SIMULATION AND THE DYNAMIC SIGN:
COMPUTER GENERATED IMAGES IN THE ELECTRONIC CINEMA

by

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ABSTRACT

Recently, a technique has developed to create cinematic images using computers. Examples range from the space battle sequences in a film called 'The Last Starfighter' to pilot training simulators and video games. The thesis examines the new cinematic technique by comparing its discourse to that of the written text.

First, a detailed examination is made of the notation system of the alphabet and of the form of discourse that results from its use. Eric Havelock's theories of literacy and the alphabet and the work of Paul Ricoeur are used. Ricoeur's work is drawn from his essays on the text as a form of discourse, in Hermeneutics and the Human Sciences. Using the analysis of the written text developed in the thesis, the characteristics of the electronic cinema are then elaborated.

The thesis finds that, at the core of the discourse of both media, a coding technique exists that uses arbitrary rather than analogous symbols. For example, the alphabet uses letters to represent movements of the vocal tract that control the production of sound; the digital code of the electronic cinema uses numerical values to represent the intensity of light and sound that constitute cinematic images.

A demonstration of a close comparability of the two media leads to four conclusions about the electronic cinema. First, the symbol system of the electronic cinema is based on arbitrary signs, like those of the language system. Thus the electronic

cinema represents part of a logical progression in the development of discourse from speech through writing to cinema. Second, the electronic cinema represents the first new coding technique to be developed since alphabetic writing, with power and flexibility comparable to that of the alphabet. Third, important differences do exist between alphabetic writing and the electronic cinema. The 'sign' of the cinema is better represented as a 'sign in motion'. What the sign symbolizes is light and sound, each of which exists as a condition of change. Fourth, the electronic sign is not linguistic; however, it originates in the same thought processes that give rise to the particular structures of language. Because of this, the thesis concludes that competence in cinematic discourse is not dependent on the prior acquisition of written literacy.

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I. Introduction

The two most important developments in communications media in the past thirty years have been television and computers. In the past ten years these have been linked together in various forms to create interactive television systems. The essential core of this technology is audio and video, a combination of sound and pictures, and their manipulation through digital microprocessors. These technologies have had a profound impact on our lives and they are often the focus of great excitement and speculation about the future. However, it is only with the recent developments in the digital processing of audio signals and the somewhat less developed digital processing of video signals, that we can begin to see the potential character of the electronic media that is maturing through these innovations. This transformative medium opens up the possibility of a new medium of discourse - or 'fulfilled' rather than 'new' medium, since it has been evolving for 150 years.

I will refer to this medium as the 'electronic cinema', a phrase coined by the American film-maker, Francis Ford Coppola. He uses the term to apply to his own merging of television and film technologies. For my purposes, the 'electronic' is apparent in video, audio and computer; 'cinema' carries certain connotations of a form of expression more generalized than the specific terms of 'film' or 'television'. In addition it can

include both as variations of a cinematic outlook.

In this thesis I will examine the core of the new technologies - the digital coding of sound and picture - and the way in which the central notation system facilitates the development of a particular form of discourse through that medium. I will compare the electronic cinema to the alphabetic text by concentrating on Eric Havelock's work on the Greek alphabet and the development of literacy , and Paul Ricoeur's essays on the text as a form of fixed discourse. The flexible nature of the alphabet led to the form of contemporary discourse that Ricoeur characterizes in his work on the text. Essentially, this essay will examine the significance of computer synthesis of sound and picture on cinematic expression. It will show the transition in progress from analogue to digital notation of sound and picture, and will compare it to the transition from syllabic to alphabetic notation of speech. In both cases, the simplicity of the code and its flexibility leads to the possibility of common access and a 'literate' population.

Alphabetic symbols were a discrete transformation of the fundamental units of speech. They were an abstraction from speech sounds. This change had a profound effect on Greek society. The objectification of speech in written letters was both a result and a facilitator of an analytical way of thinking. Ideas and principles could subsequently be thought about as entities unto themselves and no longer as a force embodied and revealed in the actions of gods and heroes. The

social impact of the alphabet has been amply discussed in other works and it is not necessary to the analysis here.[1] In the visual experience of speech and the resulting objectification of nature was the beginning of a transition in world view that eventually flowered in the art and science of the Renaissance, and which led to a modern, text-based society. It is this long evolution of a written tradition that has produced the contemporary social context for a new form of communication technology.

