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THE SEMIOTICS OF WRITTEN
DISCOURSE AND THE DUAL
REPRESENTATION OF INFORMATION IN MEMORY:
AN APPLICATION OF NONVERBAL ELEMENTS
TO FL READING METHODOLOGY

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with love and tenderness

To
Angelo &
Andrē

- with admiration and gratitude

To

Else

ABSTRACT

This dissertation advocates a recurrent and systematic use of nonverbal elements, as well as pictorial information incorporated into the reading lesson, to initiate linguistic activity in the teaching of FL reading. For this purpose, two broad avenues are brought to bear. The first is discourse-oriented and includes an expanded review of the structure of the written text with its two basic semiotic devices, the verbal and nonverbal ones. The second is cognition-oriented and includes a review of two important issues, namely, the information-processing system and the concept of schema. These two cognitive issues inform the view this dissertation adopts of comprehension as an interactive process which involves both text-presented material and the information the reader brings to the reading task in the form of previous knowledge. Still within cognitive psychology another issue is discussed, namely, Paivio's dual-coding theory, which provides the specific theoretical basis for the major argument of this dissertation. Paivio's theory of memory comprises verbal and nonverbal representations and fits in neatly with the structure of written discourse. All theoretical issues are finally translated into suggestions of activities for each phase of a reading lesson. The underlying purpose is to bridge theory and practice towards a more efficient FL reading methodology for high-school students.

INTRODUCTION

A considerable amount of current technical and scientific information has placed the English language as one of the most widespread vehicles of communication. This language has in fact been the means of conveyance of a great deal of information throughout the world over the last few decades.

As a result, reading English has become an essential prerequisite to both academic and professional accomplishments. Students of different areas will not be able to cope with the advances of science and the latest news concerning their specialism until they have acquired a fairly effective command of the conventions of written discourse in English.

The increasing need our Brazilian students presently face to use English as an essential tool in their further research or specialism is therefore partly responsible for the outcome of this dissertation. We have started our inquiry propelled by the urge to bridge the gap between theory and practice. Thus, this dissertation has been primarily designed to act as a link between the theoretical information on the reader's processing of information and the teacher's day-to-day task of developing his students' reading strategies.

By probing into cognitive psychology, linguistics, and current theories on text comprehension, this dissertation attempts to suggest some pedagogical procedures for a more efficient teaching of FL reading. The ideas passed on by various scholars interested in the study of text comprehension will thus be used for the devising of a more efficient reading methodology.

Reading as a dynamic process has in fact been the object of scrutiny of both linguistics and cognitive psychology over the last few decades. Insightful studies in these fields of inquiry have increasingly contributed to a more complete understanding of both the structure of written discourse and the processes carried out by the human mind from perception to encoding of information. It has been pointed out, for example, that a written text brings within itself important linguistic and nonlinguistic clues and that comprehension involves the processing of both. It has also been revealed that the flow of information, while it is being processed, undergoes a series of intermediate processes before its total comprehension and retention in the reader's permanent repository of knowledge. Further research indicates that the reader's preexisting knowledge plays an important role in his processing of information for understanding.

Little has been done, however, to capitalize on all this theoretical information towards a more efficient teaching of FL reading to high school students to whom this dissertation is

primarily designed. More specifically, a full use of the nonverbal elements of discourse, which the students can easily process, has been somewhat neglected. Whatever has been done in this respect seems to be loose and scattered information, which this dissertation attempts not only to bring into a unified whole but also to expand.

In fact, Widdowson remarks that teaching has concentrated on the linguistic level and that the nonverbal aspects of discourse have been somewhat overlooked. He also calls attention to the importance of nonverbal elements in the reader's construction of meaning claiming that interpreting does not operate on the verbal text only but on discourse as a whole, which is not purely verbal.

Cognitive psychologists, on the other hand, state that pictorial information, concrete sentences with high-imagery value, and so on play an important role in the ease with which information is processed for comprehension. However, the matter does not seem to be fully capitalized on by applied linguistics and reading methodology.

This neglected use of the nonverbal elements of discourse seems to be apparent in the materials produced for the teaching of reading in English to Brazilian high-school students. Current materials, aimed at preparing the students for College Entrance Examination, tend to be lexicon and grammar-based and, as a result, not actually communicative. Since these materials are often constructed pieces of discourse, they usually fail to display the characteristic redundant or complementary conveyance of meaning, which makes the students' processing of information more difficult. Furthermore, these materials do not seem to aim at developing the students' reading strategies. They may ensure the students' success in the examination but they do not really prepare them to be efficient readers in a second language. It may be also relevant to point out that pictorial information added to the text as a didactic device to assist the students in their task of constructing meaning does not seem to have a place in these materials.

Consequently, it is the main goal of this dissertation to probe into recent research on the reader's processing of information and later to suggest activities to develop our students' ability to handle a piece of written discourse in a foreign language more efficiently. These suggestions will involve a systematic and recurrent use of both nonverbal information inherent in the text and visual devices incorporated into the reading lesson as a means of facilitating our students' processing of the linguistic information that is more demanding for them.

A basic assumption in this dissertation is that fluent reading involves a simultaneous interplay of perceptual, linguistic, and

cognitive processes and that reading inefficiency reflects the inadequate development of one or more of these processes. It is our claim that nonverbal elements and visual devices incorporated into the reading lesson can be of great assistance in all the stages of information processing. The use of these devices in the development of a reading lesson will serve some complementary aims such as to activate the students' previous knowledge, to contribute to the students' grasping of the overall meaning of a text, to assist the students when deducing the meaning of unfamiliar words, to call the students' attention to important linguistic clues within the text, and so forth.

Another insight gained from cognitive psychology which specifically informs the major argument of this dissertation is related to the way our knowledge of the world is organized and represented in our long-term memory. Paivio's dual-coding theory, for example, claims that this knowledge is stored in our memory in terms of visual and verbal representations. This theory further argues that language behavior is mediated by two independent but partly interconnected cognitive systems: the image system and the verbal one. This dissertation then argues that if our two cognitive systems are interconnected and if one can initiate activity in the other, the use of nonverbal elements in the teaching of reading will facilitate the students' processing of information.

A first step towards the main purpose of this dissertation is to place the teaching of reading within the broader context of second language teaching. Chapter I is thus intended to provide a survey of some theoretical issues which have a bearing on second language teaching and on the teaching of reading as well. This survey is meant to show that several distinct theoretical orientations have guided the work of the language teacher over the years and that they have brought a change of perspective from a mechanistic approach to a more mentalistic one.

If reading was primarily viewed as a passive activity in which meaning was mechanically taken out from the written text, it is now considered as an active process which involves the reader in a dynamic construction of meaning. Artificial texts devised around a specific grammatical point and dealing with only a certain limited amount of lexical items tend to be replaced by authentic texts which are not grammar-based but discourse-oriented.

This diachronic survey centers attention only on the major points in the development of second language teaching starting with the audio-visual or audio-oral methods towards the communicative approach to language teaching. The underlying purpose is to bridge the past and the present by placing particular emphasis on the shift

undergone by second language teaching—from a formalistic orientation with primary emphasis on language structure to a more communicative one with greater concern with the communicative purposes of language.

Chapter II is concerned with some central issues in cognitive psychology which provide theoretical ground for a more accurate understanding of the reading process. Much of the discussion centers on two major concepts, namely, the information-processing system and the concept of schema. The coverage of these two topics is rather selective with emphasis on the points which are of particular relevance to a more efficient reading methodology.

This theoretical background is primarily used to inform the current view of comprehension as an interactive process involving both text-presented material and the reader's world knowledge which is brought to the comprehension task. The comprehender plays a fairly active role in his construction of meaning by inferring, predicting, guessing, establishing the continuity of a written text, and so on. It may be said that meaning emerges from the dynamic interaction of new incoming information and the reader's previous knowledge—in other words, it does not lie exclusively in the text or the reader, but in the interaction between both.

The discussion of the information-processing system attempts to emphasize that comprehension occurs gradually and that it involves intermediate processes that are of fundamental importance to an accurate understanding of what is being processed.

The discussion of the schema theory reveals that a lack of some minimal knowledge of the contents of a text can greatly contribute to comprehension inefficiency. This means that new incoming information is accurately comprehended if it can be fitted into the reader's preexisting knowledge stored in his long-term memory.

In closing, this chapter suggests a relationship between the stages of information processing and the phases of a reading lesson with emphasis on the fact that knowledge of the world plays an important role in the reader's everyday processing of information for understanding.

Chapter III relates Paivio's dual-coding theory, which posits that our knowledge of the world is stored in our long-term memory in terms of verbal and visual representations, to the structure of written discourse with its two basic semiotic devices: verbal and nonverbal. The main purpose is to specifically inform the major argument of this dissertation towards a recurrent and systematic use of nonverbal elements to initiate linguistic activity in the teaching of English for reading.

The rationale underlying the major argument of this dissertation

follows as that: first, there seems to be an analogy between the way information is represented in our long-term memory in terms of verbal and image systems and the way information is conveyed in written discourse in terms of verbal and nonverbal elements. Secondly, Paivio, on the one hand, claims that one of our cognitive systems—either the image or verbal one—can initiate activity in the other. On the other hand, a reader, when actively involved in his construction of meaning may initiate his processing of information by making use of one of the components of written discourse—either verbal or nonverbal discourse. Thus, in developing our students' ability to handle a piece of written discourse in a foreign language, we claim that if we make a recurrent and systematic use of nonverbal elements, better understanding and consequent retention of the information of the text will ensue. Since these elements are part of a universal language our students already possess, an efficient reading methodology may make use of them to initiate linguistic activity, so as to facilitate the students' construction of meaning.

Chapter IV translates the major argument of this dissertation into suggestions of activities for classroom application. It is primarily meant to demonstrate how the nonverbal elements of discourse and visual devices added to the reading lesson can be put into use for a more efficient reading methodology. Activities involving the use of these elements are suggested for each phase of the reading lesson, that is, in prediction, in reading for overall meaning, in main points comprehension, and in intensive comprehension. The primary purpose of using nonverbal information is to decrease the cognitive overload in the students' processing of new incoming information. By making use of visual information to chunk larger pieces of information, the students may overcome the limited capacity of their short-term memory and have their processing of information made easier and more accurate.

Moreover, since nonverbal information is better retained than long verbal explanations, the recurrent and systematic use of this information may contribute to later recall as well. A further argument for the use of nonlinguistic devices is related to their high potential in arising motivation. They can be an effective means to increase students' participation in all the phases of the reading lesson.

This dissertation thus redresses the balance between verbal and nonverbal elements of discourse in the teaching of FL reading. It also suggests the use of pictorial information added to the reading lesson as a means of assisting the students in their task of constructing meaning in a foreign language. The underlying assumption

is that interpreting does not operate on the linguistic level only but on discourse as a whole, which is not purely verbal. Together with the verbal material itself, several communicative devices such as maps, diagrams, tables, graphs, and so on are used to complement or enhance meaning. It may be said that these devices are counterparts to gestures and facial expression in face to face communication. Since they may carry the same information in a complementary and redundant relationship with the verbal information itself, our students can have at their disposal different clues to confirm their expectations and to comprehend more efficiently what they are processing.

Finally, it can be further argued that the use of visual devices added to the text can increase its degree of readability and then help the students to process information in a foreign language more easily. The point this dissertation makes is that the more pictorial information we use in our reading lessons, the more effective the students' processing of information will be, which can ensure better retention as well.

CHAPTER I

BRIDGING THE PAST AND THE PRESENT

1. PRELIMINARY REMARKS

This chapter makes a survey of some theoretical issues related to the scientific study of language and their influence on FL teaching methods. We will lean towards historical and interdisciplinary matters by fitting the teaching of reading within the broader context of second language teaching. We will discuss some important issues—linguistic, psycholinguistic, sociolinguistic—and use them as frameworks to explain the evolution second language teaching has undergone—from a mechanistic approach to a more mentalistic one. This means that language teaching has shifted from a view of language as an automatic phenomenon to a thinking one. In our diachronic orientation—from the 40s and 50s to our days—we mean to show that language teaching has shifted from a formalistic orientation with particular emphasis on language structure to a more communicative one with a primary concern with the communicative features of language.

Attention will be restricted only to the major and more recent trends in language teaching since this does not mean to be an exhaustive survey. Therefore, no reference will be made to the grammar-translation method. Neither will we make reference to sub-trends such as situational and notional syllabuses.

2. STRUCTURALIST LINGUISTICS AND BEHAVIORIST PSYCHOLOGY

Let us begin by presenting some tenets of Behaviorism—a school of psychology which establishes the psychological rationale for Structuralist Linguistics. Behaviorist Psychology and Structuralist Linguistics, in turn, provide the rationale behind the so-called audio-visual and audio-lingual methods for the teaching of languages. The main assumption in Behaviorism is that observed behavior provides the only valid data in psychology; it rejects concepts such as consciousness, introspection, and intuition because they are subjective and unmeasurable. Behaviorists are committed to what can be observed, measured, and manipulated experimentally. On the other hand, the privateness of mental processes make behaviorists assert that these experiences are not reasonable topics for scientific study. Behavior they say, "is to be analyzed into a set of responses that are assumed to be governed

by stimulus conditions in the environment."¹ In a behaviorist view, the process of learning is seen as the establishment of associations or bonds between stimuli and responses—little or nothing is said about the complex reasoning processes which are an integral part of any kind of learning. In the attempt to explain human learning, behaviorists thus adopt a strict empirical position: observable and measurable behavior is the only data concerning them.

Leaning heavily on the fundamental assumptions of behaviorist theories, the structuralist linguist sets forth as his goal the objective description of languages, leaving out of consideration thinking and value judgements. For the structuralist, language is a system of forms—elements or items combined in certain regular ways to produce acceptable sentences. The role of the linguist is to build up an objective and comprehensive description of this system excluding almost completely meaning from the linguistic enterprise; the analysis is more concerned with the observable sides of language, that is, the sound system and the grammatical structure rather than with problems of meanings. Speech is the data from which the linguist deduces the system of the language he is describing.

From the point of view of language teaching, Structuralist Linguistics represented a major theoretical landmark: despite its limitations, it supplied the language teacher with more precise and objective descriptions of languages than had previously been available to him.

As pointed out before, the combination of the assumptions of behaviorist theories, on the one hand, and of Structuralist Linguistics, on the other hand, gave rise to the so-called audio-visual method and its variants. In other words, this teaching method is an amalgam of the principles of Structuralist Linguistics, and Behaviorist Psychology in relation to the nature of language and the nature of the learning process.²

The acceptance of the systematic and objective nature of language in the structuralist view led language teaching to emphasize the sentence patterns of the language rather than isolated words as had been done before. The language teaching content is also defined in terms of formal items relying on the criterion of grading of difficulty. The idea is to present very easy and simplified material at the beginning taking into account the most frequent sentence patterns. Thus, the criteria for the choice of material are based on the everyday use of language by native speakers and not on the learner's actual needs.

Considering the behaviorist belief that any kind of learning

is achieved by building up habits on the basis of stimulus-response chains, the teaching of language rests upon the idea that the learner must be provided with a great amount of practice in order to acquire appropriate linguistic responses. This practice is obtained through repetition—sentence patterns are repeated and drilled until they become habitual and automatic even though this is done in a repetitive or mechanical way. Thus, it does not involve the learner's reasoning and thinking; memorization of the very structure is the goal. Accordingly, the focus of attention is more on language forms to be learned than on meanings to be communicated. Therefore, the fundamental belief is that an automatic manipulation of different linguistic structures constitutes the real ability to communicate in a foreign language. Drills and exercises are primarily designed for this purpose.

Based upon the maxim that the written system of the language is only an approximation to the spoken form, the emphasis in language teaching is set upon speech; this accounts for the importance given to pronunciation. Thus, a great amount of time is devoted to tasks which emphasize the oral component of language. Reading, for instance, plays a minor role since priority is given to oral communication. Generally, the reading passages are made up in order to fulfil the author's purpose, that is, the teaching of a particular grammatical point. The texts, usually presented after oral dialogues and drills, are built up to illustrate the sentence patterns the learner has already memorized. Thus, those texts are not authentic and they cannot be said to be actual instances of written discourse. Those constructed texts neither use nor add to the learner's previous knowledge—in other words, there is no new information. A direct consequence of this contrivance is that the passages do not have the usual layout or text iconography thus, titles, inverted commas, italics, dashes, notes, underlining, different typefaces are not generally present.

It should be pointed out that genuine and actual instances of written discourse usually make use of two main semiotic devices: the verbal text—its linguistic component proper and the graphic language of diagrams, graphs, illustrations, etc.³ Those constructed texts in the audio-visual methods rely only on the verbal component, that is, one of the two semiotic devices. Sometimes we find illustrations to go with the text. However, the illustration, rather than complementing the text, just provides the context of the situation. By providing the context of situation, the teacher does not have to make use of the native language for explanation, something which is not acceptable in this method. As we will see later, the idea of providing the context of situation is intrinsically a good one; nevertheless,

the problem lies with the artificial text and the reasons why illustrations are used.

As the sentence represents the unit of learning in the audio-visual method, reading is therefore viewed as the decoding of individual sentences in the text, in the hope that it will lead to a full comprehension of the passage. All the interconnections of a text grammar or discourse are thus artificially excluded from the teaching-learning situation.

Widdowson, for instance, argues that the basic flaw in this approach to language teaching is that

*... it represents language in a way which dissociates the learner from his own experience of language, prevents real participation, and so makes the acquisition of communicative abilities particularly (and needlessly) difficult.*⁴

3. TRANSFORMATIONAL-GENERATIVE LINGUISTICS AND COGNITIVE PSYCHOLOGY

The 1950s saw the emergence of this influential school of linguistics whose main assumptions challenged not only the prevailing beliefs of structuralist linguistics but also the maxims of behaviorist psychology. Rather than holding a behaviorist orientation, the emergent trend leaned towards a new rationalism. This doctrine

*... maintains that the mind is constitutionally endowed with concepts, or innate ideas, that were not derived from external experience. Thus, according to this doctrine, knowledge is regarded as being organized in terms of highly specific, innate mental structures. Knowledge, then, does not depend on the observation of external facts for its justification, but on mind processes which are the source of human knowledge, superior to and independent of sensorial perceptions.*⁵

Thus, language is not seen just as another form of behavior; it is, rather, seen as a highly complex skill which requires an interrelated set of psychological processes for its use.

Noam Chomsky of the Massachusetts Institute of Technology is the leading name in this new trend: transformational generative

linguistics. Since the publication of his major concepts on language, his work has had a revolutionary impact on linguistics and a remarkable influence on cognitive psychology.⁶

It is Chomsky's claim that we possess some innate knowledge about language structure which is part of all possible human languages. At the time a child is acquiring a language, he makes use of this knowledge in order to check his hypotheses about the structure of the language he is learning - he then *"only progresses further with hypotheses that do not conflict with universal features of human language."*⁷

Chomsky also accounts for the highly productive and creative character of language. He states that every natural language has a potentially infinite number of sentences. Though the components that make up sentences are small in number, the ways they may be combined into sentences are infinite. Another point Chomsky calls attention to is that natural languages are rule-governed. In spite of the fact that a native speaker is primed with the ability to create an infinite number of sentences, rules exist that limit the way he may combine words into sentences. Despite the constraints of the rules of a language, a native speaker is capable of generating and comprehending novel sentences he has never used or heard before.

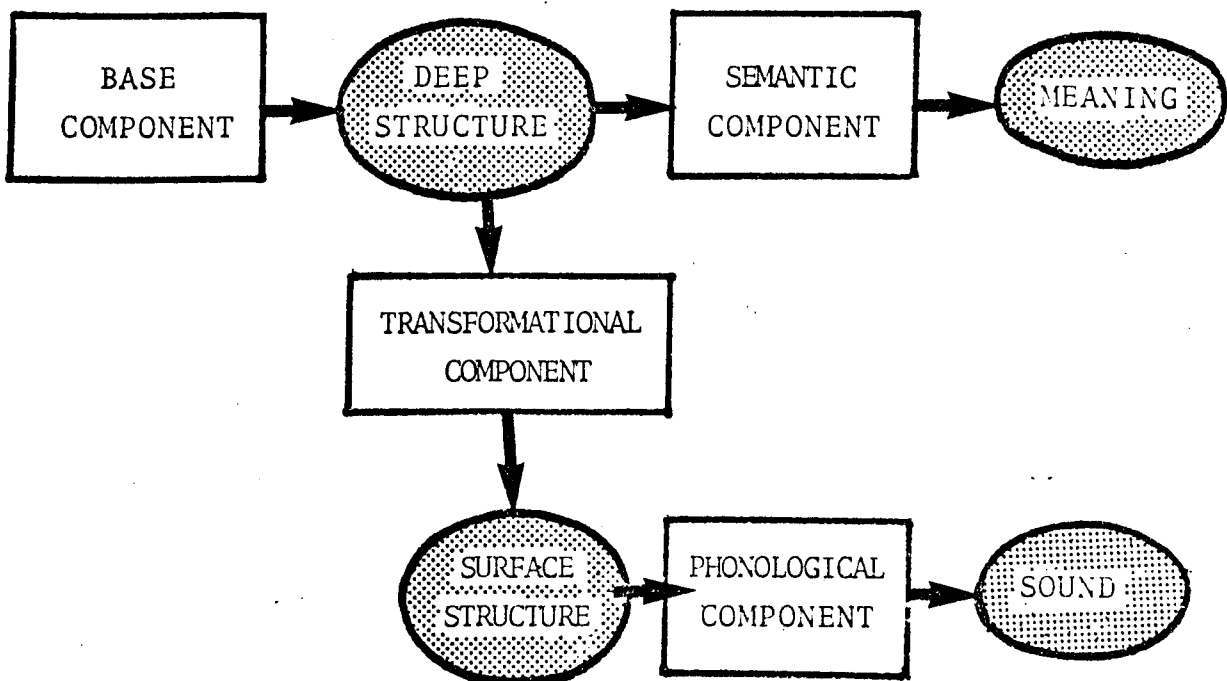
Another important idea propounded by Chomsky is that language is a mental phenomenon - internal processes occur when language is either produced or comprehended. Language is then considered primarily as a thinking process. Considering only the behaviorist view that language is a mechanical activity which can be controlled by linguistic prompts does not do justice to the complex set of inner cognitive abilities which come into play when one is using language.

In his description of language, Chomsky distinguishes between competence, the abstract linguistic knowledge an individual possesses in order to use the language, and performance, the actual production or comprehension of speech or writing. In setting up this dichotomy, Chomsky makes us realize that language is much more complex than previously believed. Therefore, it cannot be described solely in terms of its own, overt forms as done before; some way of describing the knowledge that underlies it is also needed.

In Chomsky's view, the goal of linguistic theory is to describe and explain competence, that is, our abstract knowledge of the structure of language, while it is the domain of psychology to develop a theory of performance, that is, the actual application of that knowledge in speaking and listening. A theory of competence will thus account for the structure of the language while a theory of performance will study the processes which make use of that

structure, namely, production and comprehension processes. Note that Chomsky's theory takes into account the abstract knowledge that underlies language use; it does not describe actual language use.

In developing his linguistic theory of competence, Chomsky considers the relation between syntax, semantics and phonology. The diagram below illustrates how these three elements are related in Chomsky's view of language:⁸



It should be noted, however, that in spite of the fact that phonology and semantics are given some consideration in his theory, Chomsky centers his proposal on syntax. As mentioned before, Chomsky describes competence and not performance - syntax is thus the starting point in his theory. He proposes a transformational grammar which is a device consisting of a set of rules that will account for both the productivity and regularity of a natural language and also for the linguistic intuitions of speakers of a language. The ultimate goal of this grammar is to generate all the acceptable sentences of a language and no unacceptable ones. As Bell points out *"a transformational grammar is a logical specification of the syntactic knowledge which the learner needs in order to produce grammatical sentences."*⁹

Two types of rules are present in a transformational grammar: phrase structure rules and transformation rules. The first type generates the underlying deep structure of a sentence and the second generates its surface structure. As mentioned before, a separate set of semantic rules interprets the phrase structure to generate

the meaning of the sentence. Thus, the basis for arriving at meaning lies in the syntactic relations of the sentence represented in its phrase structure.

As with the structuralist view the sentence remains the unit of linguistic analyses; a consideration of discourse as a whole has not yet received any recognition.

There is also a clear change in the focus of investigation. As mentioned before, in structuralist terms, the task of the linguist is to describe language as a coherent system of formal signs leaving out of account any reference to historical antecedents or comparisons with other languages. On the other hand, the focus of analysis in a transformationalist standpoint is on the abstract knowledge which underlies language use—what counts is the nature of the linguistic knowledge that underlies what is said. The logical result of that is twofold: the structuralist is concerned with features that make a language different from another and the transformationalist with the characteristics that are common to all natural languages as universal phenomena.

With these highlights on Transformational Grammar as background, we can positively say that it has brought about a revolutionary shift of orientation in linguistics and has also shed light on obscure points influencing research in other fields of study as well. Moreover, it has also provided a new way of looking both at language and at language learning. It should be remarked that the indirect influence of Transformational Grammar on language teaching has been quite remarkable.

Thus, from this new attitude different assumptions emerged: learning ceases to be a matter of habit formation to involve the learner's thinking, creativity and analysis.

It should also be noted that the model for the learning process is no longer behaviorist psychology. The model now is supplied by cognitive psychology whose primary attempt is to understand the workings of human intelligence and how people think and learn. The main concern of this field of enquiry is the understanding of higher mental processes. It deals primarily with mental organization, thought, and knowledge of the world. Montaner puts it in the following way:

*Cognitive psychologists ... centre their work around the mental processes underlying responses, concept formation and the nature of human comprehension. They are sometimes called "mentalists" because of their concern for the mental processes and because their theories rest on thought and language.*¹⁰

Therefore, the acceptance of a cognitive view of the learning process makes the teacher realize that important thinking processes are involved in language learning and that learning is not just a matter of habit formation but, rather, a process of hypothesis-testing on the part of the learner. Moreover, the teacher is made aware that the second language learner is not a "tabula rasa"—in fact, not only has he full command of his own language but also already developed cognitive abilities. The task of the teacher is to capitalize on that when teaching a second language.

Another point to mention is that although mastery of linguistic structure remains the focus of attention in teaching, there is some additional concern with the creative aspect of language. Thus, the exercises—whose primary function is still to develop the learner's grammatical competence—seem to be less mechanical than the ones presented under a strict structuralist orientation. Some kind of reasoning processes are also required from the learners when they are engaged in doing the exercises.

It seems we can also add that up to the 70s the teaching of reading remains almost the same as before. The reading material is still constructed around a specific grammatical point and the learner's needs are seldom taken into consideration.

In closing, we should remark that in setting up the distinction between competence and performance, Chomsky takes into consideration what really happens in our everyday use of language: the complex interaction of knowledge of language structure and a set of psychological processes required for its use. Cognitive psychologists set out from the source of ideas provided by Chomsky to seek an understanding of how these inner processes occur in the production and comprehension of language. Chomsky, on the one hand, provides a conceptualization of our abstract knowledge of language structure. Cognitive psychology, on the other hand, influenced in part by Chomskyan ideas, conceptualizes human internal mental functioning.

Unlike behaviorist psychology which is entirely engaged in the study of external behavior, failing to take into account any reference to internal processes, cognitive psychology uses overt behavior as a starting point for its theories on the abstract mechanisms of the human mind when it is engaged in the production or comprehension of language. What concerns cognitive psychology is *"the nature of human intelligence and how people think."*¹¹

This section does not exhaust all the important contributions of cognitive psychology to the learning-teaching situation. In fact, some further theoretical considerations will be taken up again in the next chapter in so far as they are essential to an understanding of some key issues concerning the current teaching of FL reading.

4. THE COMMUNICATIVE APPROACH TO LANGUAGE TEACHING

The former prevailing formalistic view in language teaching began to be questioned on the grounds that the ability to express in a given language requires more than just knowing the rules which generate well-formed sentences. Language also performs a communicative function and, as such, involves other elements like the addresser, the addressee, the setting, the code and so on. This means that knowing a language also means knowing how to deal with language in its normal communicative use. Communication entails more than a purely linguistic basis; in its complexity, language came to be regarded as interdisciplinary, involving insights from sociolinguistics and psycholinguistics.

However, as pointed out earlier, for many decades the prime concern in language teaching was towards the development of the learner's ability to handle language structure. Language learning was seen primarily as a question of acquiring structures and lexical items. Widdowson, *inter alia*, argues that language teaching has given priority to the development of the ability to handle "language usage" rather than "language use."¹²

Therefore, expressions like This is a book, That is a window were previously used with the purpose of providing a contextual situation for the teaching of grammatical items such as the demonstrative pronouns and lexical items like book and window. However, as Widdowson remarks, although these expressions are meaningful as "sentences" because they indicate the "signification" of grammatical and lexical items, they are meaningless as "utterances" since they do not carry much communicative verisimilitude and do not have any communicative "value" for the individual learner.¹³ In short, they are meaningful as sentences because they carry linguistic and grammatical signification, but are meaningless as utterances because they bear little value as communication. Therefore, the prime concern in teaching was on signification and not on communicative value and the usual strategy works in the following way: the structure is first presented, then it is drilled, next it is practised in context and then, finally, the circle is started again. The predictable outcome is a learner who is structurally competent but unable to communicate appropriately.

