAIR DISPARAGE ASPARAGUS 91
SPB	ZB	RASPBERRY 1
SPH	SF	ASPHALT PHOSPHATE BLASPHEME 10
SPL	SPL	DISPLACE DISPLAY MISPLAY 6
SPR	SPR	DISPRAISE WIDESPREAD OSPREY 7
SQ	SK	CASQUE MASQUE BURLESQUE 10
	SKW	DISQUALIFY SUSQUEHANNA DISQUIET 5
SR	SR	DISREGARD MISREPRESENTATION DISREPUTABLE 6
	ZR	ISRAEL DISRAELI ISRAELITE 4
SS	S	IMPASSABLE COSSACK AMBASSADOR 156
	S+SS	DISSATISFACTION DISSATISFY DISSIMILAR 3
	S+Z	HUSSY 1
	SW	DISSUADE ASSUAGE 2
	Y	RUSSIA PRUSSIA HESSIAN 58
	Z	HUSSAR DESSERT POSSESSION 7
SSB	SB	CROSSBAR CROSSBOW 2
SSC	SK	CROSSCUT 1
SSH	SY+YY	MISSHAPE MISSHAPEN 2
SSL	SL	BUSINESSLIKE 1
SSM	SM	BUSINESSMAN CONGRESSMAN CLASSMATE 3
SSP	SP	CROSSPIECE PASSPORT 2
SSR	SR	CLASSROOM 1
SSW	SW	GLASSWARE CROSSWORD 2
ST	S	FASTEN UNFASTEN HASTEN 25
	S+ST	PASTEBOARD PESTLE 2
	ST	SHASTA VISTA AUGUSTA 292
	ST+STY	PASTEURIZE 1
	STY	CELESTIAL SEBASTIAN CHRISTIAN 26
	ZT	CHARLESTON JAMESTOWN 2
STF	STF	CRESTFALLEN 1

STF	SC	ESTHETIC AESTHETIC ANAESTHETIC	4
	STH	MASTHEAD PRIESTHOOD	2
	STY	POSTHUMOUS	1
STHM	SM	ISTHMUS	1
	SM+ZM	ASTHMA	1
STL	STL	WAISTLINE	1
STM	SM	CHRISTMAS	1
	STM	POSTMAN	1
STN	SN	CHESTNUT	1
STP	SP+STP	POSTPONE	1
STPL	SPL+STPL	BREASTPLATE	1
STR	STR	ORCHESTRA DISTRACT DISTRACTION	71
STSCR	SSKR+STSKR	POSTSCRIPT	1
STW	STW	EASTWARD WESTWARD BREASTWORK	4
SV	SV	LOUISVILLE	1
SW	ZW	BOSWELL	1
T	T	DATA SONATA STRATA 1546	
	TY	PERPETUAL HABITUAL RITUAL	52
	Y	GALATIA CROATIA MILITIA	530
	S+Y	EQUATION	1
TB	DB+TB	TIBIT	1
	TB	BASKETBALL FOOTBALL CATBIRD	6
TBR	TBR	SWEETBREAD	1
TC	TK	SUITCASE OUTCAST OUTCOME	3
TCH	TY	SATCHEL MITCHELL GRETCHEN	9
TCHB	TYB	SWITCHBOARD	1
TCHCR	TYKR	WITCHCRAFT	1
TCHD	TYD	WATCHDOG	1
TCHF	TYF	PITCHFORK	1
TCHM	TYM	WATCHMAN SCOTCHMAN OUTCHMAN	3
TCHW	TYW	WATCHWORD PATCHWORK	2
TD	TD	OUTDO OUTDONE OUTDOOR	3
TF	TF	PITFALL FOOTFALL CATFISH	6
TG	TG	OUTGOING SHOTGUN	2
TGR	TGR	OUTGREW OUTGROW OUTGROWTH	3
TH	G	AGATHA HIAWATHA ITHACA	80
	G+GH	SOUTHAMPTON	1
	G+X	WITHAL WITHIN WITHOUT	4
	T	CHATHAM	1
	T+TH	BEETHOVEN	1
	TH	SWEETHEART FOOTHILL FOOTHOLD	6
	X	THEREWITHAL WHEREWITHAL BATHE	35
THBR	GBR	TOOTHBRUSH	1
THD	GD	SOUTHDOWN	1
THDR	GDR+XDR	WITHDRAW WITHDRAWAL WITHDRAWN	4
THH	GH+XH	WITHHELD WITHHOLD	2
THL	GL	SOUTHLAND ATHLETE ATHLETIC	4
THM	XM	RHYTHMIC RHYTHMICAL	2
THP	GP	TOOTHPICK MOUTHPIECE	2
THR	GR	OETHRONE BATHROOM	2
	XR	BRETHREN	1
THS	XS	LOATHSOME	1

THST	GST+XST	WITHSTAND NOTWITHSTANDING WITHSTOOD	3
THW	GW	SOUTHWARD ATHWART PATHWAY	5
TL	TL	SHETLAND SCOTLAND OUTLANDISH	19
TM	TM	WHITMAN FOOTMAN OATMEAL	8
TN	TN	PUTNAM WHITNEY CATNIP	4
TP	TP	FOOTPATH OUTPOST OUTPUT	3
TPR	TPR	FOOTPRINT	1
TR	TR	CLEOPATRA IMPENETRABLE RETRACE	90
TS	TS	ITSELF OUTSIDE WATSON	4
TSB	TSB	SPITSBERGEN	1
TSH	TY	NUTSHELL OUTSHINE OUTSHONE	3
TSK	TSK	CATSKILL	1
TSP	TSP	OUTSPOKEN	1
TST	TST	OUTSTANDING FOOTSTEP WHETSTONE	4
TSTR	TSTR	OUTSTRETCH OUTSTRIP	2
TT	T	MARIETTA HENRIETTA CALCUTTA	151
TTH	G	MATTHEW	1
TTL	T	BATTLESHIP RATTLESNAKE	2
TTR	TR	ATTRACT ATTRACTION ATTRACTIVE	5
TZ	TS	SWITZERLAND	1
TZG	TSDS	FITZGERALD	1
TW	TW	OUTWARD BETWEEN OUTWEIGH	9
V	V	JAVA LAVA EVA	748
X	GZ	EXACT EXACTION EXACTITUDE	29
	GZ+KS	EXIT EXUDE EXULTATION	3
	GS	LUXURIANT	1
	GS+KY	LUXURIOUS LUXURY	2
	KS	HEXAGON TEXAN TEXAS	60
	KY	CRUCIFIXION NOXIOUS OBNOXIOUS	4
XC	KS	EXCEL EXCELLENCE EXCELLENCY	11
	KSK	EXCALIBUR EXCAVATE EXCAVATION	9
XCH	KSTY	EXCHANGE	1
XCL	KSKL	EXCLAIM EXCLAMATION EXCLAVE	5
XCR	KSKP	EXCRETION	1
XF	KSF	OXFORD	1
XGL	KSGL	FOXGLOVE	1
XH	GZ	EXHAUST INEXHAUSTIBLE EXHAUSTION	8
	GZ+KS	EXHALATION EXHORTATION	2
	KS	EXHIBITION	1
XL	KSL	HUXLEY	1
XP	KSP	EXPAND EXPANSE EXPANSION	34
XPL	KSPL	EXPLAIN EXPLANATION EXPLANATORY	10
XPR	KSPR	INEXPRESSIBLE EXPRESSION EXPRESSIVE	3
XT	KST	JUXTAPOSITION SIXTEEN SIXTEENTH	22
	KSTY	TEXTUAL TEXTURE FIXTURE	5
XTB	KSTB	TEXTBOOK	1
XTR	KSTR	EXTRA EXTRADITION EXTRAVAGANCE	8
XV	KSV	KNOXVILLE	1
Z	S+Z	CITIZEN CITIZENSHIP	2
	TS	NAZI	1
	Z	PLAZA ELIZA BAZAAR	153
	ZW	VENEZUELA VENEZUELAN	2