Once a comparability between digital electronics and the alphabet has been established, it will be possible to use Ricoeur's model of textual discourse to explore the character of electronic cinema that makes it an equally powerful form of discourse. He derives his categories of the text from those of speech discourse, the essential change being the beginning of the separation of discourse from its source, and its fixation in an external medium. The four categories are: 1) Temporality - the fixation of the discourse in time, 2) Subjectivity - the separation of author and text, 3) The World of the Text - stored in the collection of written texts extending beyond living memory, and 4) The Reader - who completes the process of communication. The commonalities between electronic cinema and the text show how the new medium is a logicl development in the progression of fixed discourse from speech through writing to cinema. The differences show the scope of the innovation introduced with digital synthesis of sound and picture forms.

There is no definable final form of electronic cinema. Its present stage shows the result of a continual merging of three separate streams of technological development. The first is the electronic calculator or computer, the second is television (both audio and video), and the third is the fixation of the visual image that began with the photograph. A brief history of these three forms, emphasizing the recent developments toward merging, will serve to focus this thesis onto its specific subject and differentiate the electronic cinema from the many other forms of interactive screen systems.

Historical Trends Toward an Electronic Cinema

In this essay the cinema is being considered as a general category of expression. It is a product of the historical development of the observation and measurement of nature that characterizes the modern scientific spirit. It is part of the search for knowledge in the sensory world and part of the search for a more accurate technique of representing those observations. Realistic representation became a concern of art in the Renaissance through the inventions of perspective and the camera obscura, two sophisticated techniques for rendering realistic images of the world. At about the same time, the importation of the arabic number system and the revival of greek geometry formed the basis of modern empirical science.[2]

The roots of the specific cinematic discourse that exists today can be traced to the beginnings of three separate technologies, in a coincident burst of inventiveness in the late 1820's and 1830's. The first is the fixing of the photographic image of the camera obscura. This was accomplished through the work of the Frenchmen Niepce and Daguerre about ten years apart. Their techniques produced a single non-reproducible image on a metal plate. At the same time, an Englishman named Talbot invented the paper negative from which multiple copies could be made, a technique that is still at the core of photographic reproduction. By 1890, through the work of Muybridge, Lumiere and Edison, motion had been coupled to the photographic image; and George Eastman had invented the celluloid strip film that allowed pictures to be projected through long sequences. Until the recent introduction of the computer, the only qualitative change in cinema technology was that of sound derived from radio in the late 1920's. Otherwise the 20th century has been a time of refinement in the existing techniques of production.

An interesting development from print and photographs was the invention of the half-tone screen technique for printing photographic images in newspapers. A photograph is printed through a mesh of fine dots that render an image density as a combination of black and white dots. The percentage of each dot in a given area, that is printed black, will determine the gradation of black, gray and white in that area. If each dot is fully printed, the adjacent dots will join and the area will

appear black. If 50% of each dot is printed, the area will be half black and half white, and will appear gray. Allocating a value to each dot in a regular grid pattern such as the half-tone screen is the basis for later developments in the screens used in television and computer graphics.

The roots of television lie in the experiments in electricity and the physics of light and sound in the early 1800's. These experiments formed the basis of inventions that began with the transmission of messages through wires. The telegraph of 1839 led to the telephone, and by 1896, Marconi could send radio waves with Morse code through the air. By 1906, radio broadcasting of voice and music was in place. It was the rapid growth of radio, spurred on by World War I, that contributed to the introduction of sound to film production. Television operates on the same basis as radio but at a more complex level. Although the technique of television was patented in 1930, its actual broadcast debut was held up by depression economics and the Second World War until 1946. In the past forty years, colour and the capacity to store and edit programs on tape have been the major technological advancements. These have led to television production becoming stylistically similar to film production.[3]