Although mastery of language use has not been entirely neglected since it is impossible to completely dissociate form from meaning, it is true to say that in important respects it has not received the required and adequate treatment.¹⁴ There has been a clear imbalance between the teaching of structures and the teaching of

use—form rather than communicative use—clearly tended to dominate foreign language teaching for many years. A reaction against this view has been reported by Criper and Widdowson, *inter alia*, who contend that knowledge of the rules of grammar will ensure that each sentence generated is correctly formed but it will not ensure that the forms of the utterances are appropriate.¹⁵ In other words, grammatical competence does not automatically entail "communicative competence."¹⁶

As pointed out before, this mode of thinking in language teaching which emphasizes structure runs parallel to a similar conception of languages as structures which has dominated linguistic study. It is clear that although there is an advance from Structuralism to Transformational Grammar in that the latter has so revolutionarily changed the aims and techniques of linguistic study and has shed some light on language teaching, both theories deal primarily with the study of sentence structure to the detriment of discourse and pragmatics. In both analyses, language is almost exclusively seen as a set of structures—the fact that language also carries functional and social meanings is not taken into account. Hymes, for instance, calls attention to the following fact:

*... a normal child acquires knowledge of sentences, not only as grammatical, but also as appropriate. He or she acquires competence as to when to speak, when not, and as to what to talk about with whom, when, where, in what manner. In short, a child becomes able to accomplish a repertoire of speech acts, to take part in speech events and to evaluate their accomplishments by others.*¹⁷

Thus, a reaction against this prevailing emphasis on form is naturally taking place not only in descriptive linguistics and in applied linguistics but also in language teaching. It is a reaction which is prone to recognize the prime importance of the communicative features of language; "it is a reaction towards a view of language as communication, a view in which meaning and the uses to which language is put play a central part."¹⁸ It is a reaction against the view of competence as knowledge of the grammatical rules of a language. Widdowson, *inter alia*, argues that

*... some of the features listed under performance are also systematic and form a part of the speaker's knowledge of his language (in any normal sense of knowledge), and should also therefore be considered as part of his competence. It is then part of the speaker's competence to be able to use sentences to form continuous discourse, as Halliday points out; it is part of his competence that he should know how to use sentences to perform what Searle calls speech acts, Lyons calls semiotic acts, and I call rhetorical acts.*¹⁹

In language teaching it is the communicative approach which embodies a reaction against the widespread methodology which has primarily emphasized language structure.

The paramount assumption which stands out as the most revolutionary in this approach to language teaching is its prime concern with the communicative features of language. It is an approach which has formulated its aim towards communicative competence—rather than a Chomskyan grammatical competence. Knowledge of language is no longer equivalent to knowledge of syntactic structures, but it means knowledge of how to deal with language in its normal communicative use relating forms with the communicative functions they perform. In expressing doubt, for instance, different linguistic forms may be used to fulfil the same basic function. One might use one of the following alternative ways: I might go, or Perhaps I'll go, or I'll go, I don't know, or still I'm not sure I'm going. Language learning has then been geared to developing the learner's communicative proficiency focusing central attention on "*the development of strategies for dealing with language in use*", rather than the development of grammatical proficiency.²⁰ It seems true to add that knowledge of the elements of a language is useless unless the learner is capable of dealing with them creatively and appropriately to perform its social function according to his specific communicative purposes. Widdowson, for instance, calls attention to the fact that "*grammatical competence remains in a perpetual state of potentiality unless it is realized in communication*".²¹

The Communicative approach to foreign language teaching is thus oriented towards restoring the balance between grammatical forms and language use—it has thus extended from linguistic structures to communicative activities aiming at developing in the learner the ability to use the language as a means of communication.

It might be appropriate to remark that in this approach the foreign language is taught as a whole. This means that the language is not divided into isolated segments and taught gradually, additively and linearly up to the acquisition of a finite number of rules which, it is believed, will give the learner the ability to use the language appropriately when the need arises. Quite differently, the communicative approach presents language from the very beginning in "semantically-homogeneous" but "structurally-heterogeneous" units.²² The result is thus a lack of preoccupation with simplification of materials and situations which dissociates language from its true communicative purposes—in the same piece of teaching unit different grammatical items co-occur allowing for a more real instance of language in use. In other words, authentic samples of language are used to the detriment of graded syntactic

structures.

This view of language as communication has further implications when translated into a teaching methodology. A question immediately arises as to the students' communicative needs. It may be for social interaction, for international communication, for the transmission of science and technology, and so on. The analysis of communicative needs is important in the specification of the course content, for, as Candlin remarks, "*a view of language as communication implies teaching materials which relate form, function and strategy.*"²³ Mackay and Mountford also point out that

*... the possession of accurate, objective information about the learner, his specialism and his needs, enables the course planner to narrow down the area of language use and usage—and of course the mode, spoken or written—from which the linguistic items in communicative patterns of language use should be drawn.*²⁴

This more accurate objective information about learner's communicative needs and a greater concern with them gave rise to the teaching of ESP, a branch of communicative language teaching.²⁵ Since it is the written communication in English learners often have to cope with, ESP, as it stands now, is primarily concerned with developing the learner's ability to handle written scientific discourse in an effective way. This learner-centered approach represents a movement in the direction of the teaching of discourse as a whole and it aims at developing the learner's "*ability to understand the rhetorical functioning of language in use.*"²⁶

5. FINAL REMARKS

This chapter has described some major theoretical issues concerning the scientific study of language and their influence on second language teaching in the last 40 or 50 years. This survey reveals that second language teaching has shifted from a mechanistic view towards a more mentalistic one. It has also shown a recent shift from sentence-based materials towards discourse-based ones, a shift that has resulted from a view of language as communication.

This chapter has also shown the place reading has in each of these approaches. If reading held a marginal place in audio-visual and audio-lingual methods, it tends to receive full attention in

communicative language teaching, as the result of accurate needs analyses carried out in order to specify the learner's communicative needs.

A point must also be made about the kind of text used in the teaching of reading. If the audio-visual/lingual methods used texts constructed to exemplify a given grammatical point, communicative language teaching uses authentic instances of discourse, be it written or spoken, regardless of grammatical grading.

The next chapter will provide a discussion of both the information-processing system and the concept of Schema and how they relate to a more recent reading methodology.

NOTES

¹ Danny R. Moates and Gary M. Schumacher, An Introduction to Cognitive Psychology (Belmont, Ca.: Wadsworth Publishing Co., 1980), p. 3.

² Since we have referred to the audio-visual method, it may be appropriate to consider the primary role of visuals in this method. One of the claims of Structuralist Linguistics is that each language is self-contained, sharing no features with other languages. Based on this belief, visuals in the audio-visual method are used to avoid interference of the mother tongue in the learning of a second language. Audio-visual materials abound with illustrations whose role is to explain vocabulary and to set the context without using the mother tongue. Moreover, further uses of visuals, such as a way of activating the reader's schema, which will be considered later at length, have no place in the audio-visual teaching.

³ Gérard Vigner (Lire: du Text au Sens, Paris: CLE International, 1979, p. 117) adds a third semiotic device in scientific discourse, that is, the formal language made up of formulas and conventional symbols.

⁴ G.H. Widdowson, Explorations in Applied Linguistics, 2nd. ed. (Oxford: Oxford University Press, 1980), p. 246.

⁵ Armando Humberto Baltra Montaner, "Reading for Academic Purposes", Diss. Pontifícia Universidade Católica São Paulo 1982, pp. 26-27.

⁶ It is not always easy to tell cognitive psychology from linguistics and psycholinguistics since there is a lot of common ground. R.J. Harris in his article "Cognitive Psychology and Applied Linguistics: a timely rapprochement" (in Ensaio de Linguística, Ano IV, 7, 1982, p. 154) has remarked: "In recent years it is becoming more difficult totally to separate linguistics and psycholinguistics, or, more generally, linguistics and cognitive psychology. To truly understand how language works requires the consideration of psychological factors, such as the intention of the speaker, the context of the utterance, and the knowledge in the mind of the hearer."

⁷ Steven H. McDonough, Psychology in Foreign Language Teaching (London: George Allen & Unwin, 1981), p. 98.

⁸ John R. Anderson, Cognitive Psychology and its Implications (San Francisco: W.H. Freeman and Co., 1980), p. 381.

⁹ Roger T. Bell, An Introduction to Applied Linguistics (London: Batsford Academic and Educational Ltd., 1981), p. 107.

¹⁰ Montaner, p. 33.

¹¹ Anderson, p. 3.

¹² H.G. Widdowson (Teaching Language as Communication, Oxford: Oxford University Press, 4th ed., 1983 p. 18) explains that "language usage" refers to "the citation of words and sentences as manifestations of the language system" and "language use" refers to "the way the system is realized for normal communicative purposes."

¹³ Widdowson (Teaching, p. 19) distinguishes "signification" from "value" in the following way: "The term signification" refers to the kind of meaning "that sentences have in isolation from a linguistic context or from a particular situation in which the sentence is produced." The term "value", on the other hand, refers to "the meaning that sentences take on when they are put to use in order to perform different acts of communication."

Widdowson (Explorations, p. 8) distinguishes not only "signification from "value", but also "sentences" from "utterances" in the following way: "Language can be manipulated in the classroom in the form of text-sentences which exemplify the language system and thus indicate the signification of linguistic items. This is not the same as language use—the use of sentences in the performance of utterances which give these linguistic elements communicative value. In the classroom; expressions like "Come here", "Sit down" are utterances because they have a communicative import in the classroom situation, which provides a natural social context for their occurrence."

¹⁴ C.J. Brumfit and K. Johnson, "The Linguistic Background," in The Communicative Approach to Language Teaching, ed. C.J. Brumfit and K. Johnson, 2nd. ed. (Oxford: Oxford University Press, 1981), p. 1.

¹⁵ C. Criper and H.G. Widdowson, "Sociolinguistics and Language Teaching," in Papers in Applied Linguistics, Vol. II of The Edinburgh Course in Applied Linguistics, eds. J.P.B. Allen and S. Pit Corder (London: Oxford University Press, 1975), p. 155.

¹⁶ For further discussion of the term see D.H. Hymes, "On Communicative Competence," in Brumfit and Johnson, pp. 4-24.

¹⁷ Hymes, p. 15.

¹⁸ Brumfit and Johnson, p. 3.

¹⁹ Widdowson, Explorations p. 12.

²⁰ Widdowson, Explorations p. 249.

²¹ H.G. Widdowson "Directions in the Teaching of Discourse," in Brumfit and Johnson, p. 50.

²² Terms borrowed from Keith Johnson, "Communicative Approaches and Communicative Processes," in Brumfit and Johnson, p. 203.

²³ Christopher Candlin, Pref., English for Specific Purposes, 2nd. ed., by Ronald Mackay and Alan Mountford, eds. (London: Longman, 1979), p. VIII.

²⁴ Ronald Mackay and Alan Mountford, "The Teaching of English for Special Purposes: Theory and Practice," in Mackay and Mountford, p. 10.

²⁵ This approach has been coined ESP (English for Specific Purposes), sometimes EAP (English for Academic Purposes), EST (English for Science and Technology), etc. depending on the teaching situations and learner's requirements.

²⁶ J.P.B. Allen and H.G. Widdowson, "Teaching the Communicative Use of English" in Brumfit and Johnson, p. 124.

CHAPTER II

THE INTERACTION OF COGNITIVE ISSUES AND THE READING PROCESS

1. PRELIMINARY REMARKS

The main purpose of this chapter is to bring together some theoretical issues in cognitive psychology which are of paramount importance to an understanding of the reading process and, consequently, of particular relevance to the teaching of FL reading. The need to provide this theoretical background is twofold: first, it informs the underlying view in this dissertation of comprehension as an interactive process involving both the information in the text and the reader's knowledge of the world which is brought to the reading task. Secondly, it paves the way for an understanding of our major argument—discussed in the next chapter—that the more pictorial information we use in our reading classes, the more effective the students' performance will be, in the sense that better retention will ensue from a proper processing of information.

This chapter will first discuss how new incoming information is processed, that is, how the flow of information is perceived. how it comes into our brains, how it is fully processed, and how it is stored for future use. Then, it will stress that previous knowledge, which is the result of our experience in the world, plays a fundamental role in our everyday processing of information.

The view of comprehension as an interactive process implies that comprehension is not an effortless task—the reader cannot just wait for meaning to reach him, he has actively to construct the correct interpretation of what he is reading by making use of all linguistic and nonlinguistic guides provided by the written text itself and also by retrieving the adequate background knowledge he already possesses and which is necessary to comprehension. This means that in his task of constructing meaning the reader is not only guided by what he reads, but also by what he expects to find in a written passage based on previous knowledge and contextual clues.¹

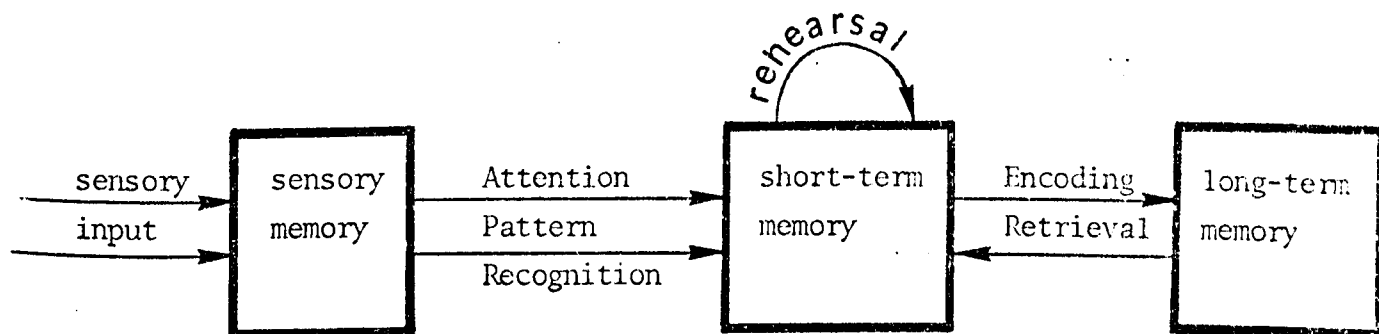
In processing written material for comprehension, the reader derives the meaning his previous knowledge enables him to. This may explain text polysemy—a piece of written material is not understood in the same way by two individuals: how, what, and how much something is comprehended is largely dependent on each individual's preexisting knowledge that is brought to interact with the information conveyed by the text itself.

Let us then proceed with a brief discussion of the theoretical issues, namely, the information-processing system and the concept of schema. We will also relate them to the reading process and, in

turn, to our argument that the use of nonlinguistic devices can be of great assistance in our task of developing the students' ability to construct interpretations of pieces of written discourse in an effective way.

2. THE INFORMATION-PROCESSING SYSTEM

Cognitive psychologists have concentrated a great deal of research on the way information is taken in, selected, processed and encoded. One of their main concerns is the study of the various processes undergone by the flow of information from the moment it is received to its comprehension and retention. The following diagram schematically illustrates the sequential tracing of information from environmental stimuli to long-term memory.²



As the arrows above indicate, the processing of information occurs mostly from left to right in the following way: environmental stimulus enters sensory memory which holds information for a very short period of time; then the processes of attention and pattern recognition come into play in order to select and identify some of the information held by sensory memory for a more detailed processing in short-term memory; finally, information that has just come into short-term memory and information that is retrieved from long-term memory interact in short-term memory and processing, encoding, and transfer to long-term memory take place.

It is important to point out that material remains in short-term memory for a very short period of time (15-30 seconds) unless it goes on being processed in some way. Thus, material may be retained in short-term memory through "rehearsal", that is, a deliberate allocation of attention to a specific item we are thinking about now as, for example, when repeating a telephone

number while dialing the phone. Material may also be retained in short-term memory while it is being processed before encoding in long-term memory. As Harris explains, *"if material is actively attended to, rehearsed, or otherwise thought about, it can remain in short-term memory indefinitely."*³

A basic paradox which involves this kind of model for the information-processing system must be pointed out here. Though the flow of information proceeds mostly from left to right, sometimes material has to be retrieved right to left from long-term memory. This occurs because we have to rely on the knowledge already stored to process and comprehend new information. This need to retrieve information from long-term memory occurs at different points: either earlier at the perception stage when attention and pattern recognition processes are taking place or later at the moment of the interaction between new incoming information and information activated from long-term memory in short-term store.⁴

While information is being processed, top-down (conceptually-driven) and bottom-up (data-driven) processes are taking place simultaneously. *"Bottom-up processes refer to the processing of the environmental stimuli themselves"* while top-down processes involve *"expectations about what the data will hold, based on past experiences and knowledge in long-term memory."*⁵

The concepts of sensory memory, short-term memory and long-term memory deserve some additional discussion, especially the last two ones, since they will be recurrent in subsequent chapters of this study. Let us then provide a more detailed description of each of them.

Sensory memory is *"the most immediate and perceptual store of memory."* The primary function of this type of memory is simply to hold new incoming information for a very brief span of time. Information held in sensory memory is *"selectively attended to and identified for further processing in short-term memory."* Information that is not selected for further processing decays very quickly from sensory memory.⁶

Short-term memory is the store of memory which *"contains all the information that we are thinking about right now."*⁷ This includes both information retrieved from long-term memory and new incoming stimuli. As mentioned before, material which is neither maintained in a state of activation nor sent to long-term memory for a permanent storage decays very rapidly from short-term memory. It is worth noting that information can only be used if in this active state. As Anderson puts it, *"STM [short-term memory] serves as a repository for knowledge that is required by cognitive processes being performed. These procedures cannot function if the*

*knowledge is not in STM."*⁸

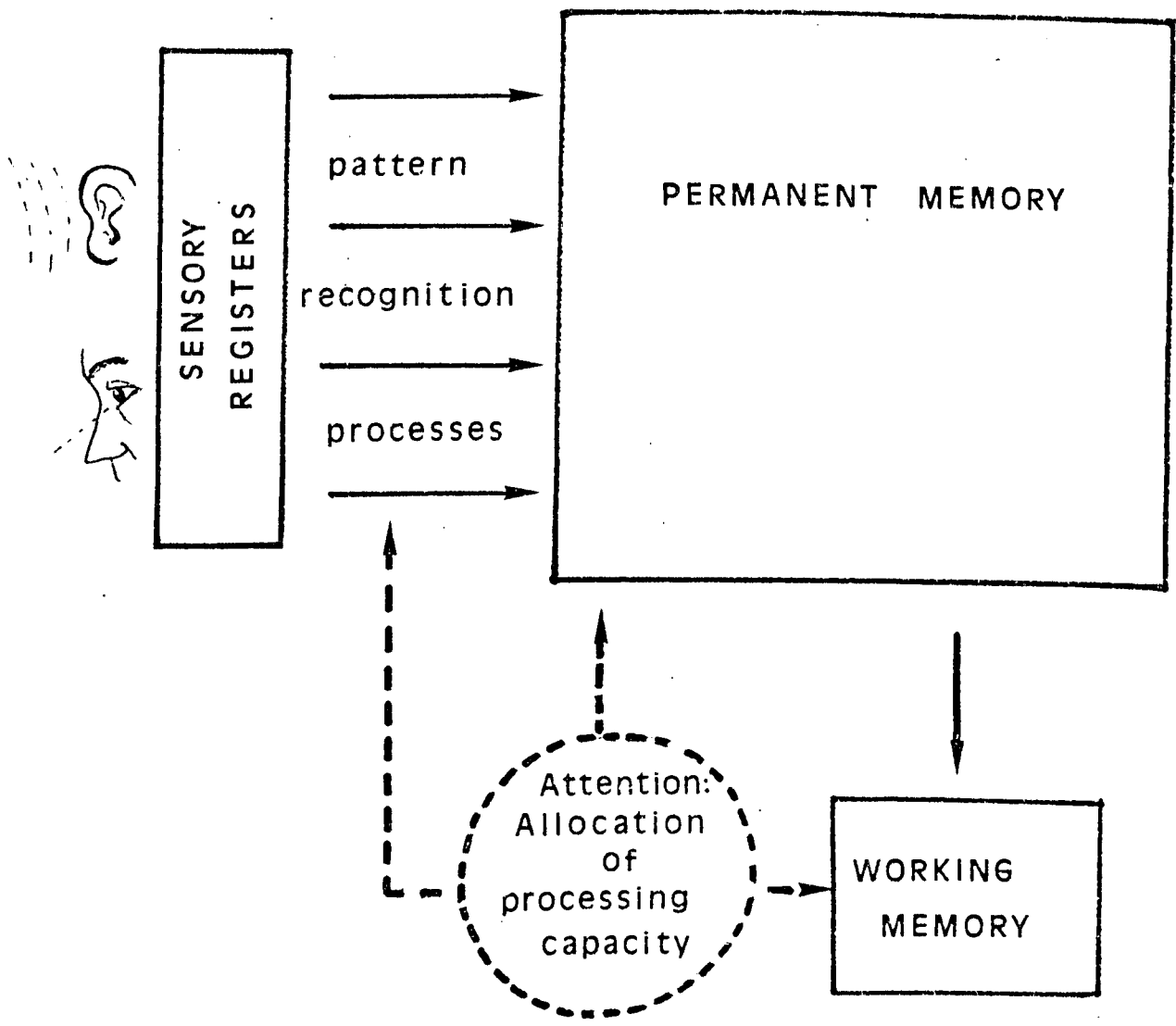
A point must be made about the limited capacity of short-term memory. Research has provided evidence that this store of memory can hold up to six or seven items at one time; thus, as Harris points out, it can hold seven numbers, also seven words, seven pictures, or even seven sentences. However, we can overcome the limitations of short-term memory by organizing "*small detail into larger units.*" This organization is known as "chunking".⁹ Harris explains that by making use of "chunking" we may combine larger pieces of information together to make them occupy less space in short-term memory. He provides the following example: we may chunk "*the three words, rabbit, hat, and hamburger, from three bits into one by encoding them as one coherent image of a rabbit wearing a baseball cap and chomping on a Big Mac.*"¹⁰

Long-term memory refers to the part of memory whose primary function is to store all our knowledge. Unlike short-term memory, it has an unlimited capacity and keeps information indefinitely. Smith points out that the basic difference between short-term memory and long-term memory is related to "*one important word—organization.*" While the former holds unrelated items, the latter is "*a network, a structure of knowledge, it is coherent.*"¹¹

At this point it might be appropriate to mention the distinction drawn by Endel Tulving between two kinds of permanent memory: episodic memory and semantic memory. Moates and Schumacher thus explains Tulving's distinctions:

*Episodic memory refers to the memory a person has for temporally dated events and for relations between these events ... Semantic memory, on the other hand, refers to the organized knowledge a person has about words, symbols, formulas, concepts and rules. It includes the knowledge base necessary for the production and comprehension of language. It is the vast compendium of information that an individual knows about his or her world which is not tagged for a particular time.*¹²

Moates and Schumacher, using a slightly different terminology, provide a more integrative view of the information-processing system. For sensory memory, short-term memory and long-term memory they use respectively sensory registers, working memory and permanent memory. Their diagrammatic description of the processing of the flow of information seems quite clear. It depicts the six major information-processing components which are labelled: sensory receptors, sensory registers, permanent memory, pattern recognition processes, attention, and working memory.¹³



In their model, sensory receptors are the channels through which environmental stimuli make contact with our perceiving senses, mostly our eyes and ears. The environmental stimulus first reaches these receptors before undergoing a complex processing by the human mind. Information which is caught by these receptors is held by the sensory registers. These are mechanisms which retain a representation of the incoming stimuli temporarily in order for meaning to be derived. Determining the meaning of a stimulus involves us in consulting a permanent repository of knowledge of the world. This component is labelled permanent memory.

On the one hand, to determine the meaning of an input implies that we relate environmental stimuli to knowledge we already possess; on the other hand, incoming stimuli are not exact copies of what we have stored in permanent memory. Thus, in order for us to determine the meaning of environmental stimuli, we have to transform and analyze these stimuli and relate them to what is already stored in our permanent memory. Thus, carrying out the activity of extracting meaning of a stimulus involves us in making use of a number of different processes which are labelled pattern recognition processes. In their model these processes occur between

the sensory registers and permanent memory.

Since we often have a great amount of environmental stimuli at our disposal, we have to select which part of the environment is to be analyzed and processed. This selection is to be done since we are primed with a limited processing capacity: there is a limited number of things we can focus on at a time. Thus, we have to decide how to allocate our limited processing capacity to the many options present in our environment. This is the process of attention.¹⁴ This component is included in the dashed circle at the bottom of the figure representing the information processing system. (see diagram on page 30).

Working memory is a key component of our information-processing system. It is indicated in the box below permanent memory. Working memory is a "*limited resource that is involved in choices, selections and decisions*" which are made "*by the individual.*"¹⁵ It plays an important role as information is retrieved from permanent memory.

When information is being processed, key aspects of our cognitive functioning are brought into working memory. The individual then has control over the processing he is doing. Thus he becomes able to monitor or modify the new different combinations of information that have to be dealt with in the process of determining the meaning of a given stimulus.

In essence, these six components are the key elements of the powerful system which is responsible for the deriving of meaning from new information which we are permanently processing for comprehension.

The discussion we have just provided about the information-processing system is extremely relevant to an understanding of the processes involved in the comprehension of a written text. It makes it clear that comprehension is a very complex activity which involves a series of processes and cognitive abilities on the part of the comprehender. It also makes it clear that comprehension occurs gradually, involving intermediate processes which are of crucial importance to the final goal of the comprehender, that is, the understanding of what he reads.

Let us then relate this body of theoretical information to the reading situation referring primarily to the model provided by Harris. Suppose a reader has, among the different reading situations he might encounter, three texts dealing respectively with, say, biology, computer science, and politics. The visual information conveyed by the texts—letters, illustrations, divisions between the paragraphs, punctuation, etc.—are registered by the reader's most immediate and perceptual store of memory: the sensory memory; it then holds information just long enough in order for it to be

selectively attended to and identified by means of the two early processes in the sequence of the processing of information: attention and pattern recognition.

Let us suppose that this particular reader chooses to attend to the text on computer science; he then allocates more attention to that text and his choice is based not only on the information in sensory memory but also on information retrieved from his long-term memory. Perception is not a passive grasping of external stimuli, it is, rather, an interaction in which new incoming stimuli are selected and associated with the knowledge of the world the individual already possesses stored in his long-term memory. Thus, it is likely that one of the reasons for this reader to choose the text on computer science is that he probably has more information about computers in his long-term memory.

Therefore, after using his processing capacity in order to select which text to attend to, this specific reader starts analyzing and identifying its components as exemplars of concepts he already possesses stored in his own memory by the use of the processes of pattern recognition. All information is then sent to short-term memory where the real processing of the information conveyed by the text takes place.

Then, the final stage is the detailed processing of information, its encoding and transfer to long-term memory. While information is being processed, already stored knowledge is again retrieved from long-term memory since comprehension only takes place when there is an interaction between incoming new information and the reader's preexisting knowledge. At this point the reader thinks about what he is reading, he judges the validity of the message, he compares what he is reading with knowledge retrieved from long-term memory, he infers from what he is reading—the slots left by the text are filled by his previous knowledge.

While the reader is actively involved in his task of comprehending what he reads, he bases himself not only on the linguistic guides provided by the text, but also on the knowledge of the world he already has. As pointed out earlier, comprehension results from the essential interplay of top-down and bottom-up processes. The reader not only brings knowledge to the comprehension task based on what he already knows, but also makes use of the explicitly information conveyed by the text, the redundancy of language, and so on in his dynamic interaction with the text he is reading.

The information about computers while actively processed remains in the reader's short-term memory. After its processing and comprehension it is encoded in long-term memory for future use. (Information which has not been processed decays from short-term

memory and is forgotten). Both processes—encoding and retrieval—occur simultaneously when the reader is interpreting his chosen text: he encodes material for future use and he also retrieves information from long-term memory to make it possible the required interaction between his preexisting knowledge and new incoming information in his active involvement with the construction of the meaning of the text he is reading. Comprehension does not lie exclusively in either the text or the reader, but in the interaction between both.

3. THE CONCEPT OF SCHEMA

We now turn our focus of attention to the concept of schema (plural schemata or schemas) relating it to the reading process. Cognitive psychology provides evidence that schemata play an important role in how we process written materials. As pointed out earlier, the process of comprehending new information involves us in making use of our schemas, that is, units of generalized knowledge we have stored in our long-term memories. These units are in fact the fundamental elements all information processing depends on. Rumelhart points out that

*Schemata are employed in the process of interpreting sensory data (both linguistic and nonlinguistic), in retrieving information from memory, in organizing actions, in determining goals and subgoals, in allocating resources, and, generally in guiding the flow of processing in the system.*¹⁶

One important characteristic of schemas or schemata is that they have slots or variables. These slots are filled with different specific information when the schema is activated. The process of filling these slots is called the instantiation of the schema.