	5	AZURE SEIZURE	2
ZT	ZT	AZTEC	1
ZV	V	RENDEZVOUS	1
ZZ	Z	PIAZZA HUZZA NEBUCHADNEZZAR	16
Y	J	VINEYARD GRAVEYARD	2
W	W	OTTAWA IOWA BEWAIL	66
	W+-	FROWARD	1
WH	HW	SOMEWHAT SOMEWHERE ELSEWHERE	
WR	R	PLAYWRIGHT REWRITE TYPEWRITTEN	3

'D-	D	HE'D SHE'D WE'D 6
'LL-	L	HE'LL SHE'LL WE'LL 6
'M-	M	I'M 1
B-	B	CAB TAXICAB SCAB 57
	B+P	JACOB 1
BB-	B	EBB 1
BT-	T	DEBT DOUBT REDOUBT 3
C-	K	ISAAC ZODIAC PONTIAC 239
CH-	CS+TY	SPINACH GREENWICH 2
	K	BACH STOMACH CZECH 11
	TY	EACH BEACH LEACH 48
CHM-	M	DRACHM 1
CHT-	KT	UTRECHT 1
	T	YACHT 1
CK-	K	BACK APACK HORSEBACK 142
CT-	KT	ACT REACT FACT 81
	T	INDICT 1
D-	D	AD BAD CAD 255
DD-	D	ADD DOD 2
DST-	DST	HADST AMIDST 2
	DST+TST	MIDST 1
DTH-	DG+TG	BREADTH WIDTH 2
F-	F	DEAF SHEAF LEAF 33
	F+V	THEREOF 1
	V	OF WHEREOF 2
FF-	F	GAFF CHAFF STAFF 36
FT-	FT	AFT SHAFT RAFT 35
FTH-	FG	FIFTH 1
G-	G	BAG HANDBAG SADDLEBAG 76
	G+K	LEIPZIG LUDWIG 2
GG-	G	EGG KELLOGG 2
GH-	-	LEIGH RALEIGH SLEIGH 16
	F	LAUGH COUGH ENOUGH 5
	F+G	TROUGH 1
GHT-	FT	DRAUGHT 1
	T	STRAIGHT RIGHT BEDIGHT 82
GHTH-	TG	EIGHTH 1
GM-	M	DIAPHRAGM 1
GN-	N	CAMPAIGN ARRAIGN DEIGN 15
H-	-	BAH JUDAH SHAH 25
HN-	N	JOHN MENDELSSOHN 2
HR-	R	RUHR 1
K-	K	KODAK BEAK LEAK 60
L-	L	BAAL CABAL CANNIBAL 1328
LB-	LB	BULB 1
LC-	LK	TALC 1
LCH-	LTY	BELCH FILCH GULCH 4
LD-	D	COULD SHOULD WOULD 4
	LD	BALD ARCHIBALD RIBALD 68
LDST-	DST	COULDST SHOULDST 2
LDT-	LT	HUMBOLDT 1
LF-	F	CALF HALF BEHALF 3

	LF	ELF SHELF SELF 14
LFTH-	LFG	TWELFTH 1
LK-	K	BALK CHALK TALK 12
	K+LK	YOLK 1
	LK	ELK WHELK MILK 9
LL-	L	ALL BALL BASEBALL 125
LM-	LM	REALM ELM HELM 5
	M	BALM EMBALM CALM 8
LN-	L+LN	KILN 1
	N	LINCOLN 1
LP-	LP	SCALP HELP WHELP 6
LPH-	LF	RALPH RANDOLPH 2
LSH-	LY+LTY	WELSH 1
LST-	LST	WHILST 1
LT-	LT	COBALT DEALT HALT 52
LTH-	LG	HEALTH STEALTH WEALTH 5
LTZ-	LTS	WALTZ 1
M-	M	AM MA'AM BALAAM 313
MB-	M	LAMB LIMB CLIMB 17
MN-	M	DAMN CONDEMN SOLEMN 7
MP-	MP	CAMP ENCAMP SCAMP 34
MPH-	MF+MPF	TRIUMPH LYMPH NYMPH 3
MPT-	MPT	UNKEMPT TEMPT CONTEMPT 6
N-	-	SALON LIAISON 2
	M+N	RIPEN OPEN RECPEN 9
	N	AN CANAAN BAN 1947
N'T-	N+NT	DON'T WOULDN'T 2
	NT	CAN'T SHAN'T WEREN'T 15
NC-	CK	FRANC ZINC 2
NCH-	NTY	BLANCH RANCH BRANCH 33
NCT-	CKT	SUCCINCT PRECINCT DISTINCT 7
ND-	N+ND	THOUSAND REVEREND RIND 3
	N+ND+NT	SECOND 1
	ND	AND BAND CONTRABAND 172
NDT-	NT	REMBRANDT 1
NDTH-	NG+NDG	THOUSANDTH 1
NG-	RC	BEING 1
	C	BANG FANG GANG 225
NGST-	GST+GKST	AMONGST 1
NGTH-	GG+CKG	LENGTH STRENGTH 2
NK-	CK	BANK BURBANK DANK 54
NN-	N	ANN PENN INN 6
NST-	NST	CANST AGAINST 2
NT-	NT	ANT CANT VACANT 411
NTH-	NG	FIFTEENTH SEVENTEENTH FOURTEENTH 12
NTZ-	NTS	CHINTZ 1
NX-	CKS	PHALANX SPHINX BRONX 5
P-	P	CAP HANDICAP NIGHTCAP 167
PH-	F	SERAPH PARAGRAPH TELEGRAPH 9
PT-	PT	APT ADAPT LEAPT 26
	T	RECEIPT 1
PTH-	PG	DEPTH 1

R-	R
RB-	RB
RC-	RK
RCH-	RK
	RTY
RCK-	RK
RD-	RD
RF-	RF
RG-	RG
RGH-	RG
RK-	RK
RL-	RL
RLD-	RLD
RM-	RM
RMTH-	RMS+RMPS
RN-	RN
RNT-	RNT
RP-	RP
RPT-	RPT
RR-	R
RRH-	R
RSH-	RY
RST-	RST
RT-	RT
RTH-	RS
RTZ-	RTS
RX-	RKS
S-	-
	S
	S+Z
	Z
SC-	SK
SH-	Y
SK-	SK
SP-	SP
ST-	ST
T-	-
	T
TCH-	TY
TH-	S
	S+X
	X
TT-	T
TZ-	TS
V-	V
X-	-
	KS
	Z
XT-	KST
XTH-	KSS
Z-	-
	Z