The third part of the cinema is the calculating machine recently incarnated as the digital computer. Like the other two parts, the computer can be traced back to the 1830's and the electrical calculating machine of Charles Babbage. By 1896,

calculating machines, based on the punch card looms of the textile industry, had found a more pragmatic use in the U.S. Census Bureau. Through developments in the electronics industry, the first digital computer was invented about 1946 and again found a ready market with the Census Bureau. The history of the past forty years in computing is a litany of growing processing power and falling prices, especially since the explosion of activity that began after the development of microprocessors in the early 1970's. These two factors have made the digital computer an efficient tool in areas that are not based strictly on calculation. The computer stores, generates and performs mathematical routines on sequences of numbers. Audio and video technology, at the core of television, are based on the concept of turning the physical waves of light and sound into sequential electric currents. A computer is then able to translate this continuous sequence of varying intensity into a sequence of numerical values. This translation can go both ways, from electrical to numerical or from numerical to electrical. In other words, the electrical sound and picture signal of television can be generated from a sufficiently large sample of numbers. How this is done will be looked at in a later chapter.

These three technologies have each contributed significant parts to make a conceptual whole called the electronic cinema. It is a technique for generating cinematic-style images with sound. The focus of this essay will be on the forms of cinema that serve as <u>fixed</u> discourse. It is separate from certain

related techniques that involve video and computers. These include such things as videophones, a method of transmitting face and voice on the telecommunication networks. This is live transmission and only becomes the fixed discourse of concern here if it is recorded by the receiver, and as such is a primitive sense of cinema. The second associated technique is the exchange of printed messages through word processing systems. Video is used here as a substitute for paper and as such the medium is still a version of written discourse.

The remainder of this essay will explore in detail the nature of the electronic cinema. In Chapter II, I will discuss Ricoeur's four categories of the text as fixed discourse, including a summary of Havelock's examination of the alphabetic notation system that lies at the core of the text. The third chapter will look in detail at the digital notation of sound and picture. The final chapter will return to Ricoeur's four categories of fixed discourse and explore the nature of a 'cinematic' discourse as it is derived from a system of digital notation.

Footnotes

1. This topic has been extensively covered in the work of Eric Havelock and Marshall McLuhan.

2. Eric Havelock, Origins of Western Literacy, (Toronto: Ontario Institute for Studies in Education, 1976),

3. For details of the history of developments in television in the United States, see Eric Barnouw, Tube of Plenty, New York: Oxford University Press, 1975.

II. Model of the Text

Discourse

The merging of computers and cinematic media forms offers a new and very flexible technique for transcribing human communication, externalized and thus storable. Many earlier forms have attempted to do this - alphabetic writing was the first to be as successful a means of communicating ideas as the fundamental medium of speech. The new form attempts to provide a more complete description of that which is contained in communication by speech. What we wish to communicate in discourse is not speech as such, but the 'thought' that preceeded it. In video and audio discourse, we can add to the possibilities of speech communication through first person narration, by representing the way in which we experience the world as images of both acoustic and pictorial space.

In communicating ideas, fidelity is desireable, not simply to the world that is represented, but to the way in which that representation conforms to the world experienced in our thoughts. In the photographic and sound recording techniques of the past 100 years, we have developed a method of accurately representing the world as we see and hear it, outside ourselves. In order to convey a mental image or an idea, it is necessary to

form it into objects and actions in the world, that can be recorded in film or television. In both there is a necessary translation from the sound and picture images of thought into another form in order to be comprehensible in communication. A mature cinematic discourse would make possible the direct representation of mental images without a translation to an intermediate form. This includes the expression of language through vocalization. Thus, the product created would more accurately embody what the discourse is intended to convey.

The significance of the computerization of sensory representations lies in the digital coding of light and sound waves. Throughout this century, film and television techniques have been restricted to what can be produced from materials in the known world. Subsequent recordings are analogue codings of these materials because they resemble the originals as exactly as possible in the continuous nature of the way they are coded. Digital coding, in which the units of the code bear no resemblance to the material being coded, opens production to anything that can be imagined and formed into units of the particular code. As the code is made up of discrete units, these units can be fabricated as well as recorded from a model that exists in a sensory world. Production can resemble the world without having actually existed in it. The advancement of discrete coding over analog audio and video is comparable to the advancement of writing in the alphabet over other written forms of ideographic and pictographic scripts. Alphabet was a discrete

coding of speech language. Each letter stands for an action performed to shape the vocal tract for the production of speech. The letters are not related to the sounds. This 'digital' core was important for its completeness and simplicity which helped the expression of abstract ideas and assisted in the spread of literacy.