A second major characteristic of schemas is that they "may be embedded within each other, thus allowing for a hierarchical structure of schematic information." Harris provides the following example: while we have a schema for face which includes two eyes, nose, two ears, and mouth, we also have a subschema for the eyes which includes information concerning the pupil, retina, iris, and eyelid. Other subschemata present are those for the nose, the ears, etc. All these subschemata are subsumed under the most comprehensive schema "face".¹⁷

The third characteristic of schemas is that they vary in their level of abstractness. Harris explains that we have very specific schemas, such as the appearance of a capital A; but we also have general schemas such as the different literary genres, e.g., what to expect from a mystery story, western, or television soap opera.¹⁸

Anderson points out that

*Schemas are important knowledge structures that enable us to deal effectively with the information processing demands of a large and complex world. They serve to extract and categorize clusters of experiences in that world.*¹⁹

Cognitive Psychology has emphasized the powerful role the reader's knowledge of the world or his background knowledge—as represented in schema—plays in the processing of written materials. This means that when reading for comprehension, the reader interacts with the information conveyed by the text by making use of his knowledge of the world to properly construct an interpretation of what he is reading. What the reader brings to the text is generally as important as what he finds in it—it is this previous knowledge that enables him to make sense of what the text is about. Harris remarks that a "fundamental assumption of [schema theory] is that a written text does not in itself carry meaning but rather provides directions for listeners or readers on how to use their own stored knowledge to construct the meaning."²⁰

One function of the schema is to guide the reader's drawing of inference in his active involvement with a piece of written material. According to Harris, the inferences which are drawn during comprehension fulfil two general functions:

*First, they make connections between propositions in the input and between propositions and knowledge already in memory. This allows for integration of new material in memory representations of previously learned information and also helps to provide some organization and structure to the information. Second, inferences fill in empty "slots" in the overall structure. For example, if a strongly implied instrument for some action is not explicitly mentioned, it may be inferred and added to the memory representation just as if it had appeared explicitly.*²¹

This means that when reading for comprehension, the reader

goes beyond the information available in the text and fills in the missing information by inference basing on his knowledge of the world.

This way reading can be considered as a constant process of guessing, predicting, evaluating, and asking oneself questions that might be answered by the text.²² The role of the reader is thus an active one—he has to construct the meaning of the text by himself. Smith calls attention to the fact that *"reading is asking questions of printed text. And reading with comprehension becomes a matter of getting these questions answered."*²³

It may be worth noting that we can only make sense of what a reading stimulus is in terms of what we already know, that is, in terms of the knowledge of the world we have acquired throughout the succeeding years of our existence. This personal knowledge is in fact the fundamental basis for our perception and understanding of the world around us—it is also the basis for all our learning. Thus, we make sense of the world by referring to this knowledge and we learn more by modifying and elaborating this preexisting knowledge.²⁴

Furthermore, one cannot understand what is not meaningful to him. It is a common situation to refer to a piece of written material as difficult or badly written if one fails to properly understand it. This lack of comprehension might be due to the fact that the reader does not have the necessary background information to interact with the new information provided by the text in question. In this case, the problem is not with the text itself, but with the gap between the amount of information in the text and what the reader already knows.

Moreover, it is very difficult for a reader to understand a piece of discourse which apparently has no theme—as the reader feels incapable of forming the overall gist of the written passage, he cannot construct an interpretation based on what he already knows. For example, suppose the following passage is given to our class of students:

*With hocked gems financing him, our hero bravely defied all scornful laughter that tried to prevent his scheme. "Your eyes deceive," he had said, "an egg not a table correctly typifies this unexplored planet." Now three sturdy sisters sought proof, forging along sometimes through calm vastness, yet more often over turbulent peaks and valleys. Days become weeks as many doubters spread fearful rumors about the edge. At last from nowhere welcome winged creatures appeared signifying momentous success.*²⁵

The predictable outcome is probably total lack of comprehension. What happens is that the students do not have at their disposal a title, a word or situation that could inform them which previous knowledge should be used to accept the new incoming information and, consequently, construct an interpretation of what they read. The information conveyed by the passage is not consistent enough in guiding the students in their task of forming predictions about the real content of the passage. As a result, they cannot use their previous knowledge to properly understand its meaning.

On the other hand, if this passage is re-read having in mind the title "Christopher Columbus Discovering America", the students can probably make sense of the information presented and construct a correct interpretation. They are capable of assigning meanings and interpreting what they have re-read because they supplement a great deal of information that is not provided by the passage based on their previous knowledge about Columbus and what he did. In other words, by having in mind an appropriate schema with slots for ocean travel, how the voyage was financed, the types of ships used in the voyage, the kind of people that welcomed Columbus, the students can then easily interpret what they have just read.²⁶ What happens is that the schema which was retrieved accounts for the various words and sentences that could not be interpretable at the time of the first reading.

A point to be re-emphasized is that new incoming information is accurately comprehended only if it can be associated with the reader's existing knowledge stored in his long-term memory. This is true in all the processing stages of information from the moment it comes into our brains to its encoding in long-term memory. As pointed out earlier, by using this knowledge, the reader is able to select the text most appropriate to his purposes and motivation, to pre-process information through attention and pattern recognition, and to process information in a greater detail in short-term memory.

When selecting among different texts which one to attend to, the reader makes his choice fundamentally based on his preexisting knowledge. He chooses the text his knowledge of the world enables him to make sense of. By using this knowledge, he is able to form predictions about the content of the text, to rule out alternatives that are not possible and keep those which properly fit the overall theme of the written material he is about to read. Smith argues that *"the basis of comprehension is prediction. And prediction is achieved by making use of what we already know about the world."*²⁷

When pre-processing information, the reader concentrates on the text he is about to read and, basing on his preexisting knowledge, he selects and identifies the general meaning through

attention and pattern recognition; he then sends this pre-processed information to short-term memory for further processing.

In the processing of information in a more detailed way in short-term memory, the reader again makes use of his preexisting knowledge when this knowledge interacts with the new information conveyed by the written material itself, when judging the validity of the message, when questioning the way linguistic information is organized in the written material, when filling the slots left by the text through the process of inference, when comparing his current reading with previous readings of the same subject, and so on.

Information that has just been processed and comprehended is sent to long-term memory for future use. Thus, an adequate processing of information ensures some additional knowledge into the reader's preexisting schemas, either by altering the schemas or simply by incorporating some new knowledge into them. Harris points out that *"the stimulus information, as it is being interpreted and encoded, and the information already stored in memory are both affected and altered by each other."*²⁸

The schematic representation that follows summarizes what has been discussed in this chapter and suggests a relationship between the various stages of information-processing and the main phases in a reading lesson.

Processing stages of information	Phases in the Reading Lesson
. information entering sensory memory	PREDICTION: use of knowledge of the world to properly accept the new information
. information in sensory memory: attention and pattern recognition processes - pre-processing of information -	READING FOR OVERALL MEANING use of knowledge of the world to grasp the general points and send them to short-term memory.
. information in short-term memory - in-depth processing of information -	MAIN POINTS COMPREHENSION & INTENSIVE COMPREHENSION: use of knowledge of the world to infer, to compare, to judge, to process linguistic information, and so on.

4. FINAL REMARKS

This chapter has considered some theoretical issues in cognitive psychology and has related them to the reading process. These issues, in turn, have brought about some changes of perspective in the current teaching of FL reading.

First, as it was pointed out, the flow of new incoming information progresses from environmental stimuli to encoding in long-term memory. This means that when constructing the meaning of a written text, we progress from its overall meaning towards a deeper a more detailed understanding. Therefore, the current reading lesson ranges from prediction as a lead-in to the topic of the text towards intensive comprehension involving, of course, the reader's knowledge of the world in all the processing stages of information, which may foster a better retention.

Secondly, the view of comprehension as an interactive process is another change in perspective. Since text comprehension involves both text information and the reader's knowledge of the world, reading is no longer considered as a passive activity, it is rather an active interaction which involves the reader in "a negotiation of meanings."²⁹ The reader is thus expected to make use of what he already knows to form hypotheses, check them, make inferences, go outside the text to understand the context of situation, and so forth. Therefore, the teaching of reading usually makes use of reading material which is meaningful to the students, that is to say, within the students' spectrum of previous knowledge. There must be always a shared area between what the students know and what the text presents, otherwise no comprehension can take place.

Thirdly, another point in the change of perspective is that the reading material is graded according to the students' background knowledge and not lexical and grammatical difficulties. The greater the shared knowledge between what the students know and what the text presents, the easier is the processing of new information towards comprehension and retention. In other words, the more links the students can establish between the new information being processed and information in their long-term memories, the easier comprehension becomes.

A point that seems paradoxical should be made concerning the reading material. As just mentioned, the reading material must be meaningful to the students, that is, the students must possess some previous knowledge to interact with the new information provided.

On the other hand, this reading material must also be challenging to the students in the sense that it must present some further information that the students do not have yet. The students can then use this new information either to alter or simply to incorporate it into their preexisting knowledge.

A further point to mention in relation to the reading material is that authentic texts are used in the reading classes to the detriment of constructed or simplified versions. This means that the text iconography, accompanying illustrations, grammatical and lexical items are totally retained. In order to bypass or lower the linguistic difficulties of authentic texts, two criteria of grading must be taken into consideration: first, as just pointed out, grading of reading material according to the students' preexisting knowledge; secondly, grading of the reading comprehension activities required of the students, that is, from reading for gist in the first lessons towards intensive comprehension.

In closing, it may be relevant to reiterate that text comprehension ties together linguistic competence, knowledge of the world, the use the reader makes of context and the interpretation of the accompanying nonverbal features of a piece of written discourse. The point to bear in mind is that when actively involved in his task of constructing meaning, the reader deals with all these elements as a whole—one element supplements the understanding of the other, all elements are used for an accurate comprehension of the whole. Everything is in fact simultaneously processed in the reader's active interrogation of the meaning of a text.

The next chapter will integrate the theoretical issues discussed up to this point and some further specific information in both cognitive psychology and the structure of written discourse. This will lead to the devising of a methodology to the teaching of reading which primarily emphasizes the use of nonverbal discourse, as well as pictorial information, in the development of the students' ability to cope with written discourse in a foreign language.

NOTES

¹ The discussion of comprehension and the information-processing system is mostly based on lectures, handouts, and classroom discussions during the courses given at UFMG by the visiting Professor Dr. Richard J. Harris from Kansas University, during the second term in 1982. The specific discussion of comprehension is mostly based on Chapter 9 of the book Human Learning (forthcoming).

² This discussion of the information-processing system is mostly based on Harris, Chapter 7 (see note 1 above). Harris, in turn, acknowledges his debt to the model of R.C. Atkinson and R.M. Shiffrin.

³ Harris, chapter 7, p. 28.

⁴ Arnold Lewis Glass, Keith James Holyoak and John Lester Santa (Cognition, Reading, Massachusetts: Addison-Wesley Publishing Co., 1979, p. viii) provide some different views to this type of model for the information-processing system. They contend that the "tracing of information from peripheral to central stages does do justice to the interactive nature of the system." It is their view that "sharp divisions cannot be drawn between separate processing stages" since "the core of cognition is not a passive long-term memory, but an active processor that interacts with the environment." They still argue that the various processes undergone by information are very closely intertwined and it is "impossible to discuss one of the topics without bringing on the others."

⁵ Harris, chapter 7, p. 4.

⁶ Harris, chapter 7, p. 5.

⁷ Harris, chapter 7, p. 27.

⁸ John R. Anderson, Cognitive Psychology and its Implications (San Francisco: W.H. Freeman and Co., 1980), p. 169.

⁹ Frank Smith, Reading 2nd. ed. (Cambridge: Cambridge University Press, 1981), p. 40.

¹⁰ Harris, chapter 7, p. 29.

¹¹ Smith, p. 43.

¹² Danny R. Moates and Gary M. Schumacher, An Introduction to Cognitive Psychology (Belmont: Wadsworth Publishing Co., 1980), p. 83.

¹³ Moates and Schumacher, p. 8 - The illustrations, which refer to the example they provide, have been left out.

¹⁴ Harris (Chapter 7, p. 8) explains that "an alternative way to conceptualize attention is as processing capacity."

¹⁵ Moates and Schumacher, p. 48.

¹⁶ David E. Rumelhart, "Schemata: the Building Blocks of Cognition" in Theoretical Issues in Reading Comprehension, eds. Rand J. Spiro, Bertram C. Bruce and William F. Brewer (Hillsdale, New Jersey, Lawrence Erlbaum Associates, 1980), pp. 33-34.

¹⁷ Harris, chapter 9, p. 23.

¹⁸ Harris, chapter 9, pp. 23-24.

¹⁹ Anderson, p. 158.

²⁰ Harris, chapter 9, p. 22 (Harris, in turn, acknowledges his debt to M.J. Adams and A Collins).

²¹ Richard J. Harris, "Inferences in Information Processing" in The Psychology of Learning and Motivation, vol. 15 (New York Academic Press Inc., 1981), p. 83.

²² Francoise Grellet, Developing Reading Skills 2nd ed. (Cambridge: Cambridge University Press, 1982), p.4.

²³ Smith, p. 105.

²⁴ Smith, p. 81.

²⁵ D.J. Dooling and R. Lachman, as quoted in Moates and Schumacher, p. 187.

²⁶ Moates and Schumacher, p. 196.

²⁷ Smith, p. 87.

²⁸ Harris, "Inferences", p. 82.

²⁹ H.G. Widdowson, Explorations in Applied Linguistics 2 (Oxford: Oxford University Press, 1983) p. 64.

CHAPTER III

THE INTERACTION OF THE DUAL-CODING THEORY AND THE
SEMIOTICS OF WRITTEN DISCOURSE

1. PRELIMINARY REMARKS

This chapter will provide a theoretical discussion of the way our knowledge of the world is organized and represented in our long-term memories. This issue has also become a focus of attention in cognitive psychology and there are diverging views concerning the topic. However, attention will be restricted to the dual-coding theory which posits that information is stored in our memories in terms of visual images and verbal representations. This theory of memory further claims that language behavior is mediated by two independent but partly interconnected systems: the image system and the verbal one and that either of these systems may initiate activity in the other.

Holding firmly on the theoretical issues provided in the previous chapters and especially on Paivio's dual-coding theory, this chapter also provides our major argument towards a systematic and recurrent use of the nonverbal elements of discourse, as well as pictorial information added to the text, as a pedagogical strategy to help beginners to cope with the verbal information that is more demanding for them.

It is also our contention that nonlinguistic devices can be used to decrease the cognitive overload in the students' interactive involvement with the processing of new information. Our contention follows as that: since there is a limited amount of information our brains can process at a time, we may make use of visuals to help our students to be economical while taking in information. By chunking larger pieces of information through nonverbal devices, the students will be able to overcome the limited capacity of short-term memory and free their brains to carry out the complex activity of processing information faster and more fully.

Chapter I has pointed out that language is currently viewed as a mentalistic activity rather than an automatic one. Visual devices used as a lead-in to full comprehension will thus contribute to the incorporation of thinking and motivation into the reading lesson.

This chapter further draws a parallel between Paivio's dual-coding theory and the semiotics of written discourse, as there seems to be an analogy between the way information is organized in our memories and the way information is structured in written discourse, as both rely on verbal and image systems. This is further evidence that the use of nonverbal information and visual devices

which are both part of a universal language can be very effective in helping beginners in their task of comprehending written discourse in a foreign language.

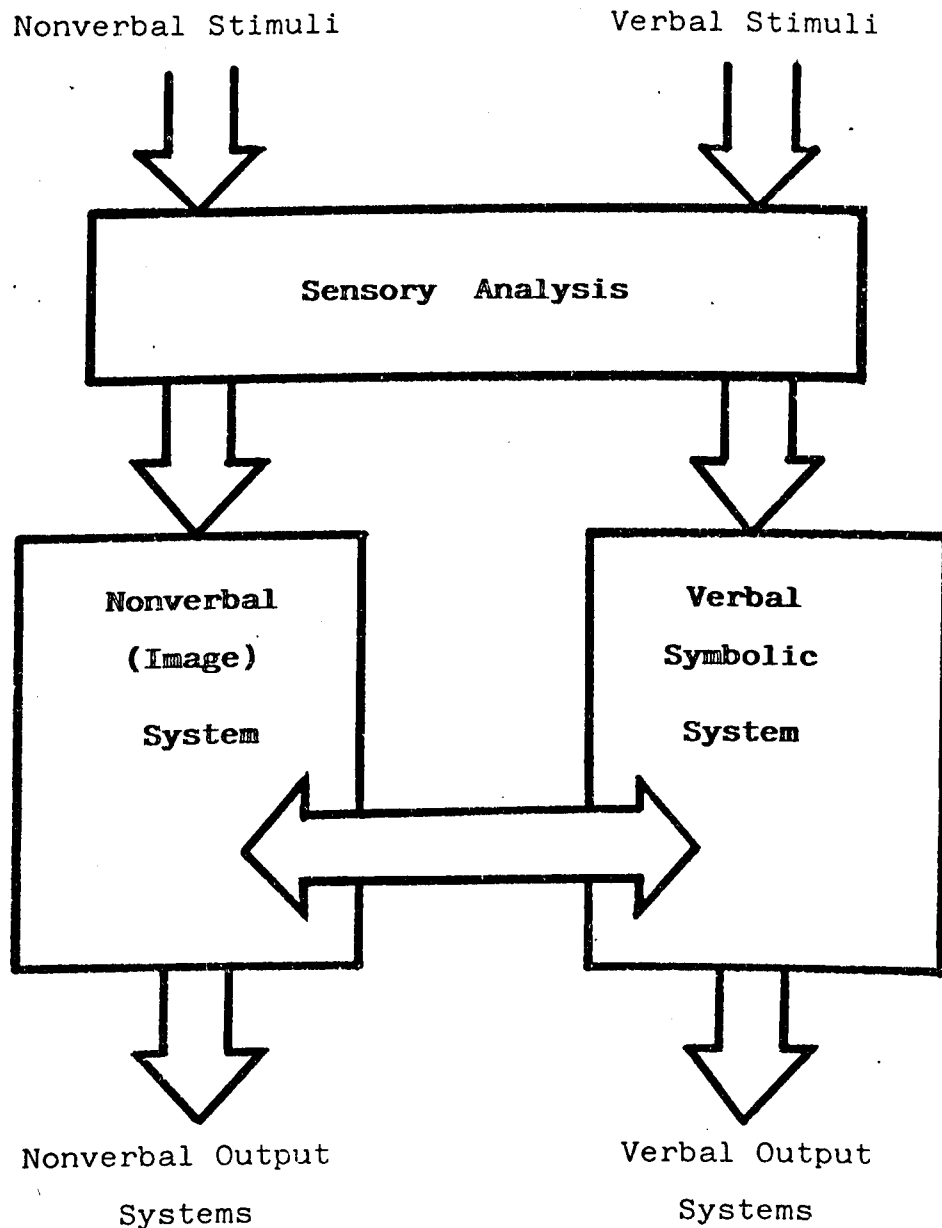
This chapter will thus be first concerned with a theoretical description of the dual-coding theory; next the structure of written discourse will be considered and then a parallel will be drawn between the dual-coding and the structure of written discourse. Finally, this chapter will provide a schematic representation to sum up all the theoretical issues together with some pedagogical implications for the teaching of F1 reading.

2. THE DUAL-CODING THEORY

According to the dual-coding theory, information is stored in our memories in two ways: as visual images and as verbal representations. Paivio's dual-code thus comprises both verbal and nonverbal systems. Says Paivio in relation to the theory:

*"Its principal assumption is that language behavior is mediated by two independent but partly interconnected cognitive systems that are specialized for encoding, organizing, transforming, storing, and retrieving information. One of these (the image system) is specialized for dealing with information about nonverbal objects and events. The other (the verbal system) is specialized for dealing with linguistic information."*¹

Paivio provides the following schematic representation of the two systems:



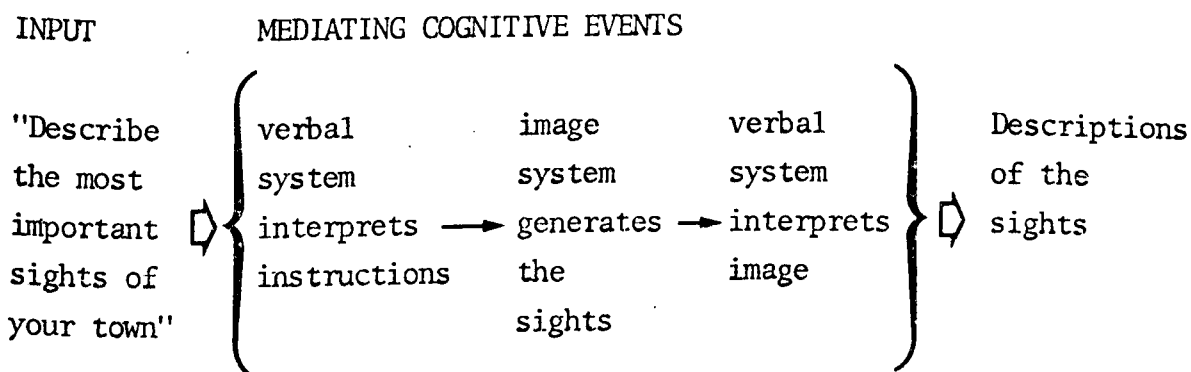
As indicated above, each system is independent in that activity can take place in one system or the other, or both in parallel (simultaneously). Thus, it is possible to

... imagine a scene without necessarily describing it verbally, talk about some things without necessarily experiencing imagery, or do both simultaneously as when we describe some familiar scene from memory. We can even imagine familiar things while talking about something quite different. Such common experiences are evidence of the independence of the systems.³

As also indicated in the given graph, the two systems are interconnected because information can shift from one system to the other. Paivio explains that we can make symbolic transformations from one kind of information to the other, or more precisely, one of our symbolic systems can initiate activity in the other.

For example, suppose someone is asked to imagine the most important sights of his town and to describe their appearance,

location, and so on. The dual-coding theory posits that this is possible only if there is a link between the language system that receives and interprets the request and the memory system that contains the information about the appearance of the sights. What happens is that the verbal input is transformed into nonverbal imagery which is finally decoded and expressed verbally. The following diagram summarizes the example just given—the arrows represent the input from one processing stage to another.



It may be also relevant to point out that this sequence of events can be reversed in case the input is a nonverbal object or picture. According to the dual-coding theory, the perceptual information is first interpreted by the image system. This image system then generates representations in the verbal system when one makes verbal references to the nonverbal stimulus.

Paivio also makes important qualitative distinctions between the two systems:

The nonverbal (image) system can be viewed as an analogue system in the specific sense that some knowledge of the world is represented as perceptual analogues of concrete objects and events. ... The verbal system, however, contains information whose units are discrete or digital in nature and only arbitrarily related to the objects and events they signify.

The qualitative differences extend to the way units of information are organized into higher-order units in the two systems. The image system organizes information in a synchronous or spatial manner; so that different components of a complex thing or scene are available at once in memory.

In contrast, verbal information is organized sequentially into higher-order structures. ... Linguistic units unfold sequentially over time, and the assumption is that the cognitive system that deals most directly with speech is similarly specialized for sequential processing.

The representation of information in our memories according to the dual-coding theory with its image and verbal systems finds a parallel in the representation of information in written discourse with its verbal and nonverbal codes, a point that will be discussed in the next part on the semiotics of written discourse.

3. THE SEMIOTICS OF WRITTEN DISCOURSE

In written discourse information is conveyed not only by passages of prose, but also by nonverbal devices such as pictures, graphs, maps, tables, formulas, line drawings, diagrams, and so on. This means that the communicative function of a text is not carried out exclusively by verbal means—nonverbal elements contribute to the whole communicative meaning as well, either by supplementing verbal statements, or replacing them, or providing a general idea of what the text is about, or still as a visible form of the verbal information, as for example, in graphs.

Widdowson, *inter alia*, argues that these devices "*are incorporated into the discourse and relate to the actual verbal text to form a cohesive and coherent unit of communication.*" He also remarks that nonverbal devices constitute fundamental features of the basic rhetoric of written discourse.⁵

In fact, books of chemistry, geography, physics, and articles in specialized magazines and journals present a great deal of nonverbal information together with the linguistic information itself. This non-textual information is in fact fully integrated with the linguistic part of the text—the verbal text explicitly refers to this nonverbal information and, consequently, cannot be fully understood without it.

As mentioned earlier, scientific discourse—the discourse which is written by a specialist to address other specialists and to transmit some relevant new information to their field of study—normally makes use, according to Vigner, of three semiotic devices:

- the verbal text—its linguistic component proper
- the graphic language of diagrams, graphs, illustrations
- the formal language—made up of formulas and conventional symbols⁶

It is important to point out that these three semiotic codes are in a relation of meaning complementation—one of the codes

adds to what has been provided by the others and vice-versa. The main purpose in using them is directly relevant to accuracy. Another point is that the writer knows in advance the conditions of reception of his message, since he writes to a homogeneous group. The result is a concise and straightforward text.

Articles and essays of the so-called "scientific vulgarization" - e.g. "Science Digest", "Scientific American", "Science", specialized parts of "Time", and so forth—also present information through the use of different semiotic devices mainly as a means to increase its degree of readability.⁷ In them the information is not usually conveyed by the linguistic code only—it is further transmitted by other devices such as accompanying illustrations or diagrams, captions under the illustrations, the labels of the diagrams, use of different type-faces, appealing titles or sub-titles which most commonly sum up and stress the main information to be presented, and so forth.

As these articles and essays are written with the purpose of reaching a large number of readers, including lay ones, they must contain a multiplicity of different semiotic devices which facilitates comprehension, that is, which decreases the readers' effort in their construction of meaning. Therefore, the same information is redundantly conveyed as a guarantee to its adequate grasping. Since the writer cannot establish in advance the shared area of background knowledge between himself and his readers, he uses different devices which make the readers' processing of new incoming information easier.

Still as a consequence of this imprecise shared area, the writers of scientific vulgarization usually assume that readers lack the necessary background knowledge in the specific area they are writing about. Therefore, these articles and essays have the additional function of instructing the readers, or rather, make the reader acquainted with basic points that are necessary to the comprehension of the information they convey. Scientific discourse itself does not have this function since it is written to readers who share a lot of background knowledge with the person who is addressing them. Footnotes, quotations from well-known scientific works and references to previous works are enough. In other words, it only informs the reader, providing the new information.

A digression is necessary since it is worth noting that there is a common erroneous view, dating from the days of structuralism, that comprehension operates on the linguistic level only and that the role of the reader is simply to extract the meaning which is thought to be statically present in the linguistic structures themselves. As just mentioned, a text does not operate on the

linguistic level only, but on the two basic verbal and nonverbal semiotic components. As also pointed out earlier, comprehension of a text is only partially determined by the text itself, it is rather an interactive process which involves an interplay of text-presented material and the reader's knowledge of the world. This means that the reader not only makes use of the two basic semiotic devices of written discourse, but also brings previous knowledge to his interactive processing of information. Widdowson in fact argues that the *"interpreting of written discourse involves the processing of these non-verbal elements and a recognition of their relationships to the verbal text."*⁸

Since the articles and essays of scientific vulgarization are particularly interesting in displaying a close relationship between verbal and nonverbal elements and since they constitute primary raw materials to be used in our reading classes for beginners, it might be appropriate to analyze an article in terms of the devices used to increase its degree of readability. The article which serves us as example, entitled "Acid Rain", is taken from Science Digest, September, 1984 (the whole article is provided in the appendix to this chapter).

In ACID RAIN the author, Nigel Sitwell, conveys his intended meanings through a highly contextualized passage—there is a close, and indeed important, relationship between verbal and nonverbal elements in an attempt, as just mentioned, to increase the degree of readability of the article. Since he writes to a large number of readers, and it is difficult for him to predict his readers' preexisting knowledge about this kind of acid precipitation, he transmits his information in a redundant way, that is, through different semiotic codes: if the reader fails to understand one of the codes, he is able to apprehend the information by making use of the other codes provided. This means that, used together, verbal and nonverbal information reinforce each other: an obscure part of a text may become clear by an analysis of an illustration, or the importance of an illustration may be readily perceived by referring to the verbal information presented in the surrounding text.

The author also guides his readers into formulating hypotheses while they are involved in the construction of the meaning of the article. For example, the title is not shown clearly on the first page. However, two important clues are given: one at the top of the page, the other at the bottom. The information at the top is conveyed linguistically by the use of the sentence: Our trees are dying; this information is also stressed in a nonverbal way by the illustration which presents trees that are not fresh and lively; it is conveyed a third time, linguistically, by the caption just below the illustration. Furthermore, there is also a visible

contrast between the typeface used in Our trees are dying and the one used in the caption. The reader can thus go from the linguistic information to the illustration, and then to the caption. The words trees, dying, and denuded probably become clear by the illustration; the meaning of the word bleak and the meaning of the verb bode are probably inferred by reference to the context of situation. The reader has then at his disposal different clues to confirm his expectations and comprehend what he is reading.

On the other hand, the information given at the bottom of the page is almost totally linguistic, except for the fact that it is in bold-face type and in upper-case. It can, however, be related to the illustration presented at the top. The reader can then infer a causal relationship between the two items of linguistic information: Acid Rain is not an ecological curiosity but a growing global concern that threatens to ravage our forests (bottom) and bleak future (top), that is, the destruction of forests will result in a bleak future. At this stage, having relied on verbal and nonverbal clues to instantiate his schema, the reader makes his hypotheses as to what the undesirable cause may be. When he turns the page, he may confirm his hypotheses by the title of the article, "Acid Rain".

If the reader glances through the article paying close attention only to the illustrations provided, he is made aware of:

- . first, the causes of ACID RAIN (page 40)
- . secondly, one possible consequence of it (pages 42-3)
- . thirdly, how ACID RAIN is formed (page 44)
- . fourthly, other possible consequences of this undesirable phenomenon (page 45)
- . finally, the hope that our forests should remain green, fresh, and lively (page 49).

The reader has then already formed the overall gist of the article by processing only the information provided by the illustrations.

Referring to the dual-coding theory, it seems possible to affirm that illustrations, dealt with by the image system, have initiated activity in the verbal system. Therefore, when reading the linguistic information that goes with each of the illustrations just mentioned, the reader only searches for confirmation of what the universal language of the illustrations has made clear for him.