BAZAAR BAR DEBAR 406
BARB RHUBARB GARB 12
ARC 1
PATRIARCH MONARCH PETRARCH 4
ARCH SEARCH LARCH 14
BISMARCK 1
BARD SCABBARD LOMBARD 135
SCARF WHARF DWARF 6
ICEBERG HEIDELBERG NUREMBERG 19
LINDBERGH BURGH 2
ARK BARK EMBARK 45
CARL EARL PEARL 17
WORLD UNDERWORLD 2
ARM FIREARM FOREARM 36
WARMTH 1
BARN DARN EARN 67
LEARNT BURNT SUNBURNT 3
CARP HARP SHARP 7
EXCERPT 1
ERR HERR BURR 4
CATARRH MYRRH 2
HARSH MARSH 2
FIRST THIRST ATHIRST 7
ART CART DART 88
EARTH DEARTH HEARTH 19
QUARTZ 1
MARX 1
APROPOS RENDEZVOUS 2
BARNABAS DORCAS MIDAS 485
PAMPAS 1
AS WHEREAS OVERSEAS 9
DISC 1
ASH ABASH WABASH 141
ASK BASK CASK 19
GASP CLASP UNCLASP 9
CAST BROADCAST DOWNCAST 233
MONET CROQUET BOUQUET 6
AT BAT ACROBAT 482
BATCH CATCH HATCH 36
BATH SABBATH DEATH 71
BENEATH UNDERNEATH WITH 10
BEQUEATH SMOOTH 2
PRATT KILCHHATT WYATT 14
METZ LEIBNITZ 2
SLAV 1
BORDEAUX SIOUX 2
HALIFAX FAIRFAX LAX 51
BEAUX 1
NEXT TEXT CONTEXT 5
SIXTH 1
AGASSIZ 1
TOPAZ SUEZ VERACRUZ 3

ZZ- Z JAZZ BLZZ 2

APPENDIX B

A Sampling of Words with Stress Assignments Depending on the Parts-of-Speech

accent
address
adept
affix
annex
arithmetic
augment

bombard

collect
combat
combine
commune
compact
complex
compound
compress
concave
concert
concrete
conduct
confine
conflict
conscript
conserve
console
consort
construct
consult
content
contest
contract
contrast
costume

defect
desert
descant
detail
detour

dictate
digest
discard
discord
discount
discourse

egress
entrance
escort
expert
export
extract

ferment
fortaste
frequent

gallant

impact
import
impress
imprint
impulse
incense
incline
increase
indent
insert
inset
instinct
insult
intercept
interchange
interdict
interlock
intrigue
invalid
invert

minute

object
offset

perfect
permit
pervert
precedent
prefix
present
produce
progress
project
protest

quadruple

rebate
rebel
rebound
recall
record
recount
redress
refill
refund
refuse
reject
relay
reprint