Discourse means to externalize human thought in some coded form, in order to communicate those thoughts to another person. Speech is probably the fundamental form of human discourse; to say something to another person. All subsequent forms of discourse have been attempts to alleviate the transitory nature of speech and to improve the 'fidelity' to the original thoughts that are being symbolically represented. Until recently the 'text' based on the alphabet was the most flexible and the most efficient.

Before dealing in depth with the characteristics of the electronic cinema, I will explore Paul Ricoeur's work on the "text" as discourse, as a model for comparison. This will be fruitful for two reasons. The first is to elaborate the characteristics of discourse as a general concept whether spoken, written, or by extension, electronic. The second reason is that in Ricoeur's dicussion of how the alphabetic text emulates spoken discourse and yet separates itself from its antecedent, lies a route to investigate the digital processing of light and sound as a comparable separation between cinematic discourse and a hypothetical speaker. The extent to which a

comparison of digital processing can be made to the alphabet will give an indication of the importance of the developments in electronic technology in this century.

Language and Text

The Oxford English Dictionary attempts to list and define all the words used in the English speaking world. This is my language, the pool of possible linguistic usages. As language, it exists outside its actual usage in everyday life. When samples are chosen from the pool and formed in a meaningful sequence, a sentence, we could say that the language has been activated in discourse. Discourse, then, is a 'language-event'. This could occur as speech or as a written text. It is the difference between speech and the text that is the focus of Paul Ricoeur's essay "The Model of the Text: meaningful action considered as text". As the subtitle indicates, his purpose is to expand the notion of discourse as text, and to use it as a model for studying social action. The purpose of this thesis is to apply the expanded notion of linguistic discourse to electronic media.

Ricoeur uses four characteristics or traits of 'speech as an event' to convey the complex notion of discourse and to establish a basis for his development of the text.

> First trait: Discourse is always realized temporally and in the present, whereas the language system is virtual and outside of time. Emile Benveniste calls this the 'instance of discourse'.
>
> Second trait: whereas language lacks a subject-in the sense that the question 'who is speaking' does not apply at its level- discourse refers back to its speaker by means of a complex set of indicators such as the personal pronouns. We shall say that the 'instance of discourse' is self-referential.
>
> Third trait: Whereas the signs in language only refer to other signs within the same system, and whereas language lacks a world just as it lacks temporality and subjectivity, discourse is always about something. It refers to a world which it claims to describe, to express, or to represent. It is in discourse that the symbolic function of language is actualized.
>
> Fourth trait: Whereas language is only the condition for communication, for which it provides the codes, it is in discourse that all messages are exchanged. In this sense, discourse has not only a world, but an other, another person, an interlocutor to whom it is addressed.
>
> These four traits taken together constitute speech as an event.[1]

From these characteristics we can say that discourse requires four things: an exchange of signs (in this case, linguistic signs), the exchange takes place between at least two people, the signs refer to a 'world', and the discourse is realized or completed in the present.

These four traits are derived from spoken language, but as writing is a form of language communication they also characterize written language. The way in which they are realized in both is what differentiates textual from oral discourse.

Temporality

The first trait refers to the time in which the speech-event is fulfilled. As discourse it is fulfilled in the present of its utterance. This is easy to understand by the fleeting nature of speech. At the moment of utterance speech disappears in the disappearance of its sound. For writing the case is different. Writing, with alphabetic symbols, is an attempt to fix speech in a permanent way, to alleviate the instant disappearance. By fixing, the spoken language exists beyond the present of its utterance.

What characteristics of speech are fixed in writing? "Not the event of speaking, but the 'said' of speaking,... what we write, what we inscribe is the noema (or intended content) of the speaking. It is the meaning of the speech-event, not the event as event".[2] What writing inscribes is the part of the overall speech-event that is said. The meaning that is fixed in the written text must be contained in that part of the event that can be spoken as sounds, and transcribed as sentences. In a sense, then, the 'present' of spoken discourse is suspended in the fixation. The event of speaking disappears at the moment of utterance, but what is 'said', the meaning contained in the speaking is fixed in the writing to be fulfilled in a later 'present'. How this works will become clearer in later sections through an explanation of the world referred to in the text, and

how the reader 're-presents' the text by returning the suspended references back to the world.