The linguistic information itself also presents a rich iconography which carries a lot of information in itself. This iconography is in close association with the linguistic information either complementing its meaning, or giving the reader important

clues to its development, or still as alternative transmissions of the same information. Again the reader has at his disposal a redundant conveyance of meanings which, in turn, contributes to a better understanding of what he reads.

One first example of this use of nonverbal devices is the division of the article in easily perceived blocks of information. There is always a visible space between one part and the other. By only glancing quickly through the text, the reader is able to perceive changes of topic. If the information of a sub-block does not interest him much, he can go to the other sub-block. Furthermore, a large capital letter is used at the beginning of each of these sub-blocks to enhance the change of topic. The sub-block on page 41, for example, begins with a large B and it deals primarily with the sources—anthropogenic and natural—of the amount of sulfur in the atmosphere. The sub-block on page 44 begins with a large A and it deals primarily with the effects of acid deposition in different locations. The sub-block on page 45 begins with a large D and it deals primarily with the effects of acid rain on some types of trees.

As pointed out earlier, the illustrations provided serve as a guiding force in the reader's formation of the overall gist of the article. On the linguistic level, the first part of the article (page 39) serves this function: if the reader grasps only its gist, he is capable of forming the overall view of the development of the information through the article. It may be appropriate to call attention to the fact that two nonlinguistic devices are used within this part of the text: it is written in bold-face type and the term "acid rain" is written in italics to draw the reader's attention to the point where it is defined. Again the text iconography itself provides clues to meaning.

Within each sub-block of information important nonlinguistic devices such as numbers, formulas, parentheses, quotation marks, proper names in capital letters, and abbreviations are recurrently used. They serve as hints in the reader's negotiation of meaning.

A close analysis of the sub-block which begins with the letter D on page 45, for example, reveals a strategy commonly used in articles of this kind. The author presents in quotation marks the ideas of a well-known specialist, Dr. Hubert Vogelmann in the present case, and then comments on what the specialist has said. This strategy is part of the redundancy characteristic of this type of discourse. The quotation marks, punctuation, and capital letters are nonlinguistic counterparts to linguistic items such as that is to say, in other words, this means that, and so forth.

It seems possible to remark that this alternative use of

verbal and nonverbal information is a powerful device in guiding the reader's interpretation of written discourse. He has at his disposal different clues which may be used to retrieve his knowledge of the world from his long-term memory, thereby comprehending more effectively what he is reading.

It may be appropriate to reiterate that the interpretation of written discourse cannot be equated with the decoding of the linguistic information only; it is rather the simultaneous processing of different codes which are sometimes redundant, sometimes complementary, sometimes both. It can be said that the use of a network of different semiotic devices really facilitates comprehension since the reader can go from one code to the other, go back to the first, and so on.

A point must be made about the use of graphs, that is, systems of visualization of the main bits of information provided by the text they go with. According to Vigner, a text with an accompanying graph conveys the same information four times:

- . by the graph itself
- . by the visualization of the elements dealt with graphically
- . by the caption of the graph
- . by the linguistic text itself⁹

Again the phenomenon of redundancy is evident—this multiplicity of codes assures a secure conveyance of the same information—the reader has then different options at his disposal in his processing of the same information: he may begin by an evaluation of the graph and its elements, then go to the linguistic text, go back to the graph, then to the caption, and so on. Furthermore, graphs have a powerful symbolic value—they not only have an extraordinary aesthetic value (some graphs are self-explanatory), but are also synonymous with scientific exactness or accuracy. Thus, the information conveyed graphically has the advantage of being interpreted as right, exact.

Vigner also points out that graphs in specialized scientific works and magazines bear a meaning complementation rather than a redundancy relationship.¹⁰ They are normally carefully scrutinized by the reader since they more often convey the essential bits of information of the text they go with.

It is beyond the scope of this dissertation to provide an in-depth discussion of the use of the various semiotic devices in scientific discourse proper and in the documents of scientific vulgarization. Our main purpose is simply to call attention to the fact that semiotic devices—verbal and nonverbal—are in close

relationship, sometimes in a relation of meaning complementation, sometimes in a relation of redundancy of meanings, sometimes both, a point we rely on to provide the major argument of this dissertation.

4. THE DUAL-CODING THEORY AND THE SEMIOTICS OF WRITTEN DISCOURSE

Having then provided the theoretical discussion of Paivio's dual-coding theory which posits that information is stored in our brains in terms of image and verbal systems and also a description of the semiotics of written discourse in terms of its verbal and nonverbal elements, let us draw a parallel between this theory of memory and the semiotics of written discourse.

What this dissertation first argues is that there seems to be a parallel between the representation of information in our memories in terms of verbal and image systems and the way information is conveyed in written discourse in terms of verbal and nonverbal components.

The parallel carries further: the dual-coding theory, on the one hand, affirms that the verbal and image systems are partly interconnected and that one of these cognitive systems can initiate activity in the other. In processing written material, on the other hand, the reader may make use of nonlinguistic devices to properly construct the meaning of the linguistic information or vice-versa.

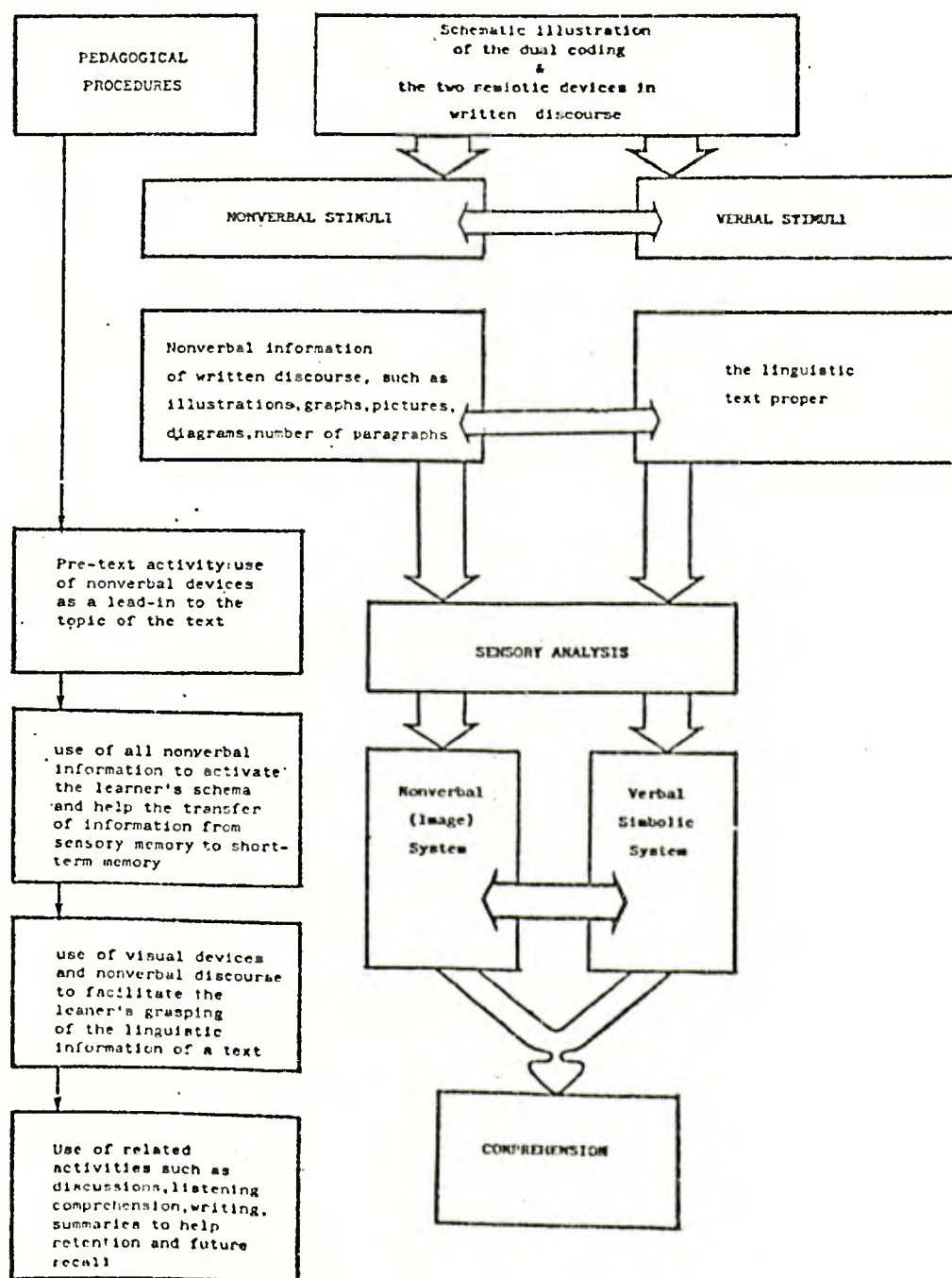
Therefore, it is our second argument and contribution to the teaching of reading that if we capitalize on the nonlinguistic devices, the ones dealt with by the image system, to initiate linguistic activities, better comprehension and consequent retention will take place, as we are making full use of both our memory structure and the structure of written discourse.

This means that we can make use of the nonlinguistic devices to help our students to effectively interact with the written material in all the processing stages of information, namely, in prediction, in the pre-processing of information, in the in-depth processing of information and also as a means to facilitate retention. These devices will be fundamentally used to activate the students' knowledge of the world which is of paramount importance to comprehension.

Still related to the dual-coding theory, Paivio has made another important point that concerns us directly. He claims that the image system is specialized for encoding, storing, organizing,

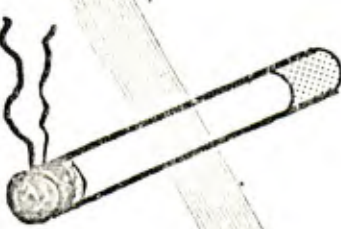
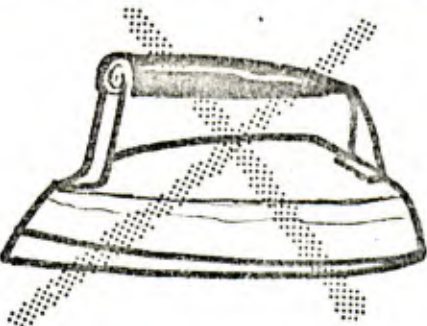

and retrieving information related to objects and events. Paivio also claims that the image system organizes information in a synchronous or spatial manner. This type of organization thus permits easy integration of units into higher-order chunks and facilitates retrieval. On the other hand, the verbal system is primarily concerned with word units organized in higher-order sequential structures. Thus, there is less efficient chunking and retrieval.¹¹ This is further argument for the use of visual devices before putting on linguistic information in the teaching of reading.

Let us then provide a schematic representation of the parallel that has just been drawn between the dual-coding theory, on the one hand, and the structure of written discourse, on the other hand, together with pedagogical implications.



To end, it may be relevant to reiterate that nonverbal discourse and visual devices are in close association with the verbal information proper in written communication in four basic ways.¹² First, a message is partially nonverbally expressible, that is, it is better conveyed by visual means. This occurs because language has its limitations to properly express some areas of human experience as, for example, when one is commenting about color, light, movement, spatial relationship, and so forth. The transmission of concepts related to these specific situations is infinitely more efficient and adequate if visual devices are used. To trace the route of the first Portuguese explorers in our country, for example, would take us many pages if it were to be given verbally. On the other hand, if this information were transmitted visually by making use of the map of Brazil with men spotting the route they had followed, the information would be more precise and economical than by using only a verbal form.

Secondly, nonverbal elements can also be used as an alternative to language, that is, the same idea can be carried out either visually or verbally according to certain conventions. Let us take the following as examples:

		<p style="text-align: center;">NO SMOKING</p>
		<p style="text-align: center;">DO NOT PRESS</p>
		<p style="text-align: center;">BUS STOP</p>

As pointed out earlier, the universal language of illustrations is a cardinal example of the use of visuals as an alternative to language. By only interpreting this universal language, the reader is capable of forming the overall meaning of what he has to read. The illustrations are therefore powerful devices in guiding the reader in his interpretation of the linguistic information proper.

Thirdly, nonverbal discourse and visual devices may also be used as a complement to language. The universal language of graphs, formulas, and labels are typical examples. These devices most usually capture the reader's attention especially for the fact that they sum up the main information of the text they go with.

Finally, the graphic form itself, that is, the text iconography, is in close relationship with the verbal textualization. Any written verbal material has a visual form in terms of the layout of the text, its distribution in the graphic space, its punctuation, the type-face used, superscript numbers or letters and asterisks, and so forth. This text iconography has significant functions and can be of specific help in the reader's task of processing written material for understanding since it provides many clues to meaning.

5. FINAL REMARKS

This chapter has tackled the issue of how our knowledge of the world is organized and represented in our memories in terms of Paivio's dual-code theory. It has also discussed the interrelationship of verbal and nonverbal elements in written discourse. Both provide the theoretical support for the major argument of this dissertation towards a systematic and recurrent use of nonverbal elements in the teaching of reading.

The underlying purpose has been to primarily emphasize that there is a constant, and indeed important, interplay of verbal and nonverbal elements in the reader's everyday processing of written discourse. Then, by making use of the nonverbal elements of discourse, dealt with by his image system, the reader may be capable of initiating activity in the verbal one—the output will be a better comprehension and interpretation of what he reads. In other words, comprehension may be dependent on the processing of the two basic semiotic devices of written discourse and on the use, on the part of the reader, of his image system to initiate representations in the verbal one.

Thus, since our students are still entering the fascinating world of a second language, nonverbal elements, which are part of a universal language they have already stored throughout their lives, can be used to initiate linguistic activity in their first acquaintance with the system of the English language. We may then make use of reading material which presents a rich iconography and whose information is redundantly conveyed to enhance the interconnection of image and verbal systems to facilitate comprehension. To those texts which convey information mostly through linguistic items, nonverbal devices will be added to facilitate the reader's negotiation of meaning.

The next chapter will exemplify how nonverbal discourse, as well as pictorial information added to the text, can be used to help beginners to cope with the linguistic information that is more demanding for them in an effective way.

NOTES

¹ Allan Paivio and Ian Begg, Psychology of Language (Englewood Cliffs, New Jersey: Prentice-Hall Inc., 1981), p. 67.

² Paivio and Begg, p. 69.

³ Paivio and Begg, p. 68.

⁴ Paivio and Begg, pp. 70-71.

⁵ H.G. Widdowson, Teaching Language as Communication, 4th ed. (Oxford: Oxford University Press, 1983), pp. 73-74.

⁶ Gérard Vigner, Lire: du Text au Sens (Paris: CLE International, 1979), p. 117.

⁷ Vigner, p. 56.

⁸ Widdowson, p. 73, italics mine.

⁹ Vigner, p. 57.

¹⁰ Vigner, p. 57.

¹¹ Paivio, pp. 189-190.

¹² This discussion is mostly based on some mimeographed material handed out by Professors Tom Hutchinson and Alan Waters during The English for Specific Purposes Teachers' Training Course, at the University of Lancaster, from January to March, 1983.

APPENDIX

OUR TREES ARE DYING



BY NIGEL SITWELL

Denuded trees atop Vermont mountains bode a bleak future.

The term *acid rain* was first coined in 1872 by Robert Angus Smith, an English chemist who used it to describe the increasingly acid precipitation that fell on the industrial city of Manchester. In fact, it is now generally agreed that acid rain is a product of the Industrial Revolution, for it stems largely from the burning of coal and oil.

In the intervening century, acid rain has been transformed from an environmental curiosity to perhaps the most pernicious global problem of the age. The specter of mass deforestation is real. But the forests of the industrial world are not the only victims. Entire lake regions are becoming sterile and devoid of life. Monuments that have withstood the erosion of centuries are being transformed into soft gypsum and may soon be washed away. Even human health could be at stake if acidified groundwater continues to leach out trace metals into the world's drinking supply.

Acid rain is a worldwide problem. It has been reported in Brazil, China and South Africa. And now the Arctic, one of the world's last great wilderness areas, has become a victim. Surprisingly high levels of pollutants have been found, and the presence of soot, or black graphite carbon particles, which can only be created by combustion, strongly suggests an in-

**ACID RAIN IS NOT AN
ECOLOGICAL CURIOSITY
BUT A GROWING
GLOBAL CONCERN
THAT THREATENS TO
RAVAGE OUR FORESTS.**

ACID RAIN

dustrial origin. Arctic haze now covers a huge area in winter and early spring and restricts visibility to as little as two miles. The pollution is thought to come from the Soviet Union.

When fossil fuels are burned, they release large amounts of waste products, such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Once in the atmosphere these reactive gases may combine with water and oxygen to form sulfuric and nitric acids, which fall back to Earth as acid rain. Or they may fall in their original gaseous form or as very fine particles. Scientists prefer to call the first kind wet deposition and the other two dry deposition, or they might call the whole phenomenon acid deposition rather than acid rain. And in any case, wet deposition can take the form of snow, hail, fog, mist or dew. The words *acid rain* are so expressive, however, and so widely used that they are unlikely to be replaced by the more accurate terms.

Acid precipitation in the eastern United States is now as much as 40 times as acidic as "normal" rain, as measured by free hydrogen ion concentrations. This is confirmed by examination of samples of preindustrial rain entombed deep inside the Greenland ice cap.

It is believed that oxidation of SO_2 is much slower than that of NO_x (the subscript indicates all nitrogen oxides), so that SO_2 may remain airborne for three or four days, compared with NO_x , which may persist for only half a day. This has significant consequences if true, for it means that acid rain derived from SO_2 is transported hundreds or even thousands of miles, while rain produced by NO_x travels only tens to hundreds of miles. Also, each sulfur molecule contributes twice as much acid as each nitrogen molecule, so as much as three-fourths of the total acid falling on land in the eastern United States originates

Nigel Stiuwell has written for many British journals about the problems of acid rain.

A murky chemical cloud pours from a stack. Scrubbers could minimize sulfur emissions, but are costly. New York State, however, recently required three existing plants to install units if they plan to burn coal.

in sulfur emissions.

Sulfur dioxide is emitted by a variety of sources. Emissions in the United States in 1980 totaled 24.1 million metric tons. Of this, 66 percent came from electric utilities, 22 percent from industries and minor amounts from other sources. But smelting can produce large sulfur dioxide emissions when the ore contains sulfur—as it does with metals such as copper, zinc, lead and nickel. In Canada, smelting contributed 45 percent of the SO_2 emissions, compared with only 6 percent in the United States.

Soils and waters have in the past received, and still do receive, acid from a wide variety of natural sources, including volcanoes, forest fires and the decomposition of plants and animals. Oxidation of carbon dioxide to form carbonic acid is also a major natural source. Lightning combined with nitrogen oxides in the air produces nitric acid.

But it has been estimated that while on a global basis natural sources contribute about the same amount of sulfur to the atmosphere as do human (anthropogenic) activities—about 75–100 million tons each—anthropogenic sources dominate natural ones in industrial regions like North America and Europe, where the latter may be only about 5 percent of the total. For instance, the giant 1,150-foot stack of the International Nickel Company's Sudbury, Ontario, smelter releases as much sulfur every year as Mount St. Helens spewed out in its most active period.

It is more difficult to make a similar comparison between natural and anthropogenic sources of nitrogen oxides, but the ratio is probably much the same.

Once airborne, the sulfur and nitrogen oxides eventually come down again, in one form or another. Precisely where depends both on the stack height at the source and the weather conditions. In general, prevailing winds in North America tend to transport pollutants toward the east.

This fact is the key to understanding one of the principal problems involved in acid rain. The nine

OVER 4,000 LAKES IN SWEDEN ARE NOW FISHLESS, AND IN WEST GERMANY, AT LEAST HALF OF THE FAMED BLACK FOREST IS DAMAGED.

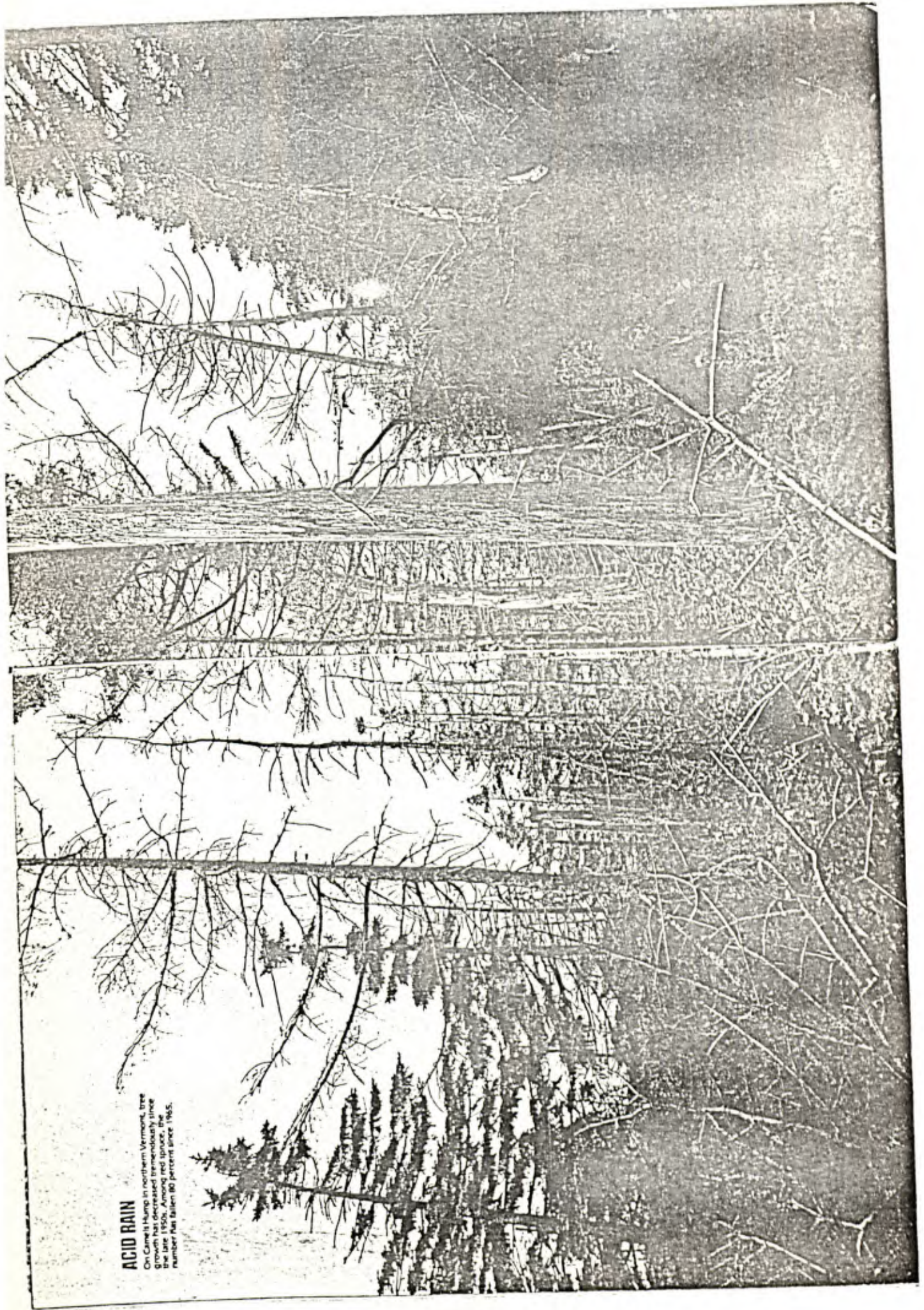
largest coal-burning states lie in the Ohio basin—Midwest area and are estimated to contribute about two-thirds of all sulfur dioxide depositions within the eastern states. In fact, the pattern of transport is quite complicated, with the United States contributing a sizable proportion of eastern Canada's acid, while Canada in turn contributes part of the acid deposited on the eastern United States. A June report by the National Clean Air Coalition indicated that the problem had extended to 13 southern states, ranging from West Virginia to Florida. In this case, the area itself is said to be responsible for two-thirds of the pollutants.

Acidity is measured on the pH scale, which is based on the negative logarithm (to the base of 10) of hydrogen concentration. The scale runs from 0 to 14, with a value of 7 being neutral. Above 7 is alkaline, and below 7 is considered acid. Because the scale is logarithmic, a decrease of one full point on the scale represents a 10-fold increase in the number of hydrogen ions. Thus pH 4.0 is 10 times more acidic than pH 5.0, and pH 3.0 is 100 times more acidic than pH 5.0.

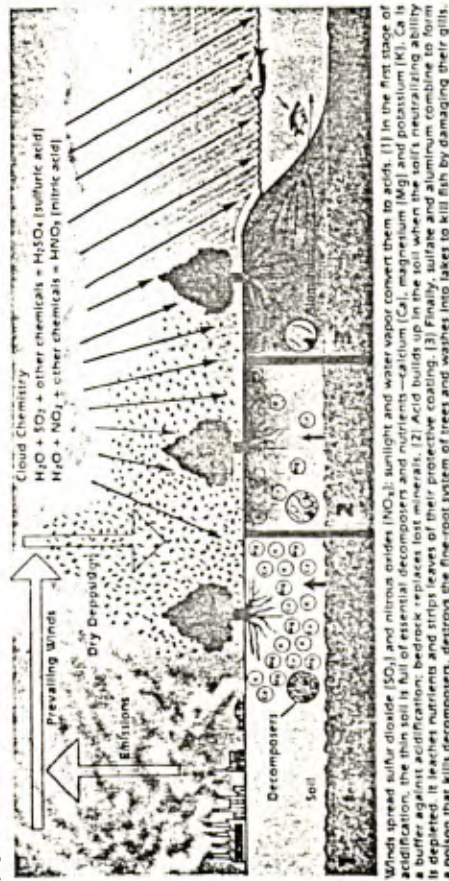
"Normal" rainfall is slightly acidic because of dissolved carbonic acid. It has traditionally been given the value of pH 5.6. However, scientists have recently concluded that rain is naturally variable in acidity and should probably be given a mean acidity value of 5.0 with a maximum of 4.5. Measurements of pH are not very accurate and, because of environmental variations, can only provide a broad picture of the situation. Furthermore, these measurements deal with wet depositions. Particulate or gaseous depositions are eventually converted

ACID RAIN

On Camel's Hump in northern Vermont, tree growth has slowed tremendously since the late 1950s. Among red spruce, the number that fallen 80 percent since 1965.



ACID RAIN



Into acid too, so they are just as important as wet depositions, though they are harder to measure. It is possible that present measuring systems underestimate the magnitude of the problem of acid rain.

Acid depositions have drastically different effects in different locations. Some soils, like limestone, have plentiful calcium carbonate and silicates that are effectively able to neutralize the incoming hydrogen ions. Such soils generally have a pH of 5.0 or more and are said to be well "buffered." But poor, thin soils, such as those overlying granite or igneous rocks or noncalcareous sandstones, are already slightly acidic and have little ability to neutralize any additional acidity. Examples of the latter are found in the mountains of New England, the Appalachians, the Adirondacks, extensive regions of Quebec and Ontario in eastern Canada and in Scandinavia.

Having established what acid rain is, let us look at its effects—bearing in mind that there can be very complex and that there is much that is still unknown.

Sandra Postel, author of the Worldwatch Institute's publication *Air Pollution, Acid Rain, and the Future of Europe's*, writes: "Trees derive their

western states contain areas sensitive to acid rain, and research by the U.S. Geological Survey indicates that alkalinity levels (a measure of the capacity to neutralize acid) are declining in surface waters at many locations in the north-central, mid-western and southeastern regions of the country. While the northeastern states face the most acute problem in the near term, the evidence suggests that in the long-term it may be a national issue.

International attention was first drawn to acid rain by Sweden, where widespread acidification of lakes was reported in the early 1970s. Currently, it is estimated that 18,000 Swedish lakes are acidified, 4,000 seriously, and 9,000 have had their fish populations affected. Dr. One Ljunck (director of the Holcombe Research Institute of Butler University in Indianapolis) estimated in 1982 that 3,000 lakes and 25,000 miles of streams had been altered by acidic inputs in the eastern states.

Some of the most dramatic effects on forests have been observed in Europe. A survey in West Germany in 1983 revealed that an area of 9,800 square miles of forest, or 34 percent of the country's total, is damaged by air pollution. This includes about half of this world-famous Black Forest. Within this overall area, 2,162 square miles have been designated a "total damage area" in which complete loss of productivity is expected. The Germans, who face an economic cost of about \$1.2 billion a year, are seriously worried about the loss of their forests.

Elsewhere in Europe, disturbing reports are filtering out of Poland, Czechoslovakia, East Germany and the Soviet Union, all suggesting massive forest damage. A recent report from the Netherlands indicates that pine and oak in some areas are seriously affected by acid rain. Since the soil on which Dutch forests grow is sand above an impermeable substratum of loess, and is among the most acid in Europe, it is not worth trying to replant. Switzerland has recorded damage to 14 percent of her forest trees, and points out that this could be potentially very serious because belts of trees above Alpine villages protect them against avalanches, landslides

and floods. Widespread visible effects on the scale observed in Europe have not yet been seen in North America, but there is mounting evidence that gives cause for concern—at the very least:

Dr. Robert Bruck, a plant pathologist at North Carolina State University, recently reported that red spruce and Fraser firs were dead or dying on the top of Mount Mitchell, North Carolina, the tallest peak on the eastern seaboard. Apparently there were few signs of any plant life reproducing there. Meanwhile, news is coming in from a number of other scientists of signs of tree-growth-rate decline in states ranging from Maine to Alabama. And it seems that the decline has unquestionably speeded up in the past 10 years.