subject

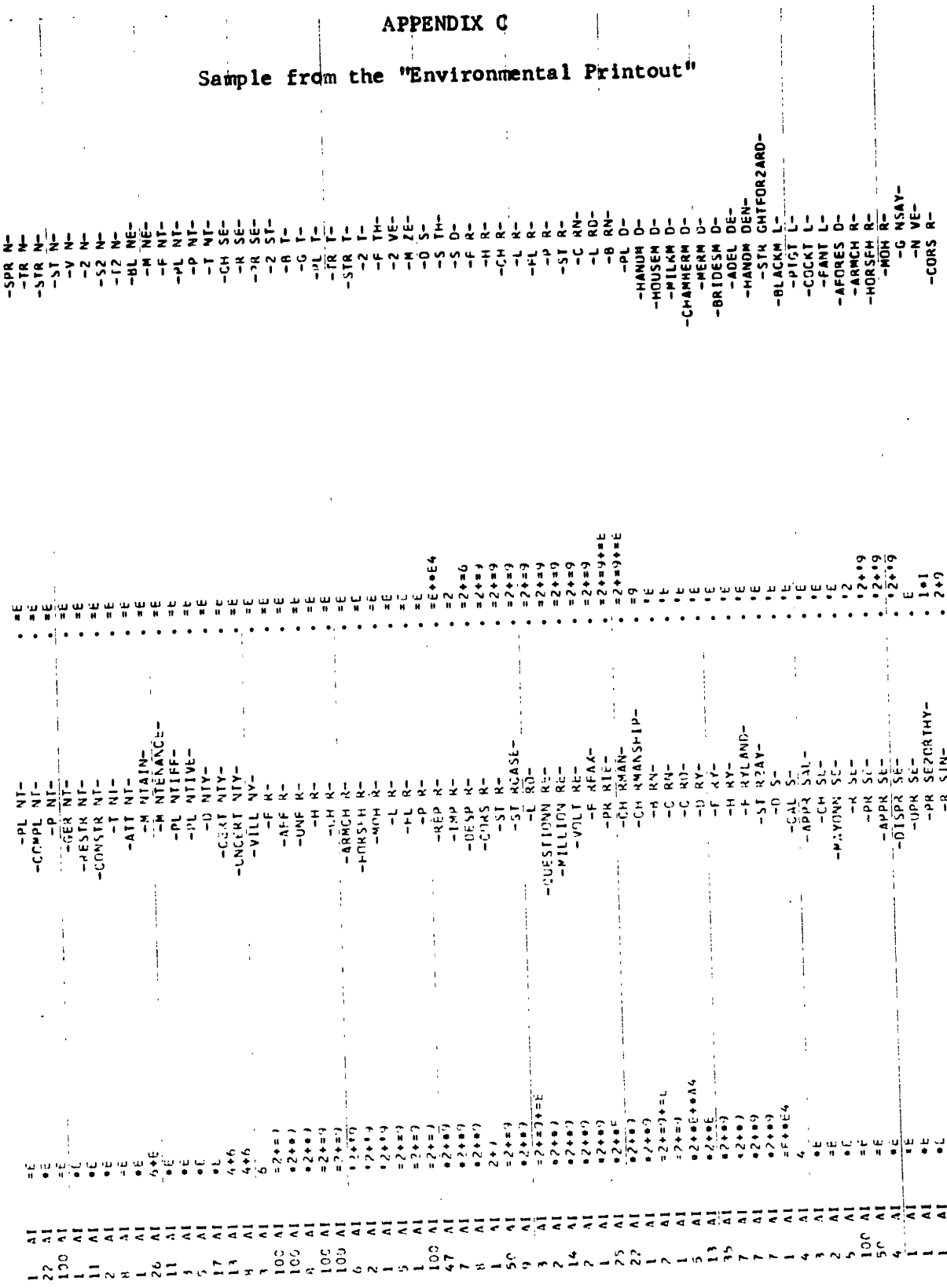
suspect

torment
transfer
transport

uplift

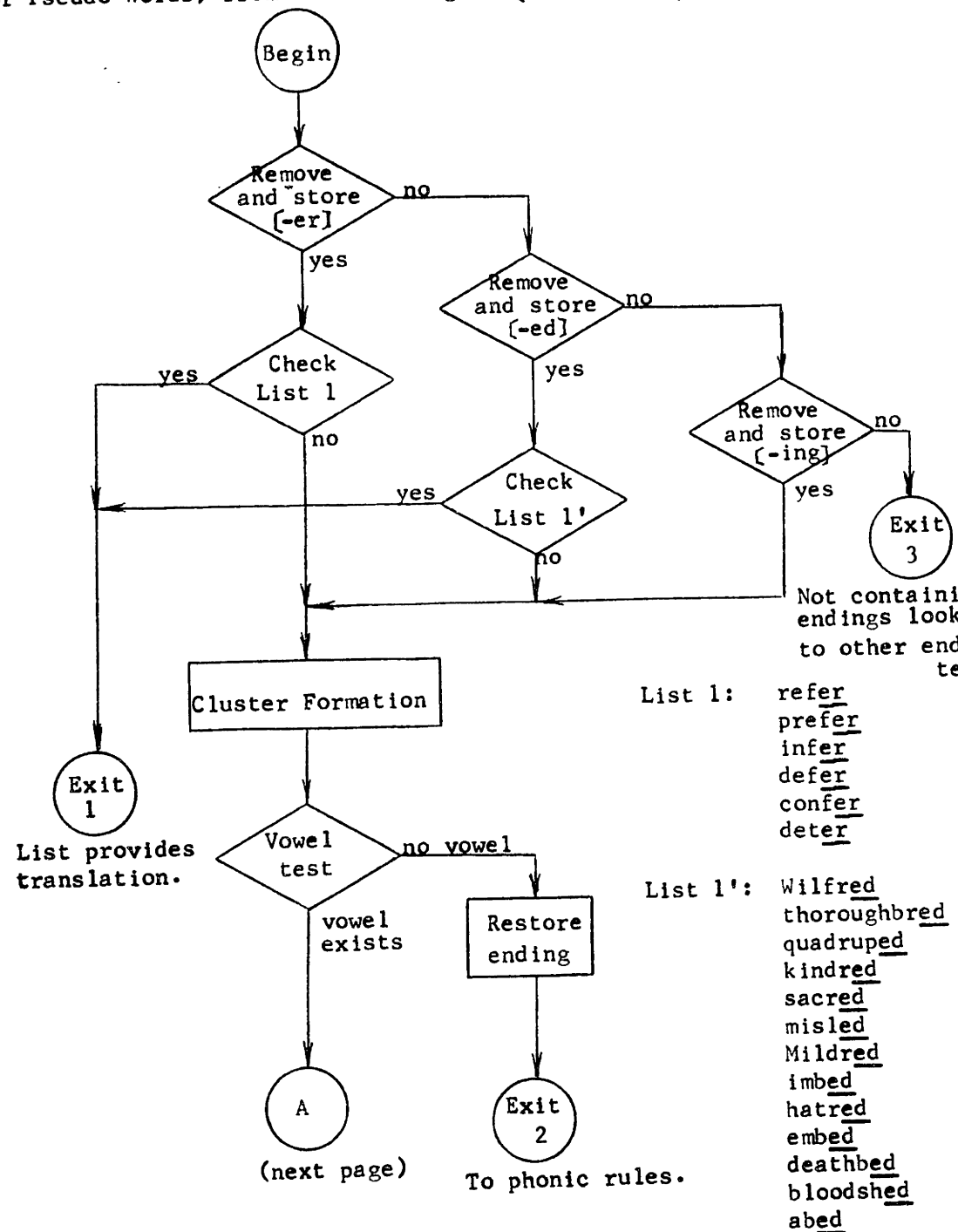
APPENDIX C

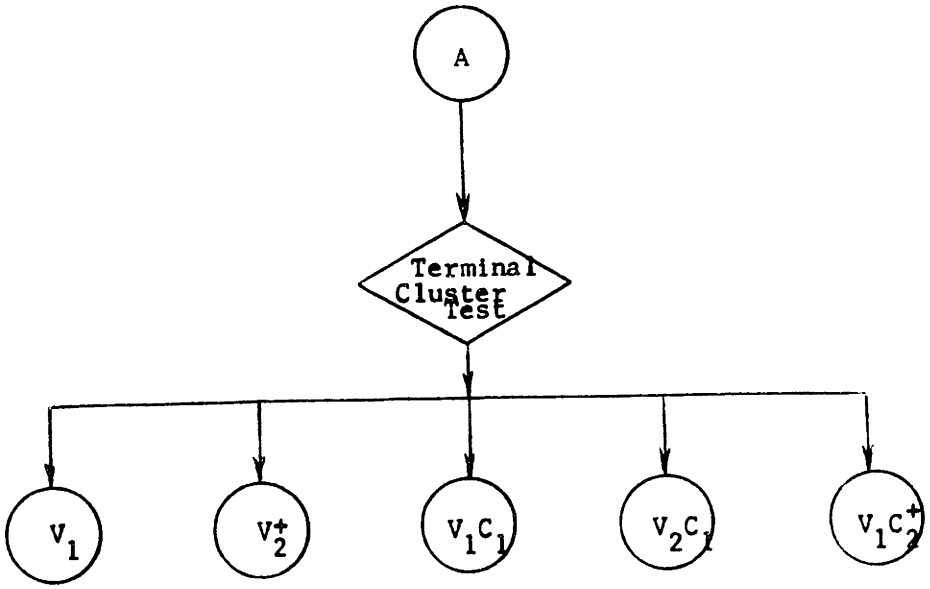
Sample from the "Environmental Printout"



APPENDIX D

Flow Chart and Exception Lists for the Derivation of Base Words (or Pseudo Words) from Words Ending in [er, ed, ing]