How well does writing act as a medium of speech-event transcription? To answer this it is necessary to explore the nature of the coding of speech-language in the alphabet. The power of the text lies in the fact that the discrete code of the alphabet allows an almost exact transcription of the sound sequences of speech. A text can be separated from any connection to the original speech and still enable meaning of the discourse to be understood. In addition, using alphabetic code, a replica of speech can be generated by an author without any speech having existed before. Without explicitly stating it, the form of writing that Ricoeur refers to is based on alphabetic writing.

The purpose of this essay is to show that the change from techniques of analogue cinema to digital coding of cinematic discourse is comparable to the change from syllabic scripts to the alphabet. This comparability implies that significant changes are possible at the level of cinematic expression and a resulting cinematic literacy. Before pursuing Ricoeur's categories of textual discourse it is necessary to explore the nature of the technique used to fix speech in writing through the code of the alphabet.

The problem of fixation originates with attempts to assist the memory in the recitation of social ritual. The search for an adequate mnemonic aid had a long history. Whatever its origins, speech-language allowed the communication of complex, abstract mental concepts.[3] The problem was to make these concepts permanent or at least to extend the capability of human memory.

In his studies of early carvings and cave paintings, Alexander Marshack, estimates that as early as 45,000 B.C. Neanderthal Man used visual images as symbols in social rituals.[4] Paintings were found to have several layers of material, as if they had been redrawn more than once. They served as an adjunct to a ceremony that probably relied more on speech than the visual image to convey the abstract meaning of the occasion. The repeated piercing of the quarry-image by symbolic arrows insured a successful hunt.[5] Their creation as decorative motifs is doubtful because of the often difficult viewing positions in which they are located. The symbols function to represent, by analogy, some aspects of the world of pre-literate human and depend for meaning on the context of their use. Such 'analog' markings develop into the greater sophistication of Egyptian hieroglyphs, as well as the ideographic and pictographic scripts of other civilizations. In all these cases, the use of the script is kept in the hands of a few craft-literate people often associated with the forces of

magic or religion.

The development of an efficient writing system began when the emphasis on what was represented in script changed. The early scripts represented ideas by analogy to the external world. However, later scripts attempted to represent the sound of speech, an already existing means of human communication. By thinking of speech as a series of discreet sound units it is possible to conceive of physical marks that could then represent each unit, and thus 'contain' speech. In contemporary terminology we could say the change was from an analog to a digital form of symbolization. The development of the Greek alphabet was not the first of these. However, in Havelock's terms, it was the first that led to common access and away from craft literacy.[6]

The power of a text as a form of discourse is dependent on its use being widespread in a society. In his book, The Origins of Western Literacy, Eric Havelock equates the common use of writing in everyday communication to the development of 'literacy' in a society. The society that uses Ricoeur's text is a literate one. Havelock traces the origins of literacy in our culture to the invention of the alphabet in Greece in the fifth century B.C. In fact he applies the term 'literate' only to those cultures whose written knowledge is derived from the alphabet and the first cultures that emerged to make use of it. On page two Havelock states:

> The civilization created by the Greeks and Romans was the first on the Earth's surface which was founded upon

> the activity of the common reader; the first to be equipped with the means of adequate expression in the inscribed word; the first to be able to place the inscribed word in general circulation; the first, in short, to become literate in the full meaning of that term and to transmit its literacy to us.[7]

For Havelock, literacy centres around reading, the act of recognition that turns the act of writing into discourse. If recognition depends on the deciphering of a highly complex code, as in early scripts, then fluency remains restricted to an elite few, who act as interpreters of the written text for a general audience. This elite would also tend to be the ones who write. The function of inscription, in this sense, is that of a mnemonic device, and what Havelock calls 'craft-literacy' develops. True literacy does not develop until the Greek invention of the alphabet where the form of inscription is simple and reading can be achieved throughout a population.

Havelock cites three qualities, necessary in a script to enable a culture to become literate.