The species most affected are conifers, though some deciduous trees are also experiencing adverse effects. Dr. Hubert Vogelmann, professor of botany at the University of Vermont, explains that this may be due in part to the fact that deciduous trees shed their leaves in the fall and so have a respite from airborne pollution during the winter months. Conifers, by contrast, have their needles balled in acid depositions (if that is what it is) all year round.

Vogelmann is well-known for having reported some startling evidence of tree damage on Camels Hump, a high peak in Vermont's Green Mountains, in 1982. Now he and his colleagues have carried out further research that looks to be equally alarming.

"We have recently updated our study to 1983, and the new information confirms the trend we had already identified. We measured the biomass [the amount of living material above ground, including trunks, branches, etc.] of a number of tree species growing on Camels Hump, and we found that nearly all of them are going down."

"For example, the balsam fir has dropped from about forty-six thousand pounds per acre in 1965 to thirty-seven thousand in 1983. That's a twenty-percent decline. And the red spruce, one of the dominant species,

"DAMAGE IN THE GREAT SMOKIES, CATSKILLS AND ADIRONDACKS IS MOSTLY AT HIGH ELEVATIONS. THE CLOUD ZONE SEEMS TO BE THE COMMON LINK."



They and other acid rain in the White Mountains, Concord may be a victim of acid rain.

Another pollutant, ground-level ozone, causes lesions on a grape leaf (middle). The altered chemical mix of an Adirondack stream appropriate brook trout (bottom).

ACID RAIN

"WE MAY NOT ALWAYS HAVE DEFINITE PROOF OF WHAT IS HAPPENING TO THE ENVIRONMENT, BUT IF WE WAIT TILL WE DO, IT MAY BE TOO LATE."

is down from about thirty thousand to just over eight thousand. That's a decline of seventy-three percent."

Vogelmann draws attention to the fact that the montane spruces, the spruce and fir, have together apparently lost 41 percent of their productivity in only 18 years. "That's mind-boggling," he exclaims. "Lower down the mountain, in the commercial forest, there is a 25-percent decline in biomass of both sugar maples and beech."

"But our measurements of biomass are largely made up of mature trees. So we needed to look at the younger trees to find out what the prospects are, what the reproductive potential is like." And the measurements of total tree numbers are perhaps even more astonishing. Red spruce dropped from 6,000 trees in 1965 to 3,000 in 1979 to 1,600 in 1983. "That's an eighty-percent decline," says Vogelmann. "It's lost its capacity to reproduce. You don't find any cones and very few small trees. The red spruce is virtually not 'generating at all.' Among other species, the sugar maple dropped 81 percent, from 345,000 trees in 1967 to 53,000 in 1983. Beech declined from 16,000 to 6,000, or 63 percent."

Alongside these studies, other scientists at the University of Vermont carried out tree-core analyses. "We bored hundreds of trees of different species, and we found that growth-rate decline began in the late 1950s and has been accelerating ever since judging from discussions I've had with other researchers. This decline seems to be taking place throughout the Northeast," Vogelmann reports. The team has also been checking

the chemistry of the wood to find out if there is any difference between wood laid down in pre-pollution times and more recent times. Two tree cores in particular, one from a century-old sugar maple and one from a 200-year-old red spruce, have been examined by chemists at the University of Massachusetts, using a very accurate technique.

"They analyzed the wood for various metals and found little change until about the late 1950s, when aluminum started to shoot way up. Aluminum was almost three times higher in the last decade than it was in the pre-1950 era. Taking the various strands of our research together, the picture you get is that there is an air pollution problem, and that it started at the time of the growth decline, in about the late 1950s."

Since coal was burned in large quantities well before the 1950s, why does the problem seem only to date from that time? "Two reasons occur to me," says Vogelmann. "This is just speculation on my part, but remember that in earlier years, when there was little control on emissions, there was a lot of alkaline fly ash going into the air along with the SO₂ and NO_x. This tended to have a neutralizing effect. It wasn't until the 1950s and 1960s, when people began to be concerned about pollution, that they cleaned up the ash; at the same time the stacks were pushed much higher into the air. So the problem was shifted away from the immediate vicinity of the midwestern power plants and dumped onto the forests and lakes of the Northeast."

He also has an answer to the question of why the problem seems most evident at high elevations. "The mountains are bathed in acid mists that are half a pH point below rain. They come in with a pH of about three point six, and they're dirty—loaded with metals and all kinds of junk. They are very different from rain, which is almost benign by comparison. The damage in the Adirondacks, the Catskills and the Great Smoky Mountains is generally at high elevations. The cloud zone seems to be the common

link." The effect of acid deposition on bodies of water—on lakes, ponds, streams and rivers—is greatly influenced by the geology and vegetation of the watersheds concerned. Some watersheds have a considerable capacity to absorb acidity, but others, such as the sensitive, poorly buffered granite soils, have much less. Change seems to be negligible until the waters start to lose their alkalinity but can then come quite rapidly. First come reductions in the number of zooplankton, phytoplankton, mollusks and small crustaceans. There will be a slowdown in the rate of decomposition of plants and animals. As acidity increases, fish may be affected by the acid directly, by a shortage of prey and by toxic metals. Acidity hits them directly by interfering with their reproductive cycles, calcium deficiency leads to bone malformations, and they can suffocate as their gills become clogged with aluminum hydroxide. Again there are indications that aluminum may be the major killer. Finally, songbirds that live along lake margins are affected by feeding on insects contaminated with toxic metals, while larger fish-eating birds like ospreys and herons disappear as their food supply vanishes.

Dr. Peter Allen, an ecologist with the New Hampshire Water Supply and Pollution Control Commission, is professionally concerned with water quality. "However you measure it," he says, "there has been a change toward greater acidity." An analysis of high-altitude lakes and ponds in New Hampshire since 1950 revealed that all but one had alkalinity levels indicating they were vulnerable to acidification. Comparison of water transparency in 214 New Hampshire lakes showed that 110 were more transparent than they were 30-40 years ago (a good, if simple, measure of increased acidity), while 51 were less transparent and 53 were essentially unchanged. Allen suggests that in some of the lakes that appear to have been unaffected by acid rain, the cause may actually lie in eutrophication—increased nutrient input—in turn reflecting the state's rapid population growth and increased use of its

lakes.

"If a substantial number of water bodies are becoming more acidic," comments Allen, "something has surely happened to the watersheds, and they will be losing nutrients and productivity. We may not always have definitive proof of what is happening to the environment, but when we look, what we find is not reassuring. What worries me is that if we wait until we have complete proof, it may be too late."

Crops are probably affected by acid deposition, but so far, apparently, to a lesser extent than forests and water bodies—perhaps they generally grow on richer, better buffered soils. However, damage from ozone (which is a secondary pollutant stemming from nitrogen oxide emissions) has been noted.

The evidence linking acid rain to human health is sparse, though it is known that sulfur particles can affect the respiratory tract, the skin and the eyes. There is also an unproven linkage between aluminum and suffering from certain mental conditions, such as Alzheimer's disease and Parkinsonism. People already suffering a calcium or magnesium deficiency, which is inclined to occur in old age, may be vulnerable in this respect.

The elderly are also vulnerable in another way, according to the National Wildlife Federation. Their lungs are less elastic, decreasing their bodies' ability to process inhaled pollutants. Such health impacts are more pronounced during periods of prolonged exposure. The young are at risk because their immune systems are not yet fully developed, making the metabolism of sulfur more difficult. Dr. David Axelrod, New York State Commissioner for Health, is in no doubt what should be done. "Are we going to have to count bodies before we determine that the time has come to reduce sulfur emissions throughout the whole country to ensure that there is no impact on human health?"

"If we consider the body burden of all the impacts of acid rain, the additional heavy metals, the potential increase in methyl mercury in fish, the long-term effects that we'll have difficulty in measuring—we don't need

A DISSENTER'S VIEW

Alan Katzenstein is a graduate of the Massachusetts Institute of Technology who has been a consultant to the Edison Electric Institute, a utilities industry spokesman, since 1979. He has a considerable grasp of the technical aspects of the acid rain debate and is a very persuasive talker, but one has to examine what he says rather carefully.

Katzenstein is given to statements like "It depends what you mean by acid rain." It is true that scientists are beginning to revise their estimates of the natural acidity of rain, and thus what should be considered as of rain, but it is the sort of question that can deflect the uneasy away from matters of perhaps greater substance.

The public is misinformed about acid rain, in Katzenstein's opinion. "Environmentalists continue to relate tales of damage and threats of potential hazards to sensitive ecosystems. The popular media spread the information as fact." But, he says, new findings began to emerge in 1981.

and by 1983 the flow of reports and assessments had accelerated dramatically. It is difficult to find a single report from this period that adds credence to the widely held but unproven notions linking fossil-fuel combustion by-products from the Midwest to ecological damage in the

northeastern United States." To this assertion biologist Dr. James White replies wryly: "It depends how hard you look." More seriously, though, it is clearly possible to make a compelling case by selective use of highly technical information.

Katzenstein maintains that the new or fading evidence considered that "precipitation acidity" is not a major cause of lake acidification or loss of fish. He argues strongly that natural sources of acidity, such as the decaying organic layer of the forest floor, are the principal source of environmental acid. Yet so, according to Dr. Michael Oppenheimer of the Environmental Defense Fund. "Organic soil acids are ruled out as a significant source... Among the reasons are that acidified clear surface waters... exist only in areas receiving intense acid deposition, and they are dominated by sulfate and nitrate, rather than organic acids."

Reversing recent statements by Katzenstein, Dr. Gary Foley of the Environmental Protection Agency comments: "I don't agree with these statements, but I could see why someone might make them. He has postulated some theories. Scientifically, we will eventually prove them right or wrong."

ter it was found that the originals were turning into soft gypsum. Other famous buildings affected include Cologne Cathedral in Germany, where annual repairs cost \$2 million. India's Taj Mahal and the Colosseum in Rome. The cost of architectural damage in the United States from pollution was put at \$2 billion a year in 1979. But no one really has any idea and current estimates range from \$1 billion to \$10 billion.

A UNESCO working group reported earlier this year that the effects of acid deposition on medieval stained glass are likely to be "disastrous." Glass dating from the eighth to the seventeenth centuries is particularly vulnerable because of the production process used. Sulfur deposition

more information to conclude that acid rain needs to be taken.

An important effect of a different kind is the corrosive action of acid deposition on buildings and construction materials. It is well established that dry deposited SO₂ significantly increases the corrosion rate of limestone, sandstone and marble. Corrosion can also affect carbon steel, zinc, copper and nickel, wood, paper, paint and plastics can also be damaged.

For 2,500 years, six glacial marble maidens, called Caryatids, supported the southern portico of the Erechtheum on the Acropolis in Athens. But since 1979 their place has been taken by six cement replicas, af-

ACID RAIN

"WE BORED HUNDREDS OF TREES AND FOUND THE GROWTH RATE BEGAN TO DECLINE IN THE LATE 1950s AND HAS BEEN DECLINING EVER SINCE."

etches and corrodes this glass until finally it disintegrates. UNESCO predicts the total loss of Europe's 100,000 medieval stained-glass objects within a few decades unless remedial action is taken.

Many people now consider that the evidence linking sulfur and nitrogen emissions with environmental damage is overwhelming, even though, strictly speaking, much of it is circumstantial. The issue pits smokesack America's overriding concern for jobs against environmentally sensitive liberals.

Among the hard-liners, perhaps predictably, are the electric utilities, which maintain that the problem is not serious or that it would be prohibitively costly to rush into solutions before carrying out more research.

Keith Amash, president of Rochester Gas & Electric, told a recent meeting in Albany, New York, that "a number of hypotheses have been advanced by scientists [to explain slowdown in growth in eastern U.S. forests], among which is the possibility of an air-quality link. However, there is no consensus that attributes the cause to a specific agent such as drought, aluminum toxicity, phosphor-dants, metal accumulation in soils, excess nitrate, magnesium deficiency or physiological changes."

Mr. Amash went on to say that since all parameters relating to sulfur are not increasing "there is no environmental penalty in waiting the few years necessary to better understand this phenomenon."

Unfortunately, as Dr. Michael Oppenheimer of the Environmental Defense Fund points out in a recently published report, "we have ample evi-

dence that the steady-state theory is simply incorrect." Sulfur continues to accumulate in watershed soils, so "large increases in the number of acidified surface waters can be expected in the next few decades unless deposition is decreased."

The cost penalty is the major reason why utilities do not welcome legislation tightening emission controls. As Mr. Amash put it, "We don't believe in spending money when we don't believe that there's an adequate cost-benefit ratio." Some scientists, however, including Dr. Oppenheimer, believe that some changes due to acid rain are effectively irreversible. Dr. Bernhard Ulrich, West Germany's leading authority on forest damage and acid rain, believes that even if the acid tap were turned off tomorrow, many ecosystems would take decades to recover, if they did at all.

Dr. F. H. Bormann, a forest ecologist at Yale, says, "The danger is that by the time a fifteen-to-twenty percent loss in productivity has been documented, degradation will be irreversible." Dr. Bormann adds, "Large-scale genetic, biological and ecosystem changes are probably occurring under current levels of air pollution stress. Since the effects of air pollution on ecosystems are mostly indirect and cumulative—for example, reduction in the reproductive capacity of a key species or the progressive loss of soil fertility in forests or alkalinity in lakes—there is a legitimate concern that in a few decades vulnerable forest, lake and stream ecosystems may simply fall apart. Already, many lakes over an enormous area of northeastern North America have undergone severe deterioration, and tens of thousands more are progressively moving toward that state."

The attitude of the Reagan Administration is that the case is still not proved and that more research is necessary. The Environmental Protection Agency (EPA) is surveying lakes to establish how many are acidic and how many are sensitive; it is also making an inventory of materials at risk. Next year it will survey headwater streams and forests. Says the EPA's Cary Foley, "By 1985 we shall attempt

to quantify the damages in economic and physical terms. By 1987 we feel that the National Acid Precipitation Program will have developed enough pieces of the science to where we can start putting together a methodology for doing cost-benefit analyses."

Meanwhile, some solutions are already available.

Pumping lime (mainly calcium carbonate) into lakes to neutralize the acid waters has been tried, with some effect. But this approach is of little use in running waters. Some lakes are just too large for it to be practicable. Liming has been compared with taking aspirin to cure cancer.

Some reduction in sulfur content can be expected by switching fuels to low-sulfur coal or oil or to natural gas, though with costs in reorganization or in miners' jobs.

So-called scrubbers—actually flue gas desulfurization equipment—remove 80-95 percent of sulfur dioxide, but they are hard to retrofit to existing generating plants and add an estimated 10-15 percent to generating costs. But scrubbers do not remove nitrogen oxides. To do that requires installation of selective catalytic reduction technology, as the Japanese do, at considerable additional cost. Japan's tough pollution-control laws make Japanese electricity costs among the highest in the world, but they have overcome this hurdle by using energy much more efficiently than most other industrial nations.

Newer technologies are under development that promise control of both SO₂ and NO_x. Fluidized Bed Combustion removes 90 percent of the SO₂ and 15-35 percent of NO_x. The limestone injection multistage burner is said to remove up to 70 percent of both SO₂ and NO_x, and it can be retrofitted with relative ease.

One thing that unites all sides in this divisive issue is that the proposed solutions will cost money. If they should be imposed, who should pay?

Continued on page 36

To save our forests, scientists must rely on new technologies. Two devices under development for emission control promise to remove what scrubbers cannot—NO_x.



ACID RAIN

Continued from page 48

for them? Economist Lester Lave, of Carnegie-Mellon University, says all solutions will be painful: "Californians will object to paying so that Ohio stops polluting New England." Nevertheless, David Sive, of the Environmental Law Institute, believes that some way must be found to share the costs equitably on a national basis, rather than shifting them entirely onto the polluting utilities.

The solution, suggests Carl Reidel, professor of environmental studies at the University of Vermont and a former president of the American Forestry Association, "is to make it a national issue. Pay for it out of general tax revenues and share the costs across all the people."

It has been estimated that improving the efficiency of refrigerators, water heaters and room and central air conditioners, using known technology, could save the United States between 40,000 and 100,000 megawatts, or the output of 40 to 100 large power plants, annually. These savings

"We want to blame our problems on smokestacks but that's like blaming murder on pistols."

would mean that up to 5,000,000 tons of sulfur dioxide would not be emitted into the atmosphere. In Reidel's opinion, "Every time you turn on an inefficient appliance, you're creating acid rain.

"We want to blame all our problems on the smokestacks, but that's like blaming murder on pistols. The smokestack is just a smoking gun in the hands of Americans who don't understand what energy is all about. I believe there is a potentially very serious problem in terms of forest growth. Remember that every tree that is going to be cut in the year 2050 for housing is already growing. So we're stuck with the trees we've got."

A growing number of countries, especially in Europe, are passing laws to control acid rain. Canada is committed to achieving by 1994 a 50-percent reduction in SO₂ emissions from the allowable 1980 levels in the eastern part of the country.

In the United States there have been a number of acid rain bills before Congress in 1984, but none so far have made any headway. The feeling of frustration in the Northeast is summed up by New York's governor, Mario Cuomo, who said in April, "While research must continue, this cannot be taken as an excuse not to act." ■

CHAPTER IV

THE USE OF NONVERBAL ELEMENTS OF DISCOURSE AND VISUAL
DEVICES IN THE TEACHING OF READING

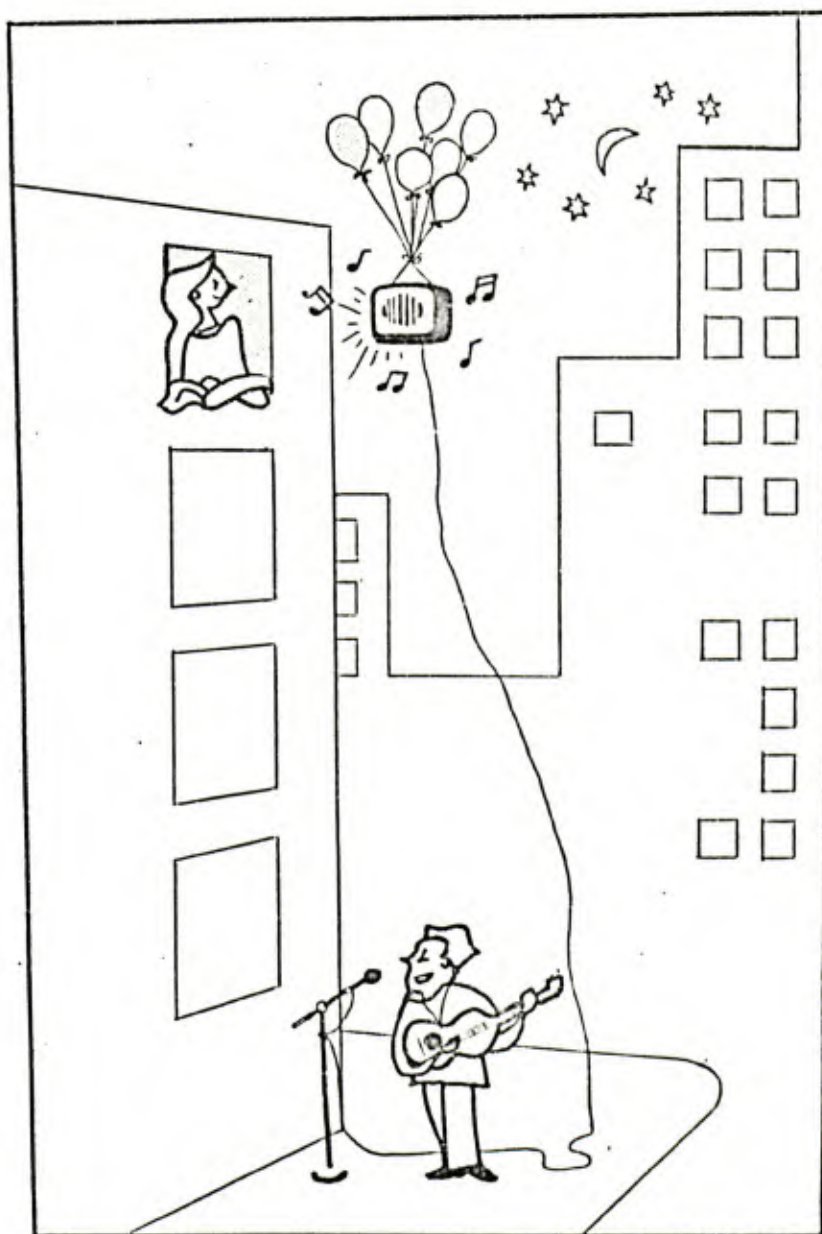
1. PRELIMINARY REMARKS

Over the last few years research has given evidence that pictorial settings can strikingly affect not only our ability to process new incoming information, but also affect the ease with which we retain processed information for future use. In a classic experimental study about the influence of pictorial settings on comprehension and retention of written material, Bransford and Johnson asked two groups of subjects to read the following passage:

If the balloons popped the sound wouldn't be able to carry since everything would be too far away from the correct floor. A closed window would also prevent the sound from carrying, since most buildings tend to be well insulated. Since the whole operation depends on a steady flow of electricity, a break in the middle of the wire would also cause problems. Of course, the fellow could shout, but the human voice is not strong enough to carry that far. An additional problem is that a string could break on the instrument. Then there could be no accompaniment to the message. It is clear that the best situation would involve less distance. Then there would be fewer potential problems. With face to face contact, the least number of things could go wrong.¹

After reading the whole text, the first group of subjects found that comprehension was nearly impossible. These subjects were unable to form the correct continuity of the passage since they needed some more clues than in fact were conveyed by the linguistic information proper. Some further information was necessary to be used by the subjects in their construction of the meaning of the passage.

The other group, however, could easily construct the meaning of the passage. Together with the linguistic information the subjects of this group were also provided the following illustration:



Therefore, since these subjects had at their disposal the drawing which filled in the slots left by the linguistic information itself, they could more adequately construct an interpretation of the written material. The primary function of the drawing was then to provide a context into which the subjects fit the linguistic information, thereby facilitating their comprehension of the whole text.

In addition, this experimental study showed that retention of the contents of the passage was remarkably influenced by the presence of the accompanying illustration. Those subjects who had seen the picture recalled much more from the content of the passage than those who had not seen the illustration.

As a teacher of reading in a foreign language a question has recurrently come to my mind: how to use the potential of the nonlinguistic information, which is part of a universal language our students have already acquired, to help them to process the linguistic information that is more demanding for them. In our

daily search for interesting and meaningful texts within the students' level of knowledge, the problem of the linguistic difficulties has always been present. If, on the one hand, the text is interesting and thus a challenge to the students' preexisting knowledge, it commonly displays, on the other hand, a number of unknown lexical items and syntactic difficulties that makes it at a first sight didactically inappropriate for the reading lesson.

Therefore, it seems to us that our major argument towards a systematic use of nonlinguistic devices to initiate linguistic activity may be a possible solution to some of our problems in the teaching of reading. It also makes the teaching of FL reading more communicative, since nonverbal elements are an integral part of written communication the same way that gestures belong with face to face interaction. It is our personal contention that the use of nonlinguistic devices can be of great assistance in our task of facilitating the students' interaction with a piece of written discourse in all the stages of information processing. It is also our contention that a better retention will naturally take place. We are then moving away from the traditional approach to the teaching of reading with a primary emphasis on the verbal information towards a systematic use of both nonverbal elements of written discourse and pictorial information added to the text for a more effective FL reading methodology.

The main purpose of this chapter is thus to provide examples of how nonverbal elements, either inherent in the text itself or incorporated into the reading lesson, can be used to facilitate the students' construction of the meaning of a written text in a foreign language.

2. SUGGESTIONS FOR THE USE OF NONVERBAL ELEMENTS IN THE VARIOUS STAGES OF A READING LESSON

Reading may serve a great variety of purposes and may thus operate on different levels. The depth with which information is processed is largely dependent on the reader's specific needs, that is, dependent on the reasons why he is engaged in the task of grasping meaning. When looking for a certain address in a telephone directory, for example, a reader searches for the specific line of information he needs rejecting all irrelevant details he might encounter.²

A reader may also quickly process the information of a text only to determine its overall content or gist when he is making up his mind whether it is worth reading it or not. On the other hand,

when reading an article of particular interest to his specific actual needs, this reader may proceed to a detailed processing of the information purposely going beyond the understanding of the main points discussed.

Recent reading methodology often takes into consideration these different levels of information processing in real life and sets its aims in accordance with the students' specific reasons for reading a certain text. As already remarked, a reading lesson usually begins with prediction as a means of increasing the student's interest and motivation towards a detailed comprehension of the material of the reading lesson. Thus, a text may be processed only for overall meaning, or it may be read for main points comprehension depending on the students' needs and motivation in the reading material.

As pointed out earlier, our main concern will be to translate the major argument of this dissertation into suggestions for the use of nonverbal elements, as well as pictorial information added to the text, in prediction, in reading for overall meaning, main points comprehension, and intensive comprehension. This visual information is intended to be used in the preparation of the class to think about the topic of the text they will read and also throughout the students' interactive interrogation of the meaning of a written material.³

The underlying assumption is that the use of visual information to initiate linguistic activity will be very effective in the reading teaching situation. Most important, visual devices may greatly contribute to the students' decrease of effort when they are engaged in the task of processing information in a foreign language. By making use of these devices, the students may chunk larger pieces of information to overcome the limited capacity of their short-term memory. These devices will be then valuable tools in the students' better achievement of their goal, that is, the comprehension of what they read.

In the preparation of the students for the acceptance of the new incoming information they will take in, visual devices assume a fundamental role because of their high potential in arising motivation. They may stimulate the imagination and encourage greater students' participation. Since poor initial motivation is a very serious hindrance to learning, the use of visuals may produce positive attitudes towards the reading material and may also engage the students' interactive relationship with what they are reading in their pursuit of an accurate understanding.

Instead of simply asking the students to predict the topic of the text by an evaluation of its title, some pictorial information

may more convincingly serve the function of eliciting information from the students. This pictorial information may be then an effective medium for activating the students' preexisting knowledge, for eliciting from the students some key vocabulary necessary in their future processing of the text, for providing information about the author and the source from which the material was taken, for guessing the rhetorical development of the text, and so on.

In developing our students' ability to process a text for overall meaning, visual devices and nonverbal elements of discourse are very helpful as well. It seems to us that the nonverbal elements within written discourse such as dates, punctuation, capital letters, as well as the layout of the text are presently often used in the reading teaching situation. What this dissertation further suggests is the use of pictorial information added to the text to make the students apprehend the gist of the text more quickly. Visual devices may then be a handy means of both filling in the slots left by the linguistic information itself and of establishing a quick and clear relationship between the "signifier" and "signified" in Saussure's terms. Since visual information seems to be more easily and vividly retained than many long verbal explanations, the use of visuals in the reading teaching situation will also facilitate later recall.

In developing our students' ability to process a text for main points comprehension, the nonverbal elements inherent in the text itself such as graphs, diagrams, tables, and so on can also be extremely useful. Since these nonverbal elements are often in complementary relationship with the linguistic information itself, it is good practice to encourage the students to proceed to a close scrutiny of the information they contain. A lot can be grasped by an interpretation of these elements and this can give beginners a feeling of success and accomplishment.

Besides grasping the main points of a text through the establishment of the relationship between its verbal and nonverbal information, the students may also be provided with some additional information to facilitate their grasping of other important points in the text. This information will then serve two important functions: it will guide the students' search for information within the text and it will also clarify points that might seem obscure in the students' task of finding out meaning for themselves.

A common form of evaluating comprehension at main points is through note-taking. The teacher normally provides a set of boxes for each paragraph filled with some linguistic information that serves as clues in guiding the students' activity. This dissertation argues that if some pictorial information is added it can greatly

assist the students in their task of getting main ideas out of a text.

In intensive comprehension the students' interaction with the linguistic information proper is far greater. Since our students do not have a full command of the English language yet, this dissertation argues that it is good practice to provide means that might help them to visualize the structure of the part they will read. If the reading teacher encourages the students to establish a relationship between linguistic directions within the text and meaning, they may more effectively understand a text at an intensive level.

The students' struggle to arrive at meaning is very hard indeed—it is the role of the teacher to provide assistance that may be helpful in their accomplishment of their goal, that is, an accurate understanding of what they read according to their specific needs as readers of a second language.

2.1. STAGE ONE: PREDICTION

2.1.1. PRELIMINARY REMARKS

Chapter II has pointed out that prediction plays an important role in the reader's active interrogation of the meaning of a text. An accurate comprehension of a piece of written material is directly related to the reader's capacity for predicting in all the stages of information processing.

The term prediction as the first stage of a reading lesson has a slightly different connotation. In this context prediction is synonymous with "starter". It is primarily meant to be a preparation of the class for the acceptance of the new information they will take in. Prediction can thus be interpreted as a pre-text activity or, rather, as a lead-in to the topic of the text.⁴

This stage is of fundamental importance to decrease the students' uncertainty about the contents of the text they will read. It is intended to place the class in a receptive mood towards the topic of the text. If a text conforms to the students' predictions it is easily interpreted. However, if the text is not in agreement with the students' predictions, its processing will be more time-consuming and, consequently, more difficult for them.

Prediction also serves as a means of activating the students' preexisting knowledge which will be required in their interactive

construction of the meaning of a written material. If some background knowledge is elicited from the students, a chance for greater interaction will take place among them. This way, they will have the opportunity to learn not only from the teacher's input but also from each other, that is, from intake.⁵

A further advantage of these pre-text activities dealing with the topic of the text is to ensure a levelling of previous knowledge which will be necessary in the students' future processing of information.