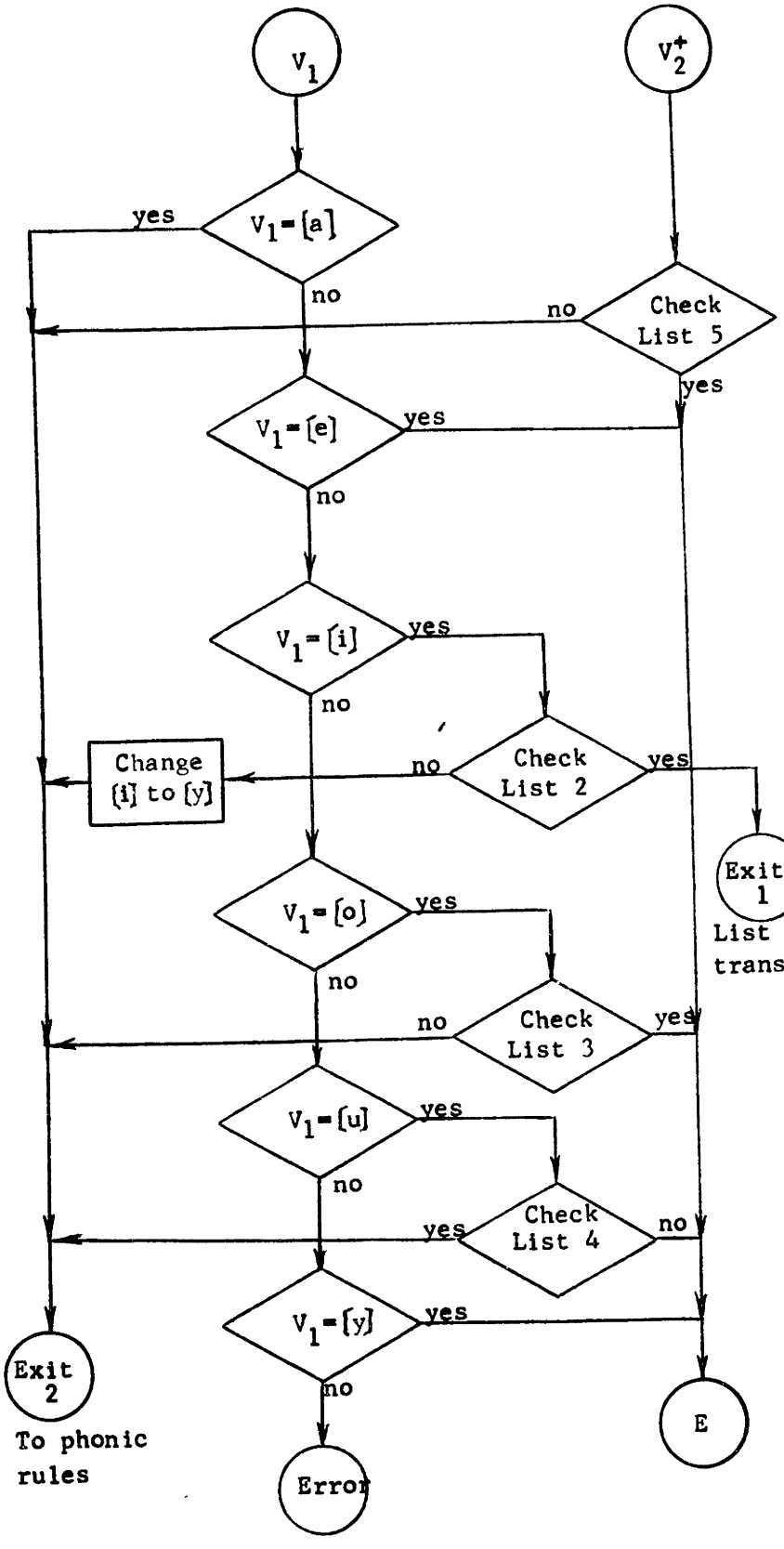




Note: V represents that the final grapheme cluster is a vowel letter cluster.

C represents that the final grapheme cluster is a consonant letter cluster.

The subscript denotes the number of letters in the cluster, the superscript (+) denotes that the number of letters in the cluster is what the subscript indicates, or more. For example, $V_1C_1^+$ represents that the final two grapheme clusters are a vowel cluster with a single letter followed by a consonant cluster of one or more letters.

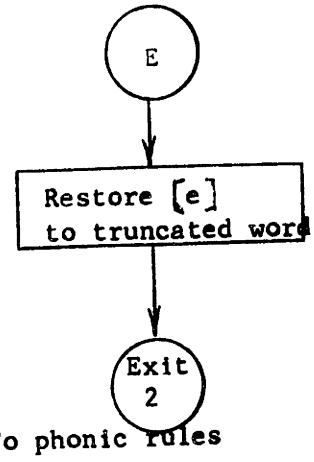


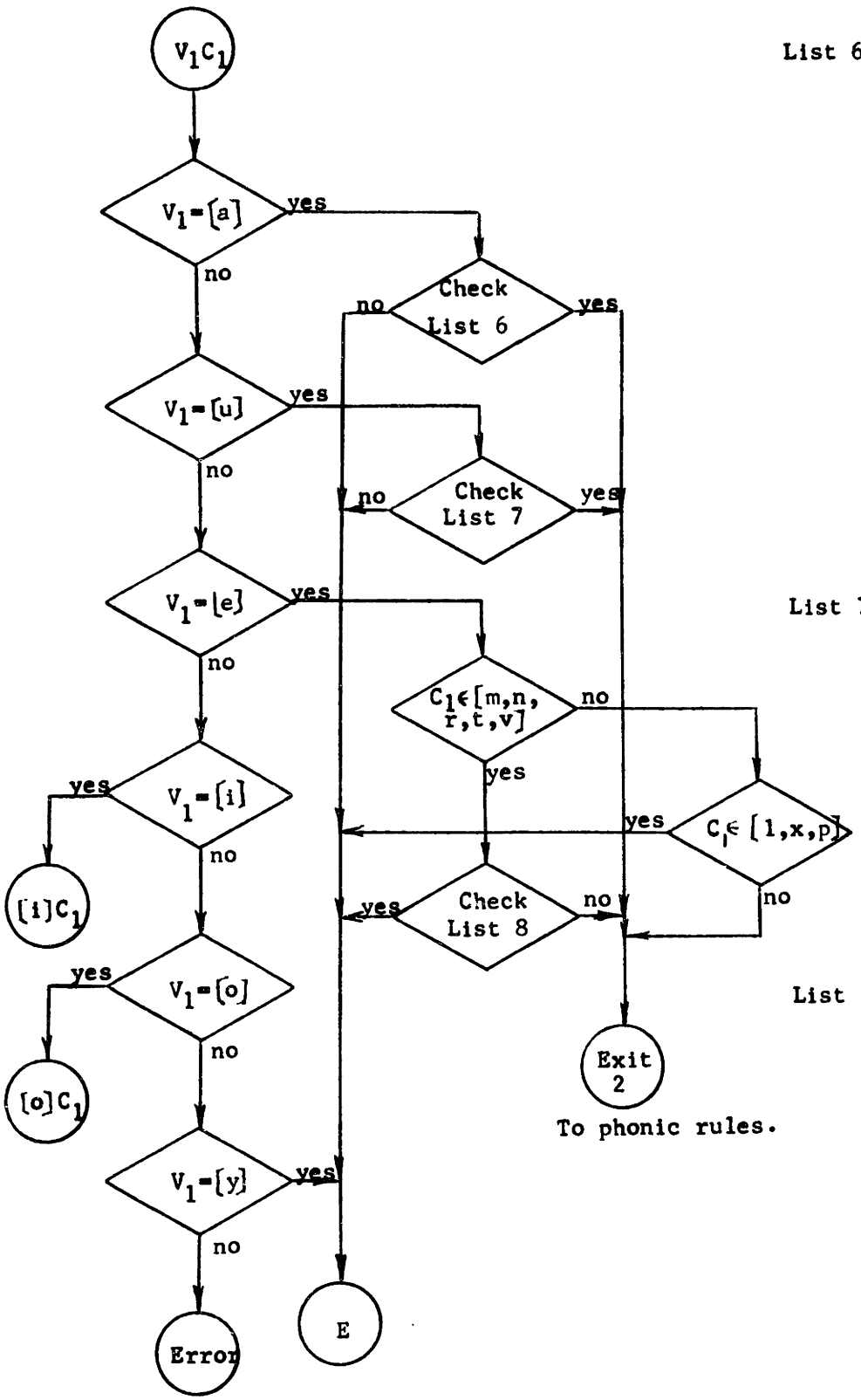
List 2: die
lie
untie
vie
grenadier
bier
pier
financier
chiffonier
chandelier
cavalier
cashier
brigadier
soldier
hoosier
osier
glacier
glazier
Siegfried