> First, the coverage of linguistic sound offered by the writing should be exhaustive. The visual shapes ... must be sufficient in number to trigger the reader's memory of all sounds of the language. Second, any one shape or combination of shapes must trigger the memory of one and only one phoneme. Third, the total number of shapes must be held to strict limit to avoid overburdening the memory with the task of mastering a large list of them before the process of recognition, that is of reading, can begin.[8]

When the final condition is met, a system of instruction can be created that develops fluency in the technique at an early age, much as people learn speech-language.

The first attempts to codify speech, those of the Near-East, tried to attach symbols to the speech-units as they

are uttered from the mouth. These scripts are called "syllabaries", and there were two approaches to their creation each leading to distinct problems.

Spoken language consists of sounds produced in the human vocal apparatus and combines two physical operations. Havelock describes them as:

> ...the vibration of a column of air in the larynx, or nasal cavity, as it is expelled past the vocal chords and modified by them, and there are controls, restrictions, and releases imposed upon this vibration by the interaction of the tongue, teeth, palate, lips, and nose. The vibration itself can produce a continuous sound which is modifiable simply by altering the shape of the mouth. These modified vibrations we call vowels. The rest of the physical equipment can also be used, to start the vibration or to stop it or to do both.[9]

In contemporary terminology each operation constitutes a 'phoneme' or minimum acoustic component of any spoken language.

What the syllabaries attempted to do was to symbolize speech without a phonetic analysis of the nature of speech . The symbol represented a unit that was heard, in other words, it represented 'syllables'. Havelock illustrates the differences between syllabaries and the alphabet in the coding of the spoken phrase "Jack and Jill went up the hill, etc."[10] The alphabetic transcription of the first three words would read:

JAK AND JIL

(fig. 1)

The seven symbols produce nine distinct linguistic sounds that

recall the original spoken words exactly. The two different syllabic attempts could be transcribed as follows:

(fig. 2)

In the first example, one sign stands for each distinctive sound, thus avoiding ambiguity of representation (eg. the 'JA' and the 'JI' sounds), but eventually it produces a large catalogue of unique signs to be memorized. The scope of what can be represented must be kept narrow. The second version, invented by the Semitic people, cuts the total number of the signs down but gives no indication of the shape of the vocal tract in sounding each of the signs. This introduces ambiguity into the reading (e.g., the vocalizing of the 'J' in both Jack and Jill). There must, again, be some prior knowledge of what is represented by the signs. Both systems retain the character of aids to memorization.

The power of the alphabet over the syllabaries came from the way in which it attempted to transcribe speech by basing it on an analysis of the linguistic unit of speech, rather than

simply attempting to assign one symbol to each distinct unit on a one-to-one basis:

> The pre-Greek systems set out to imitate language as it is spoken in these syllabic units. The Greek system took a leap beyond language and beyond empiricism. It conceived the notion of analyzing the linguistic unit into its two theoretical components, the vibrating column of air and the mouth action imposed on this vibration. The former could exist by itself in language, as in exclamations such as 'Ah', the latter could not. It was therefore an abstraction, a non-sound, an idea in the mind. The Greek system proceeded to isolate this non-sound and give it its own conceptual identity in the form of what we call a 'consonant'.[11]

The Greek alphabet was able to comply with the three conditions stipulated by Havelock for the attainmment of a literate culture, and except for modifications to the actual letters by the Romans, very little of significance has been changed with regard to the alphabet. For example, the vehicle of transportation we call the car in English, is represented by the alphabetic symbols C, A, and R, which designate the consonants and vowel of the spoken word 'CAR'. To anyone literate in English, the sight of that sequence of symbols in any medium causes instant recognition of a sound that refers to a class of objects in the world, whether the sound is made audible or not. This technique of transcription in alphabetic symbols can be successfully made no matter how extended or how complex the speech-event may be. This is possible because of the sophistication of the initial analysis of speech into its simplest discrete units.

Fixing the Speech-Act

Returning to Ricoeur we can ask: What aspects of the speech-event are transcribed by alphabetic writing beyond the inscription of letters? It was previously indicated that writing fixed speech insofar as it was said. But this is not the complete sense of the act of speaking. Ricoeur refers to J.L. Austin and John Searle,[12] for a theory of the speech-act in which it is:

> ...constituted by a hierarchy of subordinate acts which are distributed