2.1.2. USE OF VISUAL INFORMATION FOR PREDICTION ACTIVITIES

TEXT TITLE: New Jobs for Robots⁶

- SPECIFIC AIMS -

- . to provide some pictorial information related to the topic of the text to activate the students' background knowledge in order for them to use this knowledge in their future construction of the meaning of the text.
- . to properly prepare the students to accept and interact with the new information they will encounter in their future processing of the reading material.
- . to elicit from the students some key-words and main ideas necessary for an accurate understanding of the linguistic information of the text they will read.
- . to decrease uncertainty about the contents of the text.
- . to prepare the students to properly perform their role of discourse participant by interpreting the nonlinguistic clues and their relationships to the linguistic information of the text.
- . to prepare the students to consider titles as a summary of the main information.

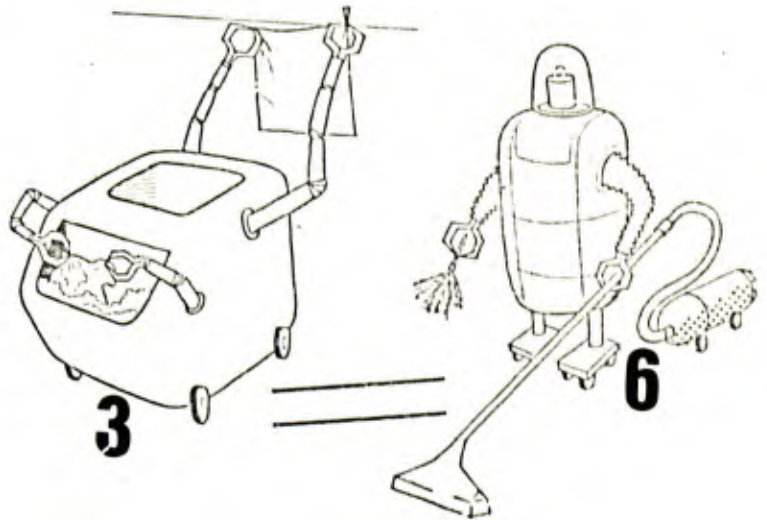
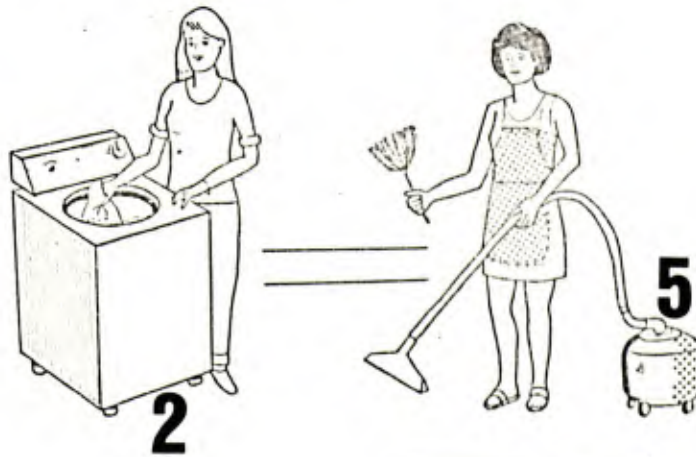
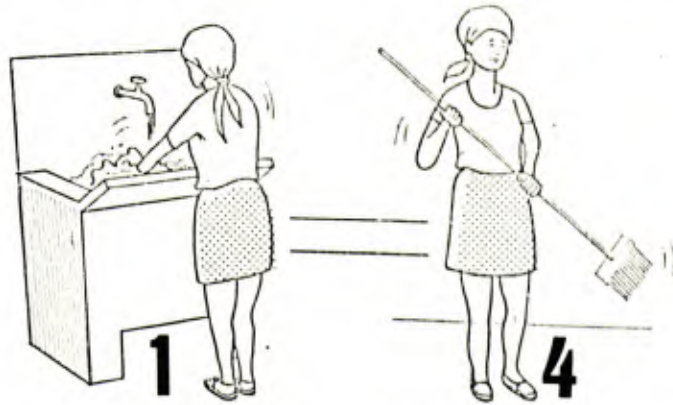
- TEACHER'S ROLES -

- . to guide the students' activities.
- . to elicit from the students the necessary details, main ideas, key-words, and so on related to the main topic of the text.
- . to write on the board or on a transparency, in the form of a summary, the important details provided by the students.

- NOTES -

- . This introductory activity is preferably carried out in English. However, this does not hinder the use of Portuguese if the students cannot do it in English.
- . The summary of the main ideas enacted by the students is, of course, written in English by the teacher.

ACTIVITY 1: Eliciting information from the students



- QUESTIONS TO BE USED -

. What do these pictures suggest?

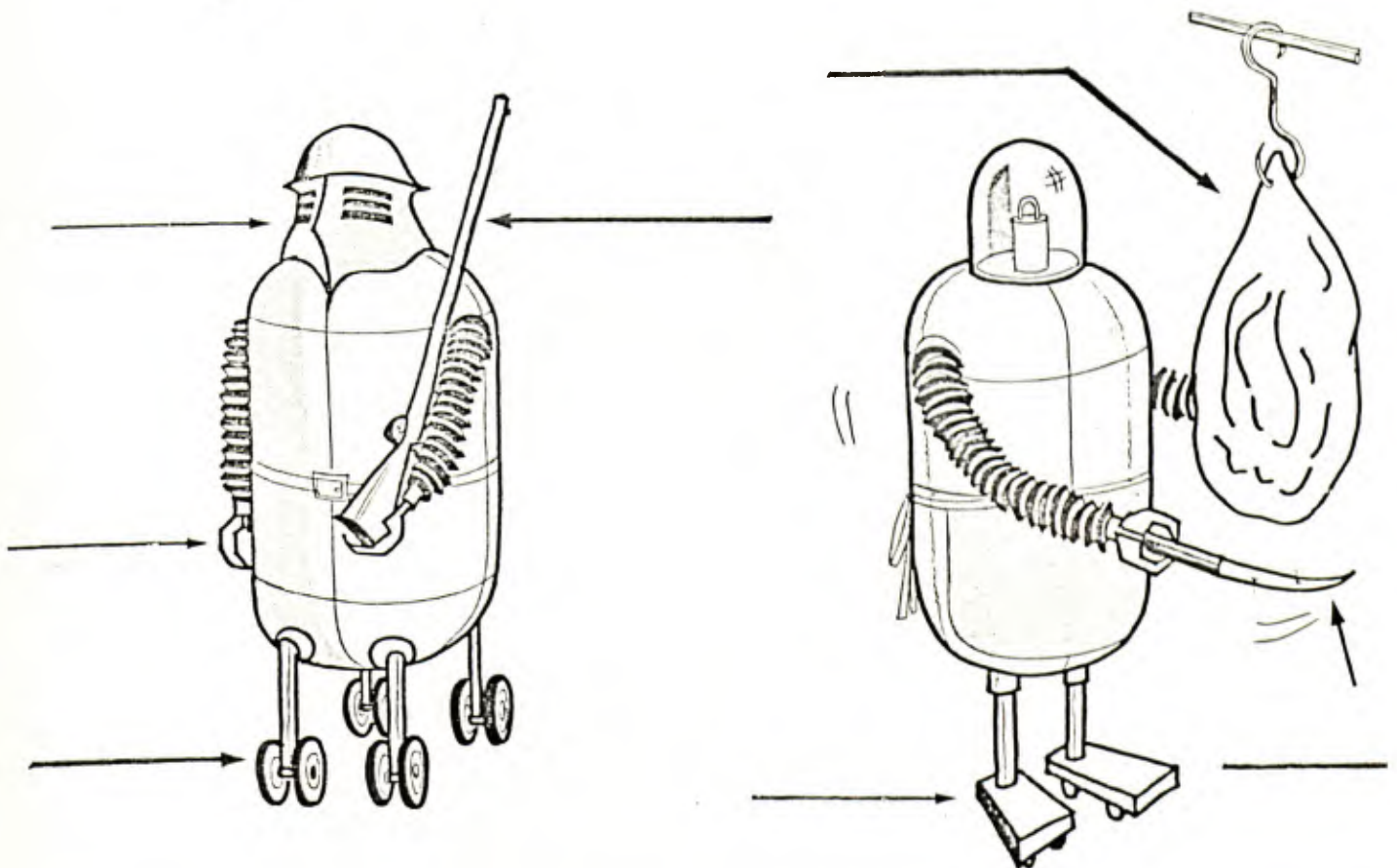
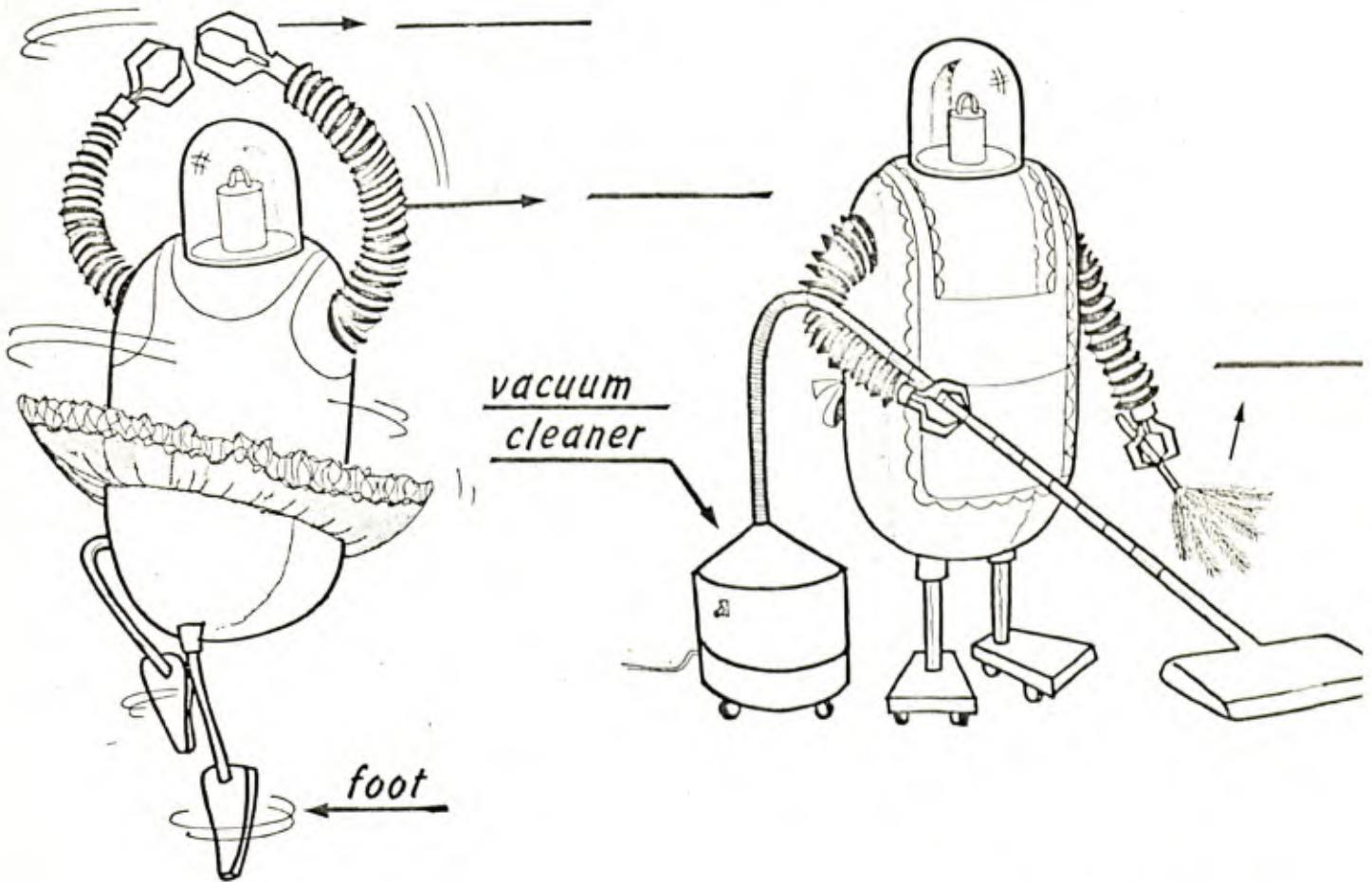
Place the following labels

- AUTOMATION IN HOUSEKEEPING
- MODERN HOUSEKEEPING
- MANUAL HOUSEKEEPING beside them.

- . How are the women in pictures 1 and 4 carrying out their tasks?
- . What about pictures 2 and 5? Do the women have any kind of help? Are their tasks made easier by the use of these two home appliances?
- . What about pictures 3 and 6? Have human beings been replaced by robots in such monotonous tasks?
- . Is there any kind of innovation when robots replace human beings in monotonous and dangerous tasks? Is this a sign of great development in modern technology?
- . In general terms, has modern technology innovated human life?
- . Which do you think are the advantages of robots over human beings? Do they get tired? Do they ask for a rise in salary? Do they go on strike?

ACTIVITY 2 :

INSTRUCTION: Label the diagrams (group-work)



ACTIVITY 3 :

INSTRUCTION: Relate the drawings above to the title of the text: NEW JOBS FOR ROBOTS. What's the meaning of "Robot" ?

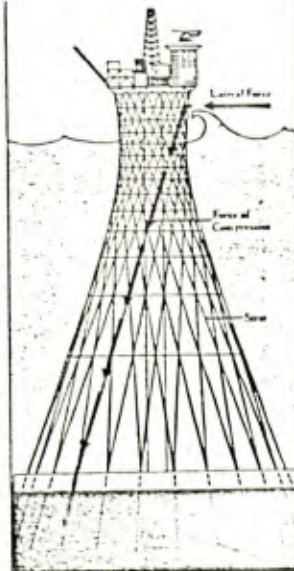
ACTIVITY 4 :

INSTRUCTION: Analysis of the magazine page from which the article New Jobs for Robots has been taken.

INNOVATIONS

Oil rig resists wind and waves

Massive offshore oil platforms can seem quite fragile in storm-tossed waters... But California architect TERENCE WATERS claims that these rigs can be made safer by incorporating the geometry of a hypertetrahedron, which resembles a laboratory flask. While most offshore platforms sway, or "give," his rig would stand completely rigid on the ocean floor. Concrete or steel struts crisscrossing the outside of the structure would divert the lateral forces of wind and waves into a single downward thrust of compression. Some engineers, expressing doubts about the design, say that individual struts could bend under the force of waves and that installation would be extremely complicated. Norway-based Oil Industries Services, representing 25 oil-related firms, is now considering Waters's design for what could be the largest North Sea rig yet.



A rigid, flask-shaped oil rig encased in crisscross struts disarms a storm's lateral forces by directing them to the seabed.

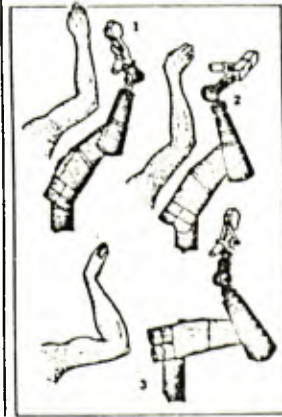
New jobs for robots

Before long, the meat you buy may be cut to order by a robot. Engineers at London's Imperial College are developing the first mechanical butcher to debone hocks of bacon. Since the size of meat and the position of its bones vary, the robot must gauge where to cut. It pierces the meat with a spiked roller, memorizes the position of the bones, then guides the cutter around them.

A four-foot robot with a menacing face that resembles Darth Vader's is being built to patrol prisons at night. Moving on wheels, it will survey areas that are supposed to be vacant. If its infrared and ultrasonic sensors detect prowlers, the robot will radio human guards for help. The prison guard, from Denning Mobile Robotics of Woburn, Massachusetts, will be ready for duty next year.

Not all robots go clunk, clunk. Stanford University has built two that dance ballet. The robots—actually mechanical arms mounted on rolling bases—are programmed to respond to such orders as "reach sensuously" with fluid, poetic gestures. They are used in physical therapy to help handicapped people express

A nimble robot arm that "dances" ballet with sequences of fluid gestures is used in physical therapy for the handicapped.



themselves through movement.

And, they can vacuum. A robot being tested by the Cranford Institute of Technology, in England, not only vacuums but does so unsupervised. Built-in sensors "memorize" where the furniture and walls are. But there's a problem. If furniture is moved, the robot crashes.

Is sneezing genetic?

Do you sneeze a lot? If so, you may have inherited the trait from one or both of your parents. A sneeze normally helps expel sources of irritation to the cells lining the respiratory tract. But some people are overly sensitive. A study of 460 Swedes by L. Beckman and I. Nordensson, of the University of Umeå, found that 64 percent of children whose mothers or fathers sneeze a lot are also frequent sneezers, suggesting that the sensitivity is genetic. Remarkably, some of the people in the study were so sensitive that a bright light was enough to set them off.

High-tech marketplace

You can now use your stress level to adjust your stereo's volume. A battery-operated device called Calmtone, manufactured by Thought Technology, Ltd., of Montreal, can be programmed to increase or lower the music's volume as you relax. How does it do it? It's hooked up to a biofeedback unit that measures changes in your fingertips' pore sizes.

Seeing in the dark is no problem with the Streamlight One Million, the most powerful flashlight ever made. The 17-pound "portable" beacon uses NASA technology and xenon gas to produce a mile-long beam, about 1,500 times brighter than that of a standard two-battery flashlight. The light, which can be seen from 30 miles away, is made by the Streamlight Company, of Norristown, Pennsylvania.

Based on an interview, Health Imaging Technology, of Austin, Texas, will design computer programs to help you lose weight or get rid of bad habits. The program—20 minutes of words and color—will allegedly reinforce such kias as "I will eat only when I'm hungry."

QUESTIONS TO BE USED BY THE TEACHER IN ELICITING INFORMATION FROM THE STUDENTS:

- . How many articles does this page present?
- . In which section of the magazine is this page inserted?
- . Take a look at the two captions below the pictures. Which of the two pictures illustrates the article of today's class?
- . Since this article is in a section called Innovations, what do you think its main function is?
- . How may the ideas be developed in this article? May the article provide descriptions? What about exemplifications? What about comparisons, contrasting ideas? May the article provide explanations for the various kinds of jobs carried out by the different robots?
- . What can robots really be used for?
- . What are the advantages of robots over human beings?

2.2. STAGE TWO: GIST OR OVERALL MEANING

2.2.1. PRELIMINARY REMARKS

This second stage of a reading lesson is primarily intended to develop the students' ability to grasp the overall meaning of a text before processing it fully for a detailed comprehension. The importance of this stage is that it paves the way for a more accurate understanding of what is to be deeply processed later on.

In this stage two reading strategies are developed: Scanning and Skimming. Nuttall distinguishes these two terms in the following way: ⁷

"By scanning we mean glancing rapidly through a text either to search for a specific line of information (e.g. a name, a date) or to get an initial impression of whether the text is suitable for a given purpose (e.g. whether a book on gardening deals with the cultivation of a particular vegetable).

By skimming, on the other hand, we mean glancing rapidly through a text to determine its gist, for example, in order to decide whether a research paper is relevant to our own work (not just to determine its field, which we can find out by scanning), or in order to keep ourselves superficially informed about matters that are not of great importance to us."

In developing the students' ability to process a text for overall meaning, the teacher draws the students' attention to relevant nonlinguistic devices within the text such as dates, figures, graphs, capital letters, proper names, quotation marks, and so on. Since these devices may provide important clues to the understanding of the linguistic information itself, the students can be encouraged to begin their processing of information by establishing a meaningful relationship between the verbal and nonverbal elements of a text.

As mentioned earlier, comprehension occurs gradually and it involves intermediate processes before the reader's encoding of processed material for future use. By first predicting the contents of a text, then by grasping its gist, the students are gradually constructing the meaning of a text they need to read in full later on.

2.2.2. ACTIVITIES FOR GIST OR OVERALL MEANING

TEXT TITLE: New Jobs for Robots*- SPECIFIC AIMS -*

- . to train the students in using two important reading strategies: scanning and skimming.
- . to prepare the students to extract relevant information from a text and to relate it to pictorial information.
- . to prepare the students to select relevant information from a text and to transfer it to some diagrammatic display.
- . to familiarize the students with one of the commonest tasks in reading, that is, the one of transferring information from the linguistic to the nonlinguistic medium, and vice versa.
- . to encourage the students to rely on the nonlinguistic elements provided by the text itself such as capital letters, punctuation, quotation marks, symbols, divisions within the text and so on to gain clues to meaning.

- TEACHER'S ROLES -

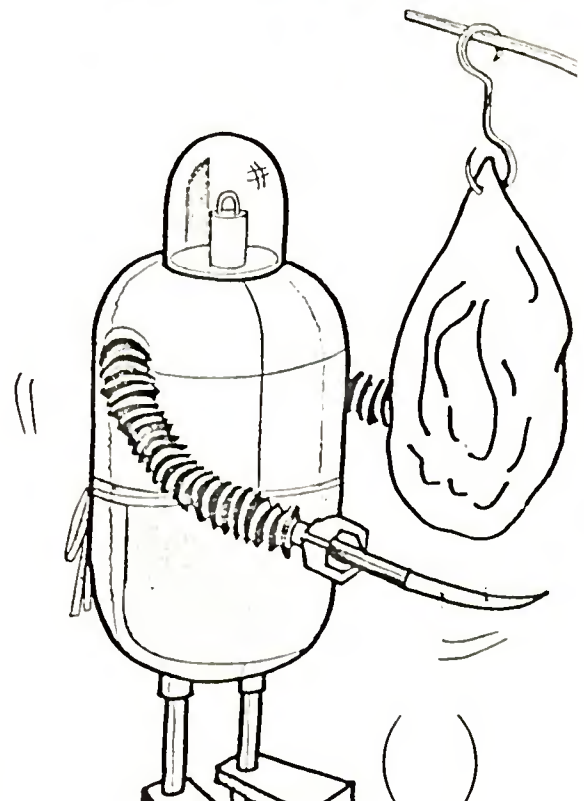
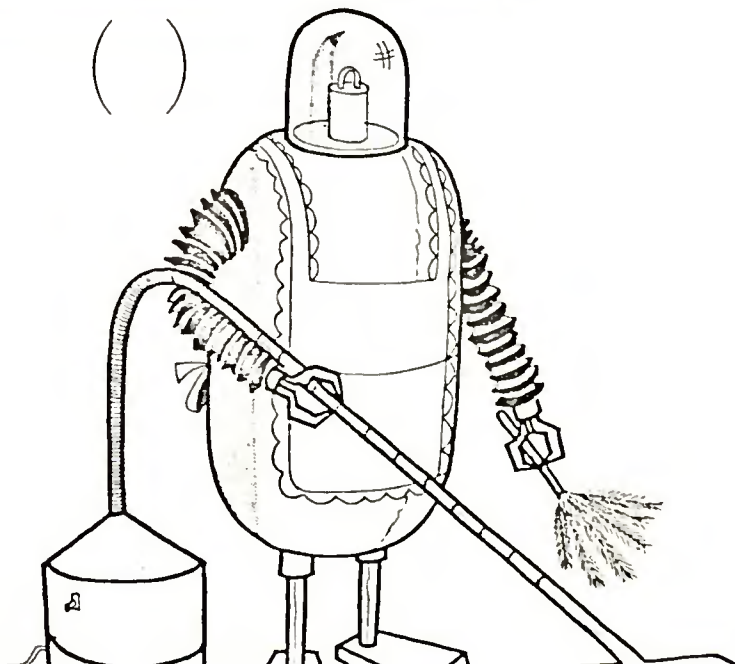
- . to guide the students' task by asking questions, by giving some hints, by asking one student to help the others, by eliciting information from the best students to help the weakest ones, to allow students to learn also from intake, and so on, avoiding as much as possible to provide answers himself to the students' questions.

ACTIVITY 1 :

INSTRUCTION: Skim the text quickly and then match each robot below with its respective description.

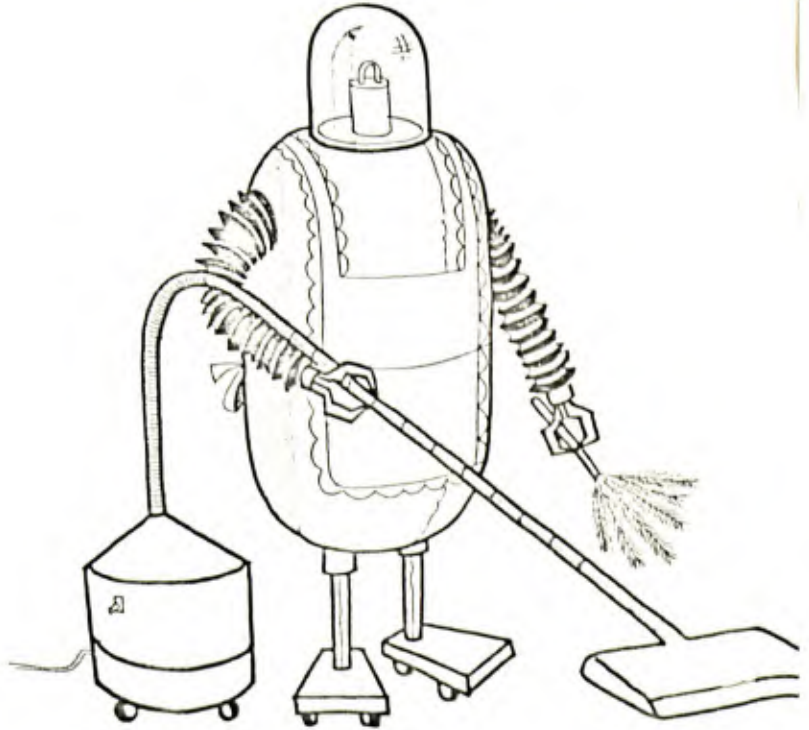
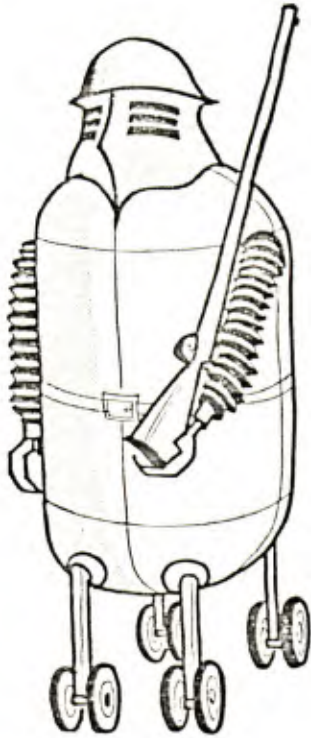
New jobs for robots

- 1 **B**efore long, the meat you buy may be cut to order by a robot. Engineers at London's Imperial College are developing the first mechanical butcher to debone backs of bacon. Since the size of meat and the position of its bones vary, the robot must gauge where to cut. It pierces the meat with a spiked roller, memorizes the position of the bones, then guides the cutter around them.
- 2 A four-foot robot with a menacing face that resembles Darth Vader's is being built to patrol prisons at night. Moving on wheels, it will survey areas that are supposed to be vacant. If its infrared and ultrasonic sensors detect prowlers, the robot will radio human guards for help. The prison guard, from Denning Mobile Robotics of Woburn, Massachusetts, will be ready for duty next year.
- 3 Not all robots go clunk, clunk. Stanford University has built two that dance ballet. The robots—actually mechanical arms mounted on rolling bases—are programmed to respond to such orders as "reach sensuously" with fluid, poetic gestures. They are used in physical therapy to help handicapped people express themselves through movement.
- 4 And, they can vacuum. A robot being tested by the Cranford Institute of Technology, in England, not only vacuums but does so unsupervised. Built-in sensors "memorize" where the furniture and walls are. But there's a problem. If furniture is moved, the robot crashes.

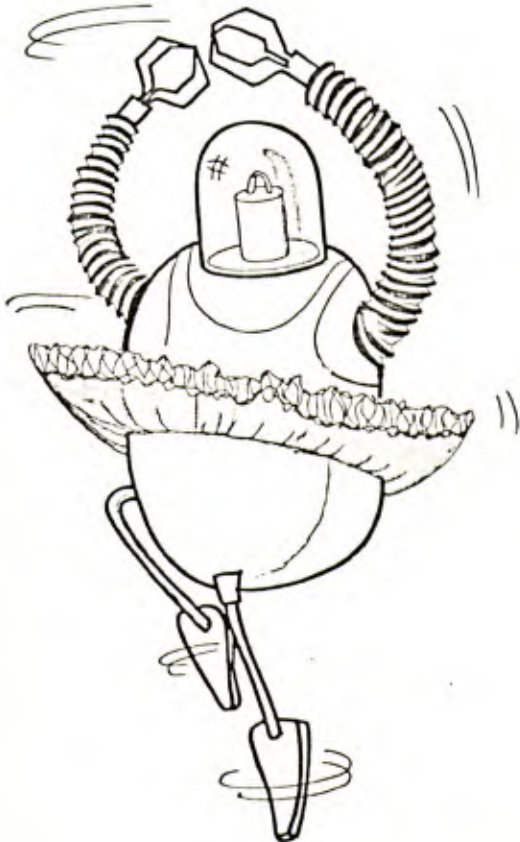


ACTIVITY 2 :

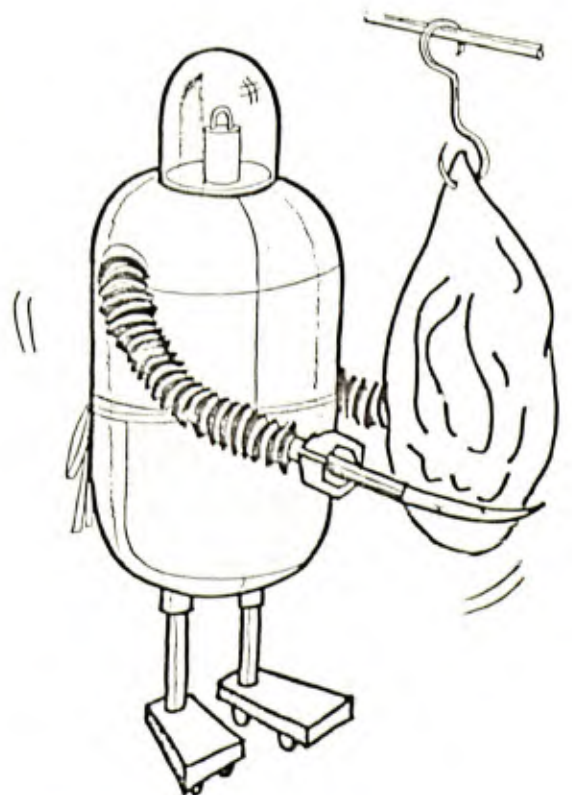
INSTRUCTION: Write two sentences about each robot: one describing its job; the other giving the profession of each according to the job done. Follow the examples.