List 3: hoe
canoe
toe
tiptoe

List 4: tabu

List 5: awe
aye
eye
cockeye
owe
overawe

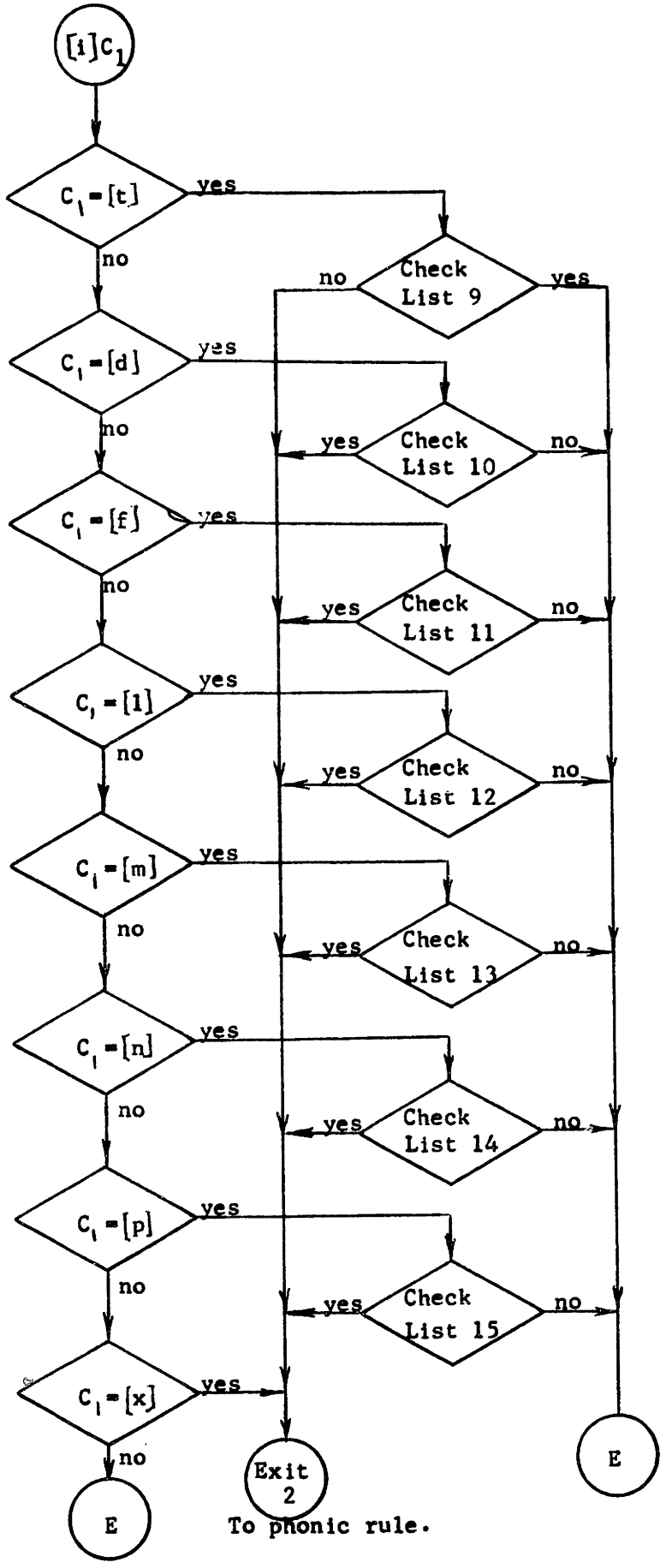




List 6: pedal
spiral
total
rival
unrival
diagram
telegram
cablegram
monogram
orphan
kidnap
sugar
canvas
water
breakwater
pillar
turban
equal
unequal

List 7: augur
sulphur
murmur
focus
caucus

List 8: scheme
blaspheme
intervene
adhere
fete
deplete
obsolete
replete
complete
compete
secrete
Peter
fever
meter



To phonic rule.

List 9: mite
dynamite
ignite
smite
unite
despite
trite
write
rewrite
typewriter
invite
uninvite