It is cleaning the house



It is a dancer



2.2.3. USE OF VISUAL INFORMATION IN ACTIVITIES FOR GIST OR
OVERALL MEANING

TEXT TITLE: Obesity⁸

- NOTES -

1. The reader of this dissertation must assume that prediction activities have already been carried out. For this text only activities for overall meaning will be suggested.

2. It is the role of the teacher to explain the meaning of "topic sentence."

- SPECIFIC AIMS -

- . to train the students in skimming and scanning a text to form its gist and to locate specific information.
- . to help the students to grasp the main information of each paragraph through the processing of the corresponding "topic sentence."
- . to train the students to relate linguistic information to pictorial information.

OBESITY, or excessive corpulence is not only unattractive; it is dangerous. It increases susceptibility to a number of diseases among them gallbladder disease, gout, diabetes mellitus, hypertension, and arteriosclerosis. It may be considered to predispose to pulmonary emphysema and chronic bronchitis, since it often results in interference with pulmonary ventilation. It increases surgical risk. And, as insurance mortality statistics have forcibly indicated, it reduces life expectancy. Obesity is the "*Number One Public Health Problem*" in the United States today.

Obesity results from a positive energy balance; that is, from the daily ingestion of more calories than are expended in the production of heat and work. The factors that affect energy imbalance, however, are varied and complex.

The importance of psychologic factors in obesity is being more and more widely recognized. Some people, for example, resort to overeating to alleviate tension, anxiety, worry, or frustration; they are fat because life is hard; food is their liquor. Hilda Brusch has made several important contributions to the understanding of psychologic factors in the development of obesity in children. Obesity in children she tells us, is "*intricately interwoven with the family interrelationship, the child's personality development and life experiences*". If home offers a child little emotional security, he may make food a substitute for the love and sense of security he craves and needs. An obese child is an unhappy child; overeating is his weapon against failure and disappointment. The abnormal eating habits developed by such a child may persist into adult life and, combined with physical indolence, lead to obesity in maturity.

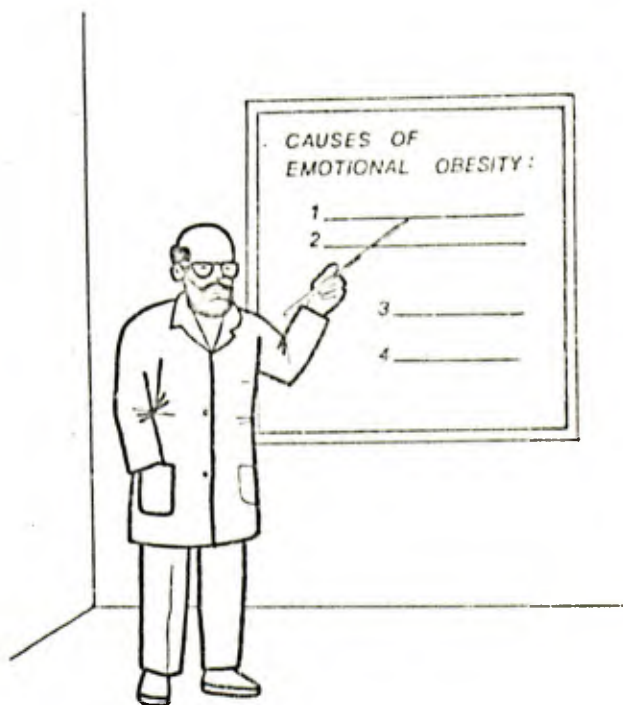
Hamburger lists four categories of overeating that lead to emotional obesity: (1) overeating as a response to nonspecific emotional tensions; (2) overeating as a substitute gratification in intolerable life situations; (3) overeating as a symptom of underlying emotional illness, especially depression or hysteria; and (4) overeating as addiction to food. A recent study on the psychiatric categories of eating difficulties in children has disclosed that there is a striking response in a child toward overeating or undereating in compliance with at times conscious or unconscious wishes communicated by one or both parents.

ACTIVITY 1 :

INSTRUCTION: Match each "topic sentence" with its respective illustration



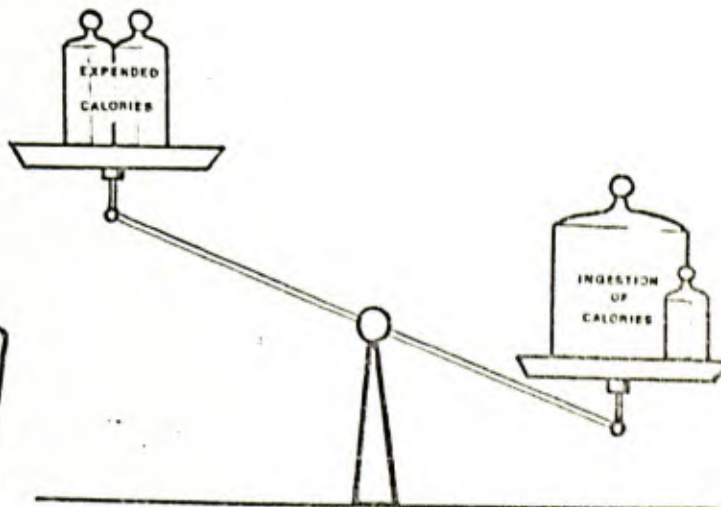
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2.3. STAGE THREE: MAIN POINTS COMPREHENSION

2.3.1. PRELIMINARY REMARKS

Stage Three of a reading lesson is primarily meant to develop the students' ability to grasp the main ideas of a text and to use them in note-taking. As mentioned earlier, an accurate understanding of a written text involves the engagement of two kinds of knowledge: knowledge of the linguistic system the text is encoded in and knowledge of the world.

It is the task of the teacher of reading in this stage to provide means to facilitate the students' processing of the linguistic information itself. One of these means may be the use of the various redundant and complementary semiotic devices of a written text. Since the nonlinguistic devices often make linguistic interpretation easier, the students may use them to lessen the working of their short-term memory and, consequently, gain a more precise understanding of what they are processing. These nonlinguistic devices may then serve two important functions: they may activate knowledge in the students' long-term memory thereby making comprehension feasible and they may also serve as important clues to the understanding of the linguistic information itself.

Apart from the clues provided by the relationship between its verbal and nonverbal elements, a written text also provides important linguistic directions within itself. It is also the task of the teacher of reading to help the students to map out these textual clues to facilitate their construction of meaning.

In reading for main points comprehension, the students need, for example, to recover the continuity of a written text through the various elements of cohesion. Thus, they must be taught that the presence of a sentence which includes reference, substitution, or ellipsis requires an additional interpreting effort. They need to recover the correct interpretation of the sentence from elsewhere in the text. In this stage it is also necessary to teach students to interpret some words as synonyms, or antonyms, or substitutes for others which have previously occurred. Their attention must also be drawn to those linguistic items that may provide clues to the meaning of the sentences they are inserted in.

A point which needs emphasis in this stage is that a text is a coherent and cohesive whole. It is not enough for the students to understand each separate sentence of a text, they need to realize that the meaning of a sentence can only be established by its "syntagmatic relationship" with the other sentences it goes with.⁹ In

reading for main points the students must be taught to find out the complex network of relationships enacted by the writer as a means of facilitating their processing of new information.

2.3.2. THE USE OF VISUALS IN ACTIVITIES FOR MAIN POINTS COMPREHENSION

- *SPECIFIC AIMS* -

- . to encourage the students to make use of the redundant conveyance of meanings enacted by the writer as a means of facilitating their interpretation task.
- . to train the students to use the nonlinguistic information to initiate linguistic activity.
- . to provide some means of visualization of the main information of the linguistic text itself.
- . to prepare the students to transfer information from the linguistic to a diagrammatic display.
- . to encourage the students to rely on what they already know to start interpretation of the unknown.
- . to prepare the students to make use of bottom-up and top-down processes during comprehension.

- *TEACHER'S ROLES* -

- . to guide the students' activity stimulating their interaction with the written text they are processing for understanding.

- *NOTE* -

The reader of this dissertation must assume that activities for prediction and overall meaning have already been carried out. For this text only activities for main points comprehension will be suggested.

Medicine¹⁰

Report from the Surgeon General

"The chief preventable cause of death"

Since 1964, the Surgeon General's report on the nation's health has dramatically changed the public attitude toward smoking. As a result of its insistent proddings and calls for "remedial action," smoking ads have been banned from television and radio, and the warning on packs of cigarettes has escalated from a modest "may be hazardous to your health" in 1970 to the current "Warning: The Surgeon General Has Determined That Cigarette Smoking Is Dangerous to Your Health." That notice may become even blunter. Last week's report from Surgeon General C. Everett Koop was the most serious indictment of smoking yet made. The conclusion: "Cigarette smoking is clearly identified as the chief preventable cause of death in our society and the most important public health issue of our time."

According to the report, men who smoke are twice as likely as nonsmokers to die of cancer. The risk faced by female smokers is 30% greater than nonsmokers and still rising. An estimated 430,000 people will die of cancer in the U.S. this year, and the report charges smoking will lead to 129,000 of those deaths. Tobacco, Koop said at a press conference, "is responsible for some 340,000 deaths in this country annually," not only from cancer but from heart trouble, chronic lung and respiratory diseases, and other ailments. Previous reports have blamed smoking by pregnant women for miscarriages, premature births and birth defects. Discussing the effects of smoking, Koop said: "This can only presage human tragedy in the years ahead and enormous economic loss to our country." He noted that smoking exacts a financial toll more than \$13 billion a year spent on smoking-related health care and at least another \$25 billion in lost production and wages.

This year's report, like its 14 predecessors, is essentially a review of existing data. But it is the first to focus exclusively on the relationship of smoking to cancer. The 1964 report concluded that cigarette smoking was the primary cause of lung cancer in men and probably in women. Today smoking is consid-

ered a major cause not only of lung cancer but of cancer of the larynx, oral cavity and esophagus, and a contributing factor in the development of malignancy in the bladder, pancreas and kidney. The report also notes an association between smoking and cancer of the stomach. There may also be a tie to cancer of the cervix.

The number of deaths due to lung cancer is steadily increasing. In 1950 the disease claimed 18,313 lives. This year it is expected to kill 111,000. "It is estimated that 85% of lung cancer mortality could have been avoided if individuals never took up smoking," the report says.

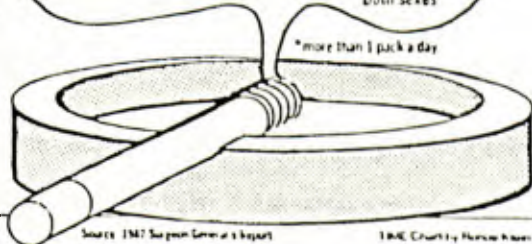
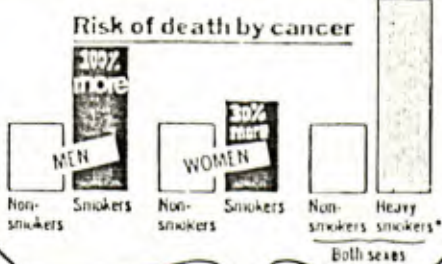
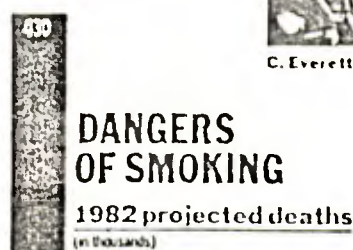


C. Everett Koop

"An epidemic among men has existed for many years; now it is being repeated among women," Koop adds. Reason: lung cancer may take decades to develop, and women began taking up smoking in large numbers only after World War II. Lung cancer, in fact, is likely soon to replace breast cancer as the leading cause of cancer death among women.

"If it were not for lung-cancer deaths," says Koop, "the overall cancer mortality would have fallen, reflecting improved diagnosis, treatment and survival times" for other forms of the disease. Unlike cancer of the prostate and breast malignancies, lung cancer, which accounts for a fourth of all cancer deaths, often fails to respond to treatment. According to the report, only 40% of its victims survive five years after diagnosis.

The report cautions against the use of pipes, cigars, snuff and chewing tobacco, and warns of dangers to nonsmokers exposed to cigarette smoke. "Side-stream" smoke emitted into the air from a smoldering cigarette sometimes includes carcinogens in higher concentrations than those inhaled directly by a smoker. The Surgeon General cites two studies that showed increased risk of lung cancer in nonsmoking women who are married to smokers. Such findings are considered preliminary but, the report notes, "the evidence does raise concern about a possible serious public health problem." Says Dr. Edward N. Brahm, Jr., Assistant Secretary for Health: "Nonsmokers should avoid being in smoke-filled rooms."



Source: 1987 Surgeon General's Report

TIME Courtesy: Horace Newell

ACTIVITY 1 : Processing some of the ideas of the text through an association between nonlinguistic and linguistic information.

- INSTRUCTIONS TO BE USED -

- . Relate the sub-title to the graphs provided. "What's the chief preventable cause of death"? What's the meaning of "chief"? What's the meaning of "death"? What's the meaning of "danger"?
- . By considering the graphs, how many people died of cancer in the U.S. during 1982? Of these how many are smoking-related deaths?
- . By considering the graphs again, how many people died of lung cancer during 1982? Of these how many are smoking-related deaths?
- Consider the graphs again and answer:
 - . what's the risk of death by cancer among men? What about the smokers? What about the nonsmokers?
 - . what's the risk of death by cancer among women? What about the smokers? What about the nonsmokers?
 - . what's a heavy smoker? Which information does the graph display about the nonsmokers and heavy smokers of both sexes?

ACTIVITY 2 :

INSTRUCTIONS: Look through the text and locate the paragraph which primarily presents linguistically the information displayed nonlinguistically in the graphs we have just analysed.

Box this part and use arrows to link each sentence to its corresponding graph.

Circle all the nonverbal information such as numbers in the part you have boxed. How do they relate to the graphs just analysed?

ACTIVITY 3 :

INSTRUCTION: Read the text and look for the required information to fill in the blanks below.

PREVIOUS REPORTS

Dangers of smoking to pregnancy



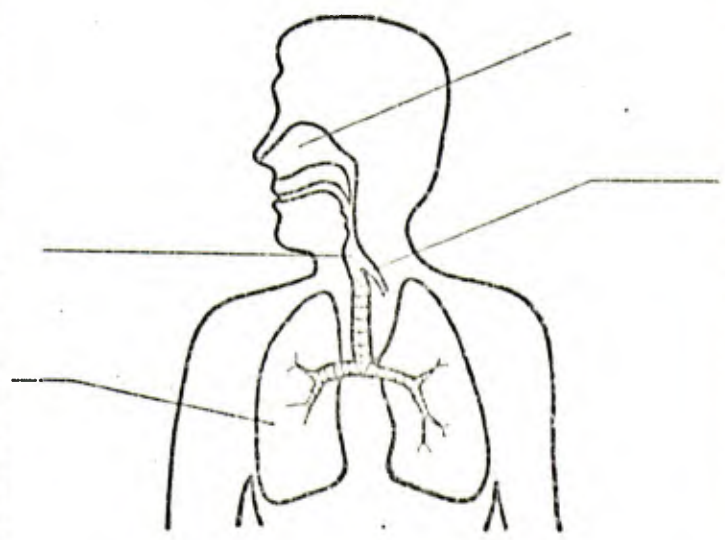
1982 REPORT

. a review of exiting data

. its primary focus: _____

. Organs to which tobacco can be considered a major cause of cancer:

. conclusion reached by the 1964 report



ACTIVITY 4 :

INSTRUCTION: The illustrations below refer to three of the direct quotations from Mr Koop. Look through the text, associate the illustrations to the quotations. Then, fill in the blanks.



BILLION A YEAR SPENT BY THE HEALTH SERVICE IN THE U.S.

WITH



SMOKING-RELATED HEALTH CARE & _____

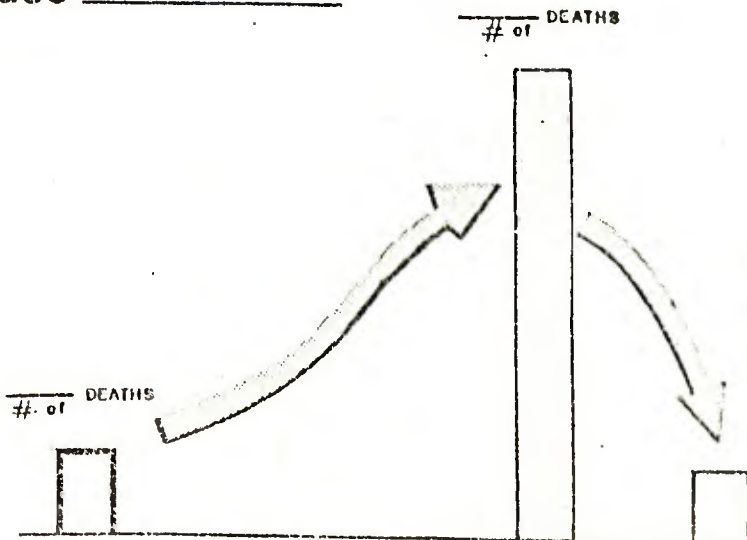
TOBACCO IS RESPONSIBLE

FOR SOME 340,000 _____ IN THE U.S.

NOT ONLY FROM CANCER BUT ALSO FROM

NUMBER OF DEATHS

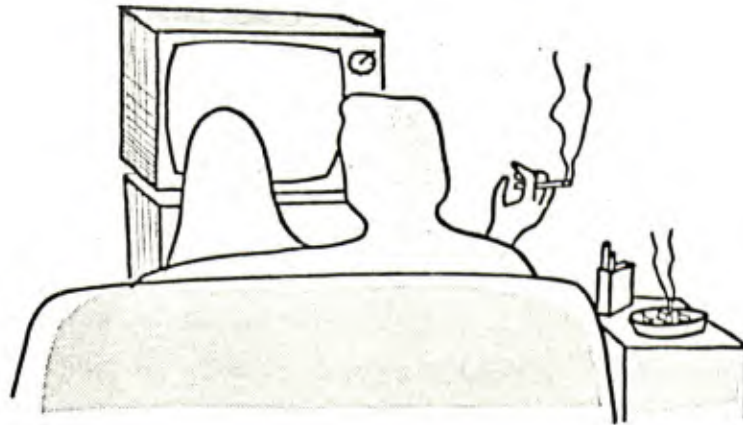
cause _____



Could be dropped in 85% if _____ should be avoided

ACTIVITY 5 :

INSTRUCTIONS: Find the section of the text which can be related to the following illustrations. Then, answer the question : **HOW CAN NONSMOKERS BE AFFECTED BY CIGARETTE SMOKE ?**



2.4. STAGE FOUR: INTENSIVE COMPREHENSION

2.4.1. PRELIMINARY REMARKS

Stage Four of a reading lesson is primarily intended to develop the students' ability to process a text in a detailed way. The interaction of the reader with the complex network of relationships enacted by the writer is far greater in this stage. Therefore, it is the task of the teacher of reading to provide some systematic means to be used by the students in their intensive processing of information. One of these means may be the use of visual devices such as circles, boxes, arrows, underlining, and so on to help the students to visualize the linguistic directions within a text.

The "topic sentence", that is, the sentence which commonly sums up the main idea to be developed in the paragraph it is inserted in, is an example of an important linguistic direction that can be used by the students when processing a text intensively. From a detailed interpretation of the topic sentence, the students can go to the "supporting sentences" which may develop the topic sentence through exemplification, enumeration, classification, and so on.¹¹ By establishing a relationship between the topic sentence and its supporting sentences, the students can have their processing of new information made easier.

Other linguistic directions may come from the use of certain linguistic elements such as The primary purpose of this chapter was ..., What emerged from this discussion was ..., Let us conclude by summarizing ..., In short ..., To end ..., and so on. The primary function of the use of these "retrospective procedures" is to bring into focus the main points which have been developed in the paragraph they are placed.¹²

A paragraph may also contain linguistic items such as This chapter sets out to ..., There are certain points that I want to highlight: first ..., second ..., third ..., and so on. The use of these "prospective procedures" provides important clues concerning the main ideas to be developed in the part they inserted in.¹³

Discourse markers such as moreover, however, on the contrary, likewise, although, for example, thus, as a result, and so on are also important linguistic clues in the text development of ideas. In the students' task of recovering discourse from the textual clues, these markers assume a fundamental role since they provide many clues to the meaning of the sentences they are placed.

By picking up these linguistic items and interpreting their value in relation to the corresponding part they are inserted in,

the students can gain important clues to meaning in their processing of linguistic information.

2.4.2. ACTIVITIES FOR INTENSIVE COMPREHENSION

- SPECIFIC AIMS -

- . to train the students to visualize the rhetorical organization of a written text as a means of decreasing the working of their short-term memory.
- . to train the students to establish a relationship between the relevant details provided by the supporting sentences and the topic sentence.
- . to prepare the students to interpret the linguistic information of a text more purposely.
- . to prepare the students to seek for clues to meaning in the linguistic items themselves.
- . to encourage the students to see interpretation as a constant process of guessing, predicting, evaluating, and asking themselves questions that may be answered by the text.

- TEACHER'S ROLES -

- . to guide the students to detect the network of relationships enacted by the writer.
- . to help the students to realize that these relationships may be effected through repetition of lexical items, exemplification of important points, repetition of syntactic structures, use of reference, use of discourse markers, and so on.

- NOTE -

- . The suggestion of activity for intensive comprehension that follows is meant to show how a teacher may draw the students' attention to the linguistic directions within a text. We will deal with only one paragraph because of constraints of space and time. Our aim is to demonstrate how the students can visualize the linguistic structure of a written text thereby making their processing of information more efficient.

ACTIVITY 1: Reading a paragraph intensively

Compassion is the ability to understand another person's misfortunes. It is kindness, tenderness, mercy, pity, and sympathy. A nurse may have compassion for an irritable patient by understanding that the illness may be the cause of that patient's behavior and by treating that patient with kindness and sympathy. An airline stewardess displays compassion for her passengers by considering the fact that they may be nervous about flying and by answering their questions in a patient, sympathetic manner. In the same way, a judge may have compassion for a juvenile offender by taking his age into consideration and setting the punishment accordingly. Compassion is not merely a verbal expression of sorrow. It is not begrudgingly contributing money to charitable causes out of a sense of duty. Compassion is putting yourself in another person's situation and treating that person the way you would want to be treated.¹⁴

INSTRUCTIONS TO BE USED

- . Let us analyze the topic sentence. Identify its beginning and its end by enclosing it between brackets.
- . What's the subject of this sentence? What's the function of this sentence? Is it classifying "compassion"? Is it describing "compassion"? Or is it defining "compassion"?
- . How is then "compassion" being defined? Circle the definition. Use a blue pen.
- . Box the word "compassion" in the topic sentence and all the pronouns, words or expressions related to compassion in the supporting sentences to the topic sentence. Use a red pen.
- . Which words or expressions are substitutes for "compassion" in the supporting sentences? Which pronoun has been used in the place of the word "compassion"?
- . Use arrows to link the word "compassion" in the topic sentence to the words or expressions you have just boxed. Use a red pen.
- . Let us analyze the first supporting sentence. How does it support the topic sentence? Is it providing other names for compassion?
- . Underline the subject of the three next supporting sentences. Use a yellow pen.
- . By making use of your world knowledge, how can a nurse, an airline stewardess, and a judge be related to the topic of the paragraph, that is, to compassion?
- . How do these three sentences support the topic sentence? Do they provide examples of people who commonly display compassion for somebody else?
- . By making use of your knowledge of the world, for whom do a nurse, an airline stewardess, and a judge display compassion? Read these three supporting sentences and then, link with arrows, each professional to the people they are commonly associated with. Use a yellow pen.
- . Let us analyze the last three sentences. How do they support the topic sentence? Do they provide additional details to the topic sentence? How?
- . What is the function of each of these three last supporting sentences? Do they exemplify, classify, or define?
- . Circle the definitions to compassion in the last three sentences. Use a blue pen.

2.5. ACTIVITIES FOR OVERALL MEANING AND MAIN POINTS COMPREHENSION

TEXT TITLE: Acid Rain

- NOTES -

- . These activities are primarily meant to show how the text iconography itself can be fully used in a reading lesson.
- . Since this text is rather long, only a few activities will be provided with the sole purpose, as just mentioned, of exemplifying an exploitation of the text iconography itself.
- . Many of the activities suggested are based on information transfer from the nonlinguistic to the linguistic medium, and vice-versa.
- . The complete text can be found in the appendix to Chapter III of this dissertation. In this section only the parts of the text focused on in the activities will be provided.

2.5.1. ACTIVITIES FOR OVERALL MEANING

ACTIVITY 1: Analysis of the text iconography — illustrations, titles, sub-titles, captions, and "headlines" — of the first page of the article (p.39)

SCIENCE
digest

OUR TREES ARE DYING

BY NIGEL SITWELL



Denuded trees atop Vermont mountains bode a bleak future.

Nigel Sitwell has written for many British journals about the problems of acid rain.

**ACID RAIN IS NOT AN
ECOLOGICAL CURIOSITY
BUT A GROWING
GLOBAL CONCERN
THAT THREATENS TO
RAVAGE OUR FORESTS.**

- QUESTIONS TO BE USED -

- . What's the name of the magazine this article is inserted in?
- . What does the illustration suggest to you? In other words, what does it represent?
- . Read the "headline" on the left of the illustration.¹⁵ Does it confirm what the illustration suggests? Why?
- . Who is the author of this article?
- . Read the note about Nigel Sitwell. What is he? What's his nationality? Which subject matter interests him?
- . Read the "headline" on the right. It presents some ideas about "acid rain". Which ideas are these?
- . Read the caption under the illustration. What does it mean?

ACTIVITY 2 : Further analysis of the text iconography —
 illustrations and captions — provided by the
 article



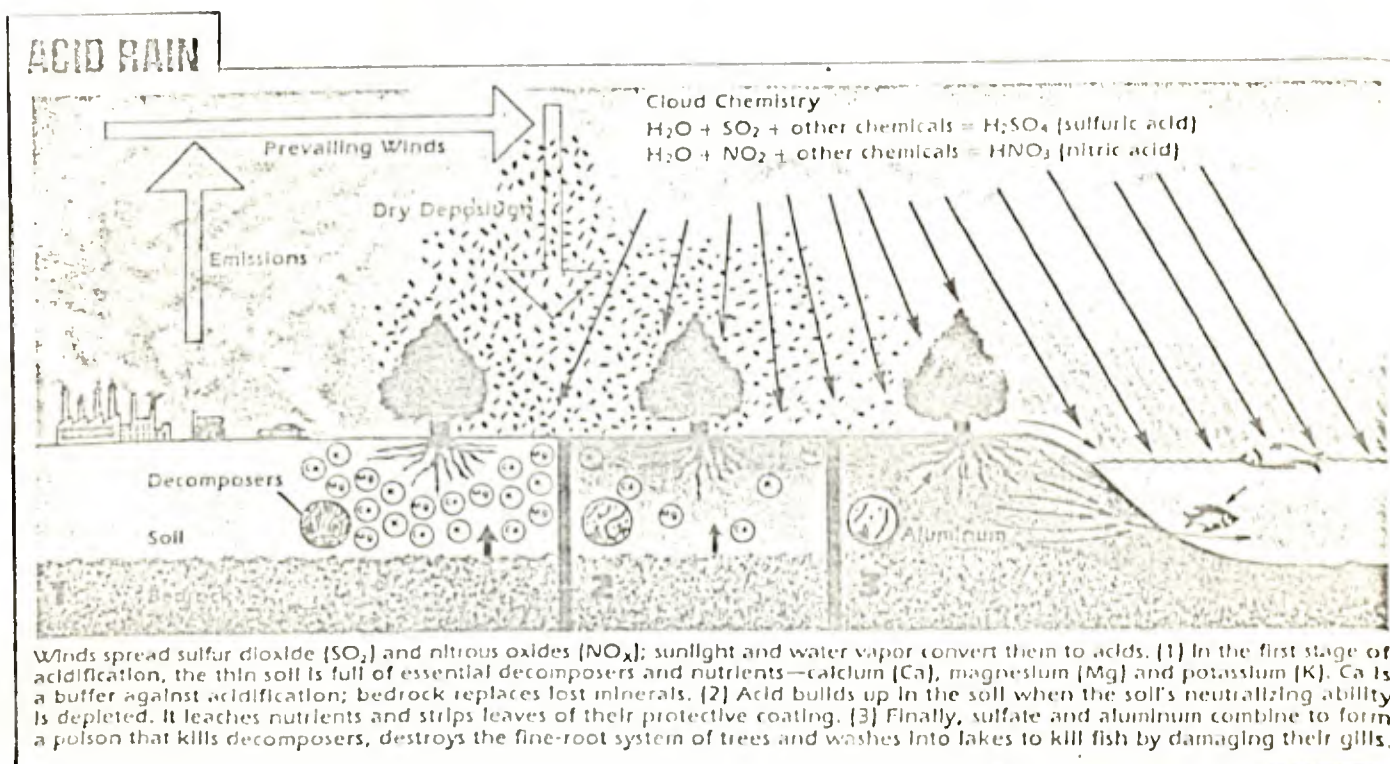
- QUESTIONS TO BE USED WITH THE ILLUSTRATION ON PAGE 40 -

- . What does this illustration suggest?
- . Read the caption to the illustration quickly. Which of the three sentences describes what is shown in the illustration?
- . Which kind of cloud is this? Where is this cloud pouring from? What is then the meaning of "stack"?



- QUESTIONS TO BE USED WITH THE ILLUSTRATION ON PAGES 42 AND 43 -

- . What does the illustration suggest?
- . Read the caption. What has decreased tremendously? Since when? Where has the decrease in tree growth taken place?



- QUESTIONS TO BE USED WITH THE ILLUSTRATION ON PAGE 44 -

- . Take a careful look at the illustration and answer:
 - which kind of pollutants thrown into the atmosphere is the upwards arrow indicating?
 - What do prevailing winds do?
 - Relate the cloud chemistry to the first sentence of the caption. How are acids formed then?
 - What comes back into the earth?



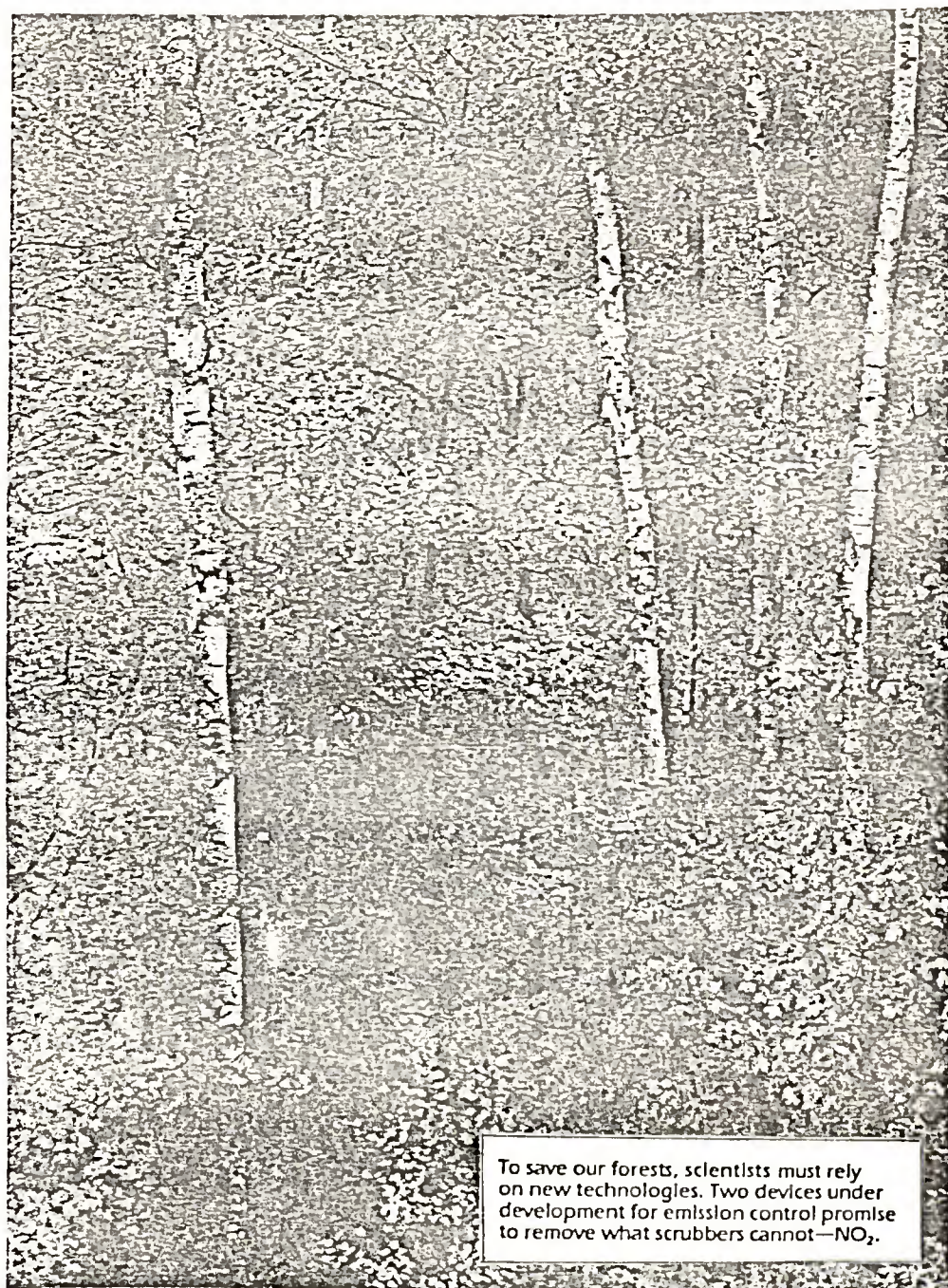
This marble malden (top) in the Place de la Concorde may be a victim of acid rain.

Another pollutant, ground-level ozone, causes lesions on a grape leaf (middle).

The altered chemical mix of an Adirondack stream asphyxiates brook trout (bottom).

- QUESTIONS TO BE USED WITH THE ILLUSTRATIONS ON PAGE 45 -

- . Read the first caption just below the illustrations. Relate it to the three illustrations above and answer: WHAT DO THESE THREE ILLUSTRATIONS SUGGEST?



- QUESTIONS TO BE USED WITH THE ILLUSTRATION ON PAGE 49 -

- . Are these trees green and lively? How do they contrast with the first picture of trees on page 39?
- . Read the caption to this illustration. Who is trying to save our forests? What do they rely on to achieve their goal?

ACTIVITY 3 : Relate the illustrations and respective captions you have just analysed to the labels given below.

- _____ causes of "acid rain"
- _____ formation of "acid rain"
- _____ consequences of "acid rain" over living beings as well as over existing material things
- _____ attempts to save forests against ecological problems like "acid rain".

ACTIVITY 4 : Analysis of the first part of the article by drawing the student's attention to the nonverbal elements of discourse such as dates, symbols, and markers of proper names such as capital letters, and so on.

- INSTRUCTIONS TO BE USED -

- . Scan page 39 and find the places where "acid rain" has already been reported.
- . Scan the page and find when the term "acid rain" was first coined. Who coined it? What was he?
- . The first paragraph claims that "acid rain" is a product of the Industrial Revolution. Why?
- . What does the "topic sentence" of the second paragraph say? Can you relate it to the "headline" just below the page?
- . Two symbols are used in paragraphs 04 and 06. Which symbols are these? Which gases do they represent? How are these two gases related to "acid rain"?
- . Scan paragraph 07 and find the sources from which sulfur dioxide is emitted.
- . Paragraph 08 gives some examples of natural sources from which soils and water receive acid. Which sources are these?

ACTIVITY 5 : Analysis of the whole text by drawing the student's attention to some quotations and some proper names in the text.

- INSTRUCTIONS TO BE USED -

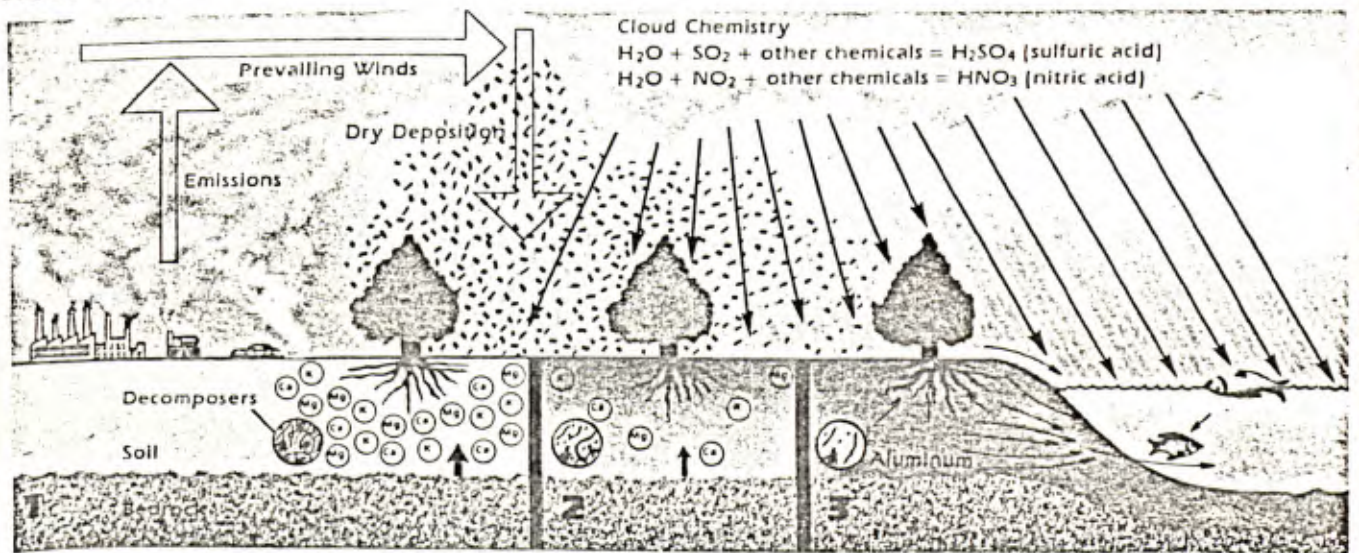
- . Scan page 44 and answer: Who is Sandra Postel? What has she already written? What is she stating in this article?
- . Scan page 45 and answer: Who is Dr Orie Loucks? What is the idea that has been quoted from him?
- . Scan page 45 and answer: How is Dr Vogelmann related to "Camels Hump"?
- . Scan page 46 and answer: What has Dr Peter Allen said about water quality?
- . Scan page 47 and find the paragraph which establishes some relationships between "acid rain" and human health.
- . Scan page 47 and find the paragraphs which describe the effects of "acid deposition" on buildings and construction materials.

2.5.2. ACTIVITIES FOR MAIN POINTS COMPREHENSION

ACTIVITY 1 : Relating Nonverbal to Verbal Information

Nonverbal Information - Illustration on page 44 provided below:

ACID RAIN



Verbal Information : paragraph 2 page 41 provided below:

When fossil fuels are burned, they release large amounts of waste products, such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Once in the atmosphere these reactive gases may combine with water and oxygen to form sulfuric and nitric acids, which fall back to Earth as acid rain. Or they may fall in their original gaseous form or as very fine particles. Scientists prefer to call the first kind wet deposition and the other two dry deposition, or they might call the whole phenomenon acid deposition rather than acid rain. And in any case, wet deposition can take the form of snow, hail, fog, mist or dew. The words *acid rain* are so expressive, however, and so widely used that they are unlikely to be replaced by the more accurate terms.

- 1.1 Relate the illustration on page 44 to the verbal information provided on page 41. Find the paragraph which displays verbally the same information conveyed by the illustration. Then, fill in the table below.

FORMATION OF ACID RAIN

First stage (related to how waste products are released into the atmosphere)

Second Stage: (related to how the acids are formed)

Third Stage: (related to acid rain proper)

- 1.2 Now relate the illustration to its caption below. Then, answer:

- What happens in stage one of soil acidification ?
- What happens in stage two ?
- What happens in stage three ?

Winds spread sulfur dioxide (SO_2) and nitrous oxides (NO_x); sunlight and water vapor convert them to acids. (1) In the first stage of acidification, the thin soil is full of essential decomposers and nutrients—calcium (Ca), magnesium (Mg) and potassium (K). Ca is a buffer against acidification; bedrock replaces lost minerals. (2) Acid builds up in the soil when the soil's neutralizing ability is depleted. It leaches nutrients and strips leaves of their protective coating. (3) Finally, sulfate and aluminum combine to form a poison that kills decomposers, destroys the fine-root system of trees and washes into lakes to kill fish by damaging their gills.

ACTIVITY 2 : Relating "headlines" to more detailed information
in the text

- 2.1 Read the "headline" below (p. 41). What does it state about lakes? Where are these lakes? What does it state about a famous forest? Which forest is this? Where is this forest?

**OVER 4,000 LAKES
IN SWEDEN ARE NOW
FISHLESS. AND IN WEST
GERMANY, AT LEAST HALF
OF THE FAMED BLACK
FOREST IS DAMAGED.**

- 2.2 Relate this "headline" to page 45 and find out where some more information is given about the consequences of acid rain over lakes and forests.

International attention was first drawn to acid rain by Sweden, where widespread acidification of lakes was reported in the early 1970s. Currently, it is estimated that 18,000 Swedish lakes are acidified, 4,000 seriously, and 9,000 have had their fish populations affected. Dr. Orié Loucks (director of the Holcombe Research Institute of Butler University in Indianapolis) estimated in 1982 that 3,000 lakes and 25,000 miles of streams had been altered by acidic input in the eastern states.

Some of the most dramatic effects on forests have been observed in Europe. A survey in West Germany in 1983 revealed that an area of 9,800 square miles of forest, or 34 percent of the country's total, is damaged by air pollution. This includes about half of the world-famous Black Forest. Within this overall area, 2,162 square miles have been designated a "total damage area" in which complete loss of productivity is expected. The Germans, who face an economic cost of about \$1.2 billion a year, are seriously worried about the loss of their forests.

Elsewhere in Europe, disturbing reports are filtering out of Poland, Czechoslovakia, East Germany and the Soviet Union, all suggesting massive forest damage. A recent report from the Netherlands indicates that pine and oak in some areas are seriously affected by acid rain. Since the soil on which Dutch forests grow is sand above an impermeable substratum of loess, and is among the most acid in Europe, it is not worth trying to replant. Switzerland has recorded damage to 14 percent of her forest trees, and points out that this could be potentially very serious because belts of trees above Alpine villages protect them against avalanches, landslides and floods.

Widespread visible effects on the scale observed in Europe have not yet been seen in North America, but there is mounting evidence that gives cause for concern—at the very least.

2.3 Fill in the table below.

EFFECTS OF "ACID RAIN" ON EUROPEAN FORESTS	
. in WEST GERMANY:	_____

. in CZECHOSLOVAKIA and in the SOVIET UNION:	_____

. in the NETHERLANDS:	_____

. in SWITZERLAND:	_____

2.4 Now answer the following question : WHAT SERIOUS PROBLEM MAY SWITZERLAND FACE DUE TO THE LOSS OF HER FORESTS ?

ACTIVITY 3 : Relating the caption to the illustration on pages 42-43 to some more information in the text.

On Camels Hump in northern Vermont, tree growth has decreased tremendously since the late 1950s. Among red spruce, the number has fallen 80 percent since 1965.

- 3.1 Relate the caption on pages 42-43 to page 45 and find out the paragraphs which give further information about Camels Hump, Vermont. What do these five paragraphs say about the decline in tree growth ?

Vogelmann is well-known for having reported some startling evidence of tree damage on Camels Hump, a high peak in Vermont's Green Mountains, in 1982. Now he and his colleagues have carried out further research that looks to be equally alarming.

"We have recently updated our study to 1983, and the new information confirms the trend we had already identified. We measured the biomass [the amount of living material above ground, including trunks, branches, etc.] of a number of tree species growing on Camels Hump, and we found that nearly all of them are going down,

"For example, the balsam fir has dropped from about forty-six thousand pounds per acre in 1965 to thirty-seven thousand in 1983. That's a twenty-percent decline. And the red spruce, one of the dominant species,

is down from about thirty thousand to just over eight thousand. That's a decline of seventy-three percent."

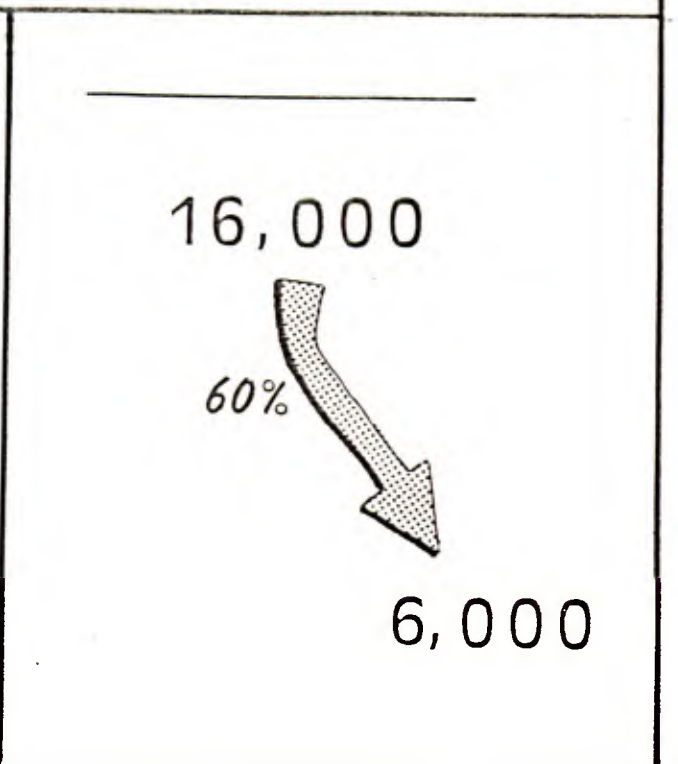
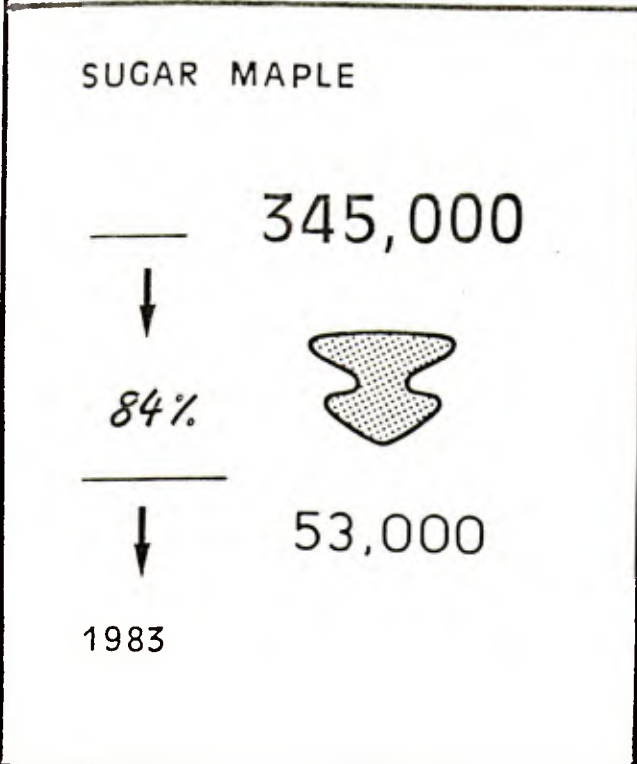
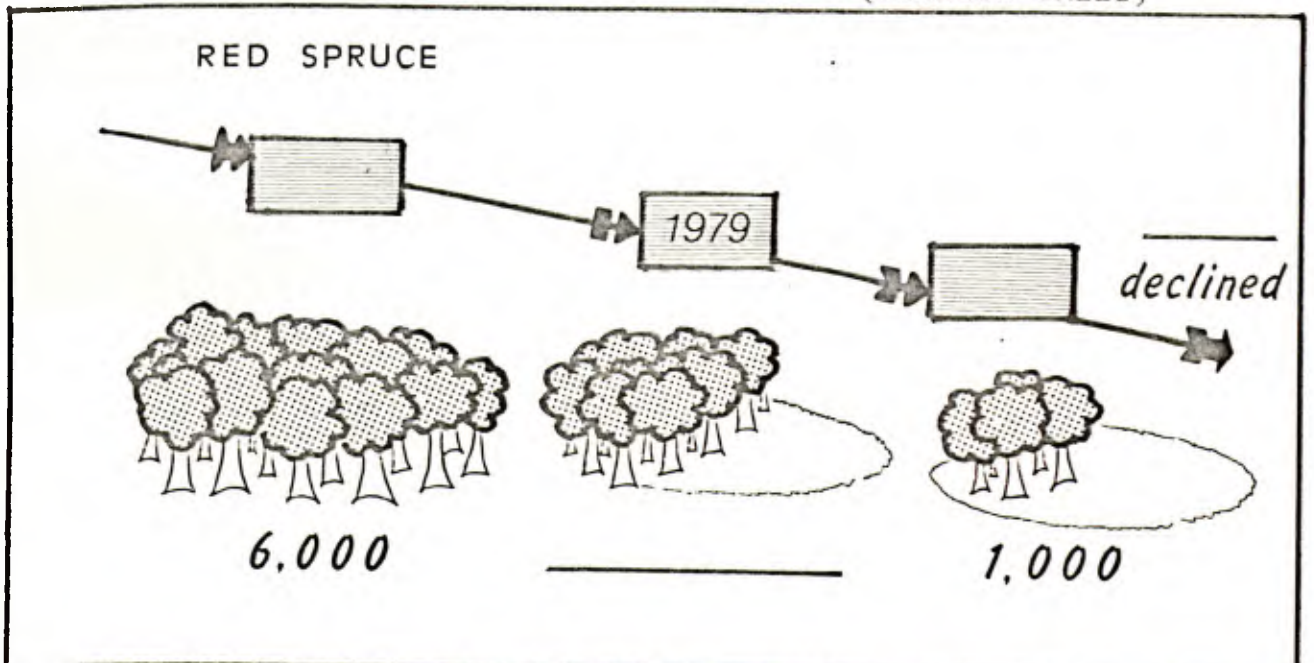
Vogelmann draws attention to the fact that the montane species, the spruce and fir, have together apparently lost 41 percent of their productivity in only 18 years. "That's mind-boggling!" he exclaims. Lower down the mountain, in the commercial forest, there is a 25-percent decline in biomass of both sugar maples and beech.

"But our measurements of biomass are largely made up of mature trees. So we needed to look at the younger trees to find out what the prospects are, what the reproductive potential is like." And the measurements of total tree numbers are perhaps even more astonishing. Red spruce dropped from 6,000 trees in 1965 to 3,000 in 1979 to 1,000 in 1983. "That's an eighty-percent decline," says Vogelmann. "It's lost the capacity to reproduce. You don't find any cones and very few small trees. The red spruce is virtually not regenerating at all." Among other species, the sugar maple dropped 84 percent, from 345,000 trees in 1965 to 53,000 in 1983. Beech declined from 16,000 to 6,000, or 63 percent.

3.2 Fill in the tables below.

DECREASE OF TREE GROWTH ON CAMELS HUMP (MATURE TREES)	
• _____	30%
• RED SPRUCE	_____
• SUGAR MAPLES and _____	_____

(YOUNGER TREES)



3. FINAL REMARKS

This chapter has served two complementary aims: first, it has emphasized the specific function of the nonverbal elements of discourse and visual devices added to the text in each phase of a reading lesson. Secondly, it has provided some examples of activities that can be used in prediction, in reading for overall meaning, in main points comprehension, and in intensive comprehension, that is, all the stages of a reading lesson. The underlying purpose was to highlight the importance of pictorial information as a means of facilitating the students processing of information. The students can then make use of visual information, which is universal and more easily apprehended, in their task of constructing meaning in a foreign language. Referring back to the dual-coding theory, it seems we can state that the pedagogical strategy of using nonverbal information—dealt with by the image system—to initiate linguistic activity, can ensure a better processing and consequent retention of information.

NOTES

¹ J.D. Bransford and M.K. Johnson as quoted in Danny R. Moates and Gary M. Schumacher, An Introduction to Cognitive Psychology (Belmont, California: Wadsworth Publishing Co., 1980), p. 186.

² Francoise Grellet, Developing Reading Skills 2nd. ed. (Cambridge, Cambridge University Press, 1982), p.4.

³ The neglected use of nonverbal elements of discourse and visual devices incorporated into the reading lesson seems to be apparent not only in the materials produced for the teaching of reading in English to Brazilian high-school students, but also in books which are intended to a larger audience of learners. The books published by Nelson, written by a team of writers at the University of Malaya, for example, reflect a somewhat inappropriate use of these elements. Although these books display a great variety of nonverbal information together with the verbal text itself, the nonverbal information does not seem to be fully exploited as a means of facilitating the students' reading task in all the phases of information processing.

The material produced under the orientation of the "Projeto Nacional de Ensino de Inglês Instrumental em Universidades Brasileiras", coordinated by the Pontifícia Universidade Católica de São Paulo, aimed at university students, seems to deal mostly with the nonverbal elements of discourse. Any didactic visual device does not seem to be incorporated into the various phases of information processing. The students only have at their disposal, as a means of facilitating their construction of meaning, the nonverbal elements of discourse, as the material uses authentic pieces of written discourse in the reading lesson.

Insightful examples of the use of nonverbal elements of discourse and visual devices incorporated into the reading lesson come from two recent books which are primarily intended for teachers: Nuttall's Teaching Reading Skills in a Foreign Language and Grellet's Developing Reading Skills: A practical Guide to Reading Comprehension. The former provides an illustrative chapter dealing with the ways readers can respond nonlinguistically to a written text. The latter has a rather insightful chapter which demonstrates how nontext information can be used in the reading lesson. However, none of these two materials suggests a recurrent and systematic use of nonverbal information and visual devices in all the phases of a reading lesson.

⁴ For a discussion of the various stages of a reading lesson see John Holmes, "Stages, Strategies and Activities," Working Papers Nº 4 (mimeo), Pontifícia Universidade Católica, São Paulo, 1982.

⁵ For a more detailed discussion of these two terms see Else Ribeiro Pires Vieira, "Recent Trends in ESP" (in Revista do Departamento de Letras Germânicas da Faculdade de Letras da UFMG, Ano IV, 1, dez., 1983), pp. 265-282.

⁶ This text was taken from "Science Digest" (Vol. 92, Nº 9 Sept., 1984), p. 84.

⁷ Christine Nuttall, Teaching Reading Skills in a Foreign Language (London: Heinemann Educational Books Ltd., 1983), p. 34.

⁸ This text was selected by the "Departamento de Letras Germânicas da Universidade Federal da Bahia" to be used in "Inglês Instrumental II", 1980.

⁹ H.G. Widdowson, Explorations in Applied Linguistics 2 (Oxford: Oxford University Press, 1984), p. 40.

¹⁰ This text was selected by the project: "Ensino de Inglês Instrumental na UFMG: Reavaliação de Programas e Elaboração de Material Didático," Coordinated by Maria Helena Lott Lage, Faculdade de Letras, UFMG, 1985.

¹¹ For a more detailed explanation of the term "supporting sentences" see Natsumi Onaka, "Developing Paragraph Organization Skills at the College Level" (in English Teaching Forum, July, 1984), p. 16.

¹² Widdowson, p. 89.

¹³ Widdowson, p. 89.

¹⁴ This paragraph was taken from Onaka, p. 17.

¹⁵ The term "headline" is used here in its dictionary definition, namely, "a line or lines, usually in larger type, at the top of a newspaper article, giving a short statement of its contents." (Webster's New World Dictionary, p. 644). It is between inverted commas because in this case it is not at the top and it is primarily a summary of some main information to be further developed in the text.

CONCLUSION

This dissertation has advocated the use of nonverbal elements and visual devices in the teaching of FL reading to facilitate the students' processing of information in a language they do not have a full command of yet. It has bridged the past and the present by focusing attention on the fact that reading is currently viewed as a communicative activity which involves the reader in a dynamic construction of meaning. The reader is not passive, but rather an active processor of information who uses his previous knowledge to apprehend meaning in an effective way.

By advocating a recurrent and systematic use of visual information in the teaching of reading we are somehow anticipating the future, since teaching through visual media is increasingly used in our age. Computers and video cassettes tend to be important instructional resources in the coming future and they have probably come to stay.

Furthermore, by advocating the use of visual information in the teaching of FL reading, we are taking advantage of the fact that our students have been born in the age of television. This way, they have their sense of sight highly developed. By making use of visual information to initiate linguistic activity, we are bridging the gap between their life experience and their academic studies. The visual information will serve as a starting point to put on linguistic information and to develop their reading strategies as well.

A point to bear in mind is that this dissertation is mostly theoretical and includes practical suggestions—it was not meant to be experimental. However, some informal experiment was carried out at Colégio Técnico, UFMG, where most of the students are false beginners. Comparing the results to previous years, my personal account is that the students' comprehension of a written text is better when a great variety of visual information is used in the reading lesson. The same holds true for retention of the material.

A final point needs to be made. The major argument of this dissertation is not to be understood as a definite solution to our pedagogical problems in the teaching of reading, but as a possible course of action in our challenging task of developing our students' ability to handle written discourse in a foreign language. As Widdowson has once remarked, it indicates a direction to follow and a ground to explore—but it is only a starting point, not a destination.

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