List 10:
consider
reconsider

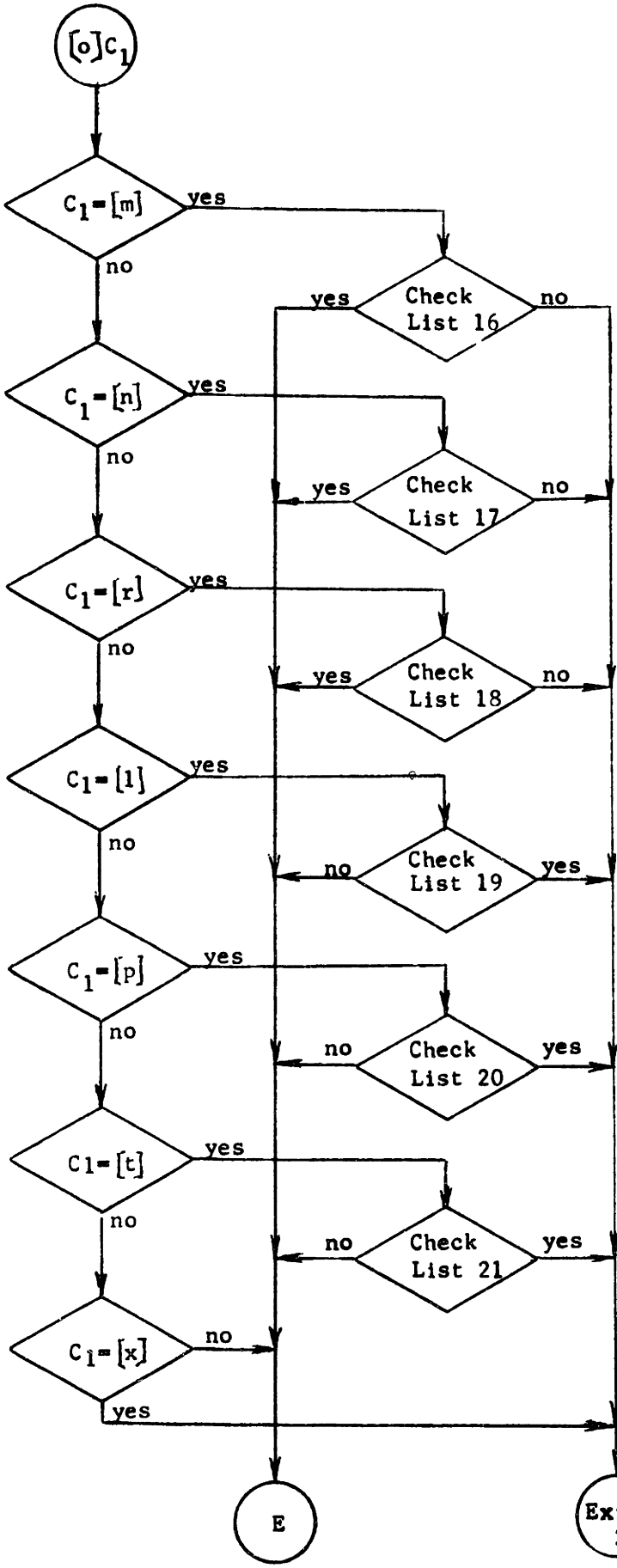
List 11:
lucifer
conifer

List 12:
pencil
stencil
council
peril
fossil
devil
anvil

List 13:
Latimer
Mortimer

List 14:
coffin
cabin
gardiner
mariner
milliner

List 15:
gossip
juniper



List 16: become
Homer
misnomer

List 17: enthrone
dethrone
bone
postpone
telephone

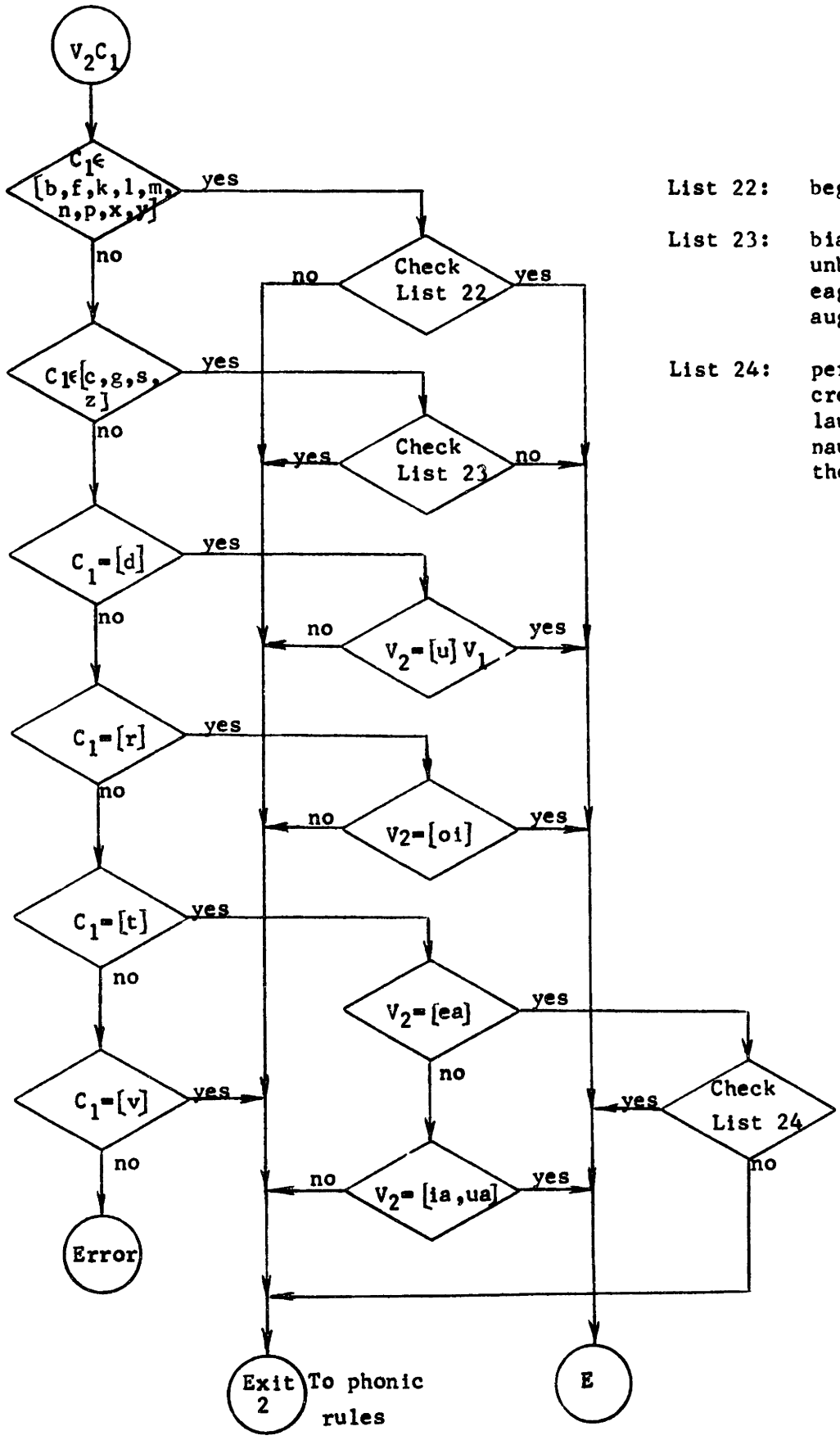
List 18: score
adore
gore
deplore
implore
explore
ignore
unexplore
snore
pore
spore
restore

List 19: symbol
pistol

List 20: develop
envelop
undevelop
scallop
wallop
proper
improper

List 21: fagot
faggot
bigot
pilot
ballot
parrot
pivot

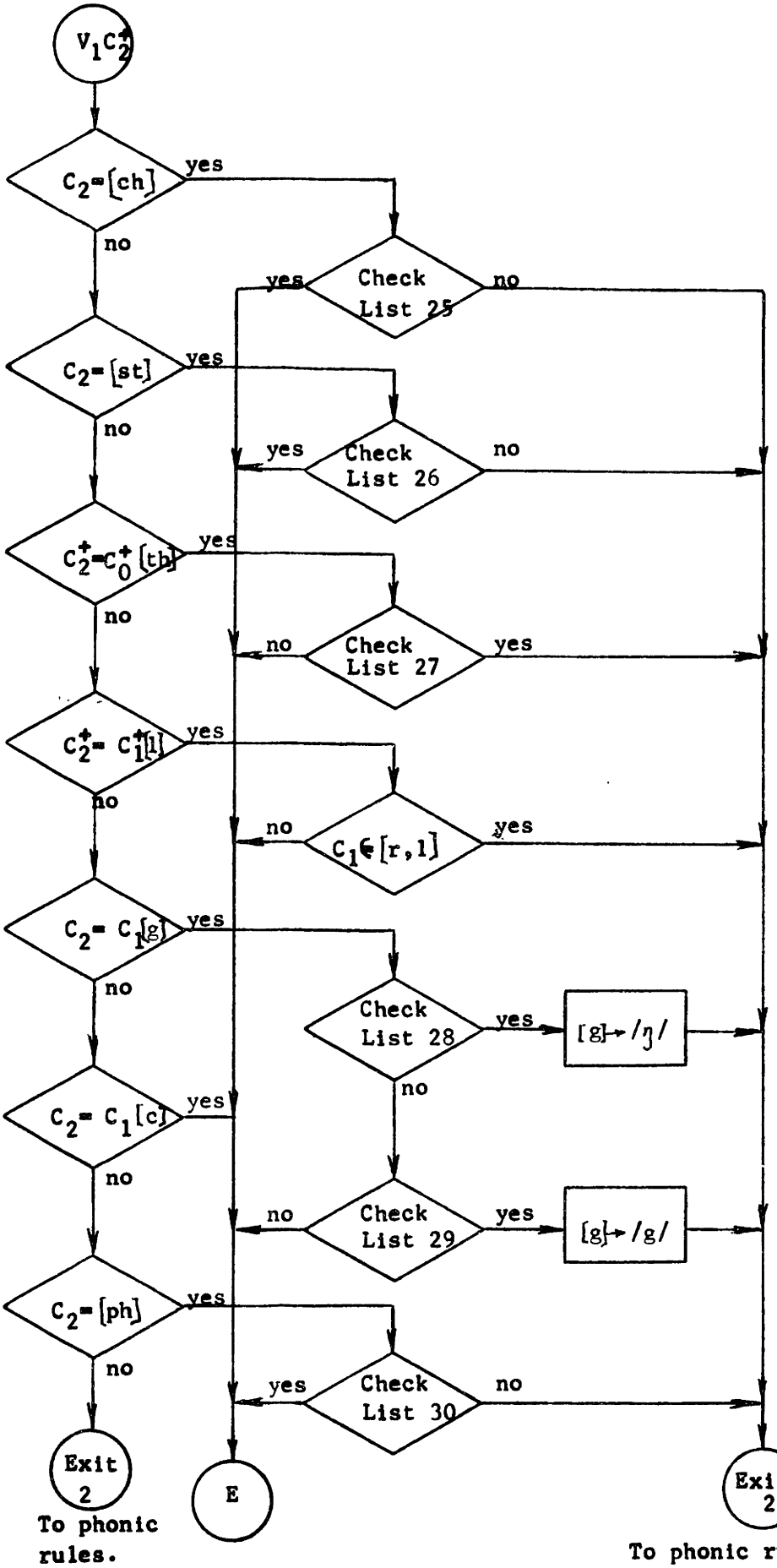
To phonic rules.



List 22: beguile

List 23: bias
unbias
eager
auger

List 24: permeate
create
laureate
nauseate
theater



List 25: ache
headache
toothache
heartache
avalanche

List 26: baste
haste
chaste
paste
taste
distaste
waste

List 27: bequeath
smooth
sooth
ether
panther
Luther
Uther
anther

List 28: ring
sing
hang
cling
fling
bring
spring
string
wring
sting
wing
swing
belong
prolong

List 29: anger
hunger
linger
finger
forefinger
longer
stronger

List 30: cipher
decipher
gopher

BIBLIOGRAPHY

1. Zickel, V.E.: "Automatic Braille Reproduction", Proceedings of the International Congress on Technology and Blindness, (1963). Vol. 1, pp. 403-408.

2. Annual Report, The Commonwealth of Massachusetts, Department of Education, Division of the Blind, (1964).

3. d'Albe, E.E. Fournier: "The Optophone: An Instrument for Reading by Ears", Nature, Vol. 105 (1920), p. 295.

4. Nye, P.W.: "Reading Aids for Blind People - A Survey of Progress with the Technological and Human Problems", Med. Electronic Biol. Engineering (1964), Vol. 2, pp. 247-264.

5. Clemens, J.K.: "Optical Character Recognition for Reading Machine Applications", Ph.D. Thesis, M.I.T., September, 1965.

6. Bliss, J.C.: "Communication via the Kinesthetic and Tactile Senses", Ph.D. Thesis, M.I.T., 1961.

7. Troxel, D.E.: "Tactile Communication", Ph.D. Thesis, M.I.T., August, 1962.

8. Metfessel, M.F.: "Experimental Studies of Human Factors in Perception and Learning of Spelled Speech", Proceedings of the International Congress on Technology and Blindness, Vol. 1, pp. 305-308.

9. Fairbanks, G., N. Guttman and M.S. Miron: "Effects of Time Compression upon the Comprehension of Connected Speech", Journal of Speech and Hearing Disorder, Vol. 22 No. 1, March 1957, pp. 10-19.

10. Cooper, F.S.: "Speech from Stored Data", 1963 IEEE International Convention Record, pp. 137-149.

11. Haskins Laboratories: "Recording Words for a Spoken Dictionary: Specification of Word Stress on the Basis of Grammatical Function", (about 1962).

12. Harris, K.: "Study of the Building Blocks of Speech", J. Acoust. Soc. Amer., vol. 25 (1952), pp. 962-969.

13. Cooper, F.S., F.C. Delattre, A.M. Liberman, J.M. Borst, L.J. Gerstman: "Some Experiments on the Perception of Synthetic Speech Sounds", J. Acoust. Soc. Amer., Vol. 24 (1952), pp. 597-606.

14. Peterson, G.E., W. S-Y. Wang: "Segmentation Techniques in Speech Synthesis", J. coust. Soc. Amer., Vol. 30 (1958) p. 739.

15. Estes, S.E., H.R. Kerby, H.D. Maxey, R.M. Walker: "Speech Synthsis from Stored Data", IBM Journal of Research and Development, Vol. 8, January 1964, pp. 2-12.

16. Kelly, J.L., C. Lockbaum: "Speech Synthesis", Proceedings of the Speech Communication Seminar, 1962,

Stockholm. Gerstman, L.J., J.L. Kelly: "An Artificial Talker Driven from a Phonetic Input", J. Acoust. Soc. Amer., Vol. 33 (1961) p. 835(A).

17. Holmes, J.N., I.G. Mattingly, J.N. Shearme: "Speech Synthesis by Rule", Language and Speech, Vol. 7, part 3 July-September, 1964, pp. 127-143.

18. Jepersen, O.: "Growth and Structure of the English Language", Basil Blackwell, Oxford, 1948 (Ninth Edition), p. 60, p. 75.

19. Clymer, T.: "The Utility of Phonic Generalizations in the Primary Grades", The Reading Teacher, January 1963, pp. 252-258.

20. Higginbottom, E.M.: "A Study of the Representation of English Vowel Phenemes in the Orthography", Language and Speech, April-June 1962, pp. 67-117.

21. Gibson, E.J., A. Pick, H. Osser and M. Hammond: "The Role of Grapheme-Phoneme Correspondence in the Perception of Words", The American Journal of Psychology, Vol. LXXV, December 1962. pp. 554-570.

22. Gibson, E.J., H. Osser and A. Pick: "A Study of the Development of Grapheme-Phoneme Correspondences", Journal of Verbal Learning and Verbal Behavior. Vol. 2, No. 2, August 1963, pp. 142-146.

23. Bhivmani, B.V., J.L. Dolby and H.L. Resnikiff: "Acoustic Phonetic Transcription of Written English", Paper delivered at the 68th Meeting of the Acoustical Society of America, Oct. 21, 1964.

24. Monroe, G.: "Phonemic Transcription of Graphic Post-Base Suffixes in English; A Computer Problem", Ph.D. Thesis, Brown University, June 1965.

25. Weir, R.H., R.L. Venezky: "Formulation of Grapheme-Phoneme Correspondence Rules to Aid in the Teaching of Reading", Cooperative Research Project No. S-139 Report, Stanford University, 1964.

26. Weir, R.H., R. L. Venezky: "Rules to Aid in the Teaching of Reading", Research Project No. 2584 Report, Stanford University, 1965.

27. Klein, S., R.F. Simmons: "A Computational Approach to Grammatical Coding of English Words", Journal of the Association for Computing Machinery, Vol. 10, No. 3, July 1963, pp. 334-347.

28. Thorndike, E.L., I. Lorge: "The Teacher's Word Book of 30,000 Words", Bureau of Publications, Teachers College, Columbia University.

29. Kenyon, J.S., T.A. Knott: "A Pronouncing Dictionary of American English", 1953 Edition, G. & C. Merriam Company.

30. Dewey, G.: "Relative Frequency of English Speech Sounds", Harvard University Press, 1923. p. 14, Table 2.

31. Jespersen, O.: "A Modern English Grammar on Historical Principles", George Allen & Onwin Ltd., Vols. I & VI.

32. Walker, J.: "The Rhyming Dictionary of the English Language", E.P. Dutton and Company, New York, (1936).

33. Teall, F.H.: "The Compounding of English Words", John Ireland, 1891.

34. Itek Corporation: "MCP-1000 Systems", Itek Technical Bulletin (about 1965).

BIOGRAPHY

Franics Fan Lee was born on January 28, 1927 in Nanking, China.

He received his S. B. and S. M. degrees in Electrical Engineering from M. I. T. in 1950 and 1951.

Between 1951 and 1963 he was engaged primarily in the engineering and development of computing and data processing equipment, including the digitally controlled milling machine, BIZMAC Sales Recorder, and the LARC computing system. He was with the UNIVAC division of Sperry Rand Corporation from 1956 to 1963, serving in various capacities as Project Engineer, Section Head, Department Manager for LARC, Division Director of Systems Development, and Manager of Advanced Systems.

He returned to M. I. T. in mid-1963 and was a staff member on Project MAC until he resumed his academic study a year later as a Hertz Fellow. It was during his association with Project MAC he became aware of and interested in the problems in human cognitive process.

Mr. Lee is a member of Eta Kappa Nu, Tau Beta PI and an associate member of Sigma Xi. He is a Registered Professional Engineer in the Commonwealth of Massachusetts and a Senior Member of IEEE.

During the Second World War Mr. Lee served as a first lieutenant in the Chinese Army with the American Office of Stragegical Service and China Combat Command.

Mr. Lee is married and now lives in Lexington, Mass. with his wife and four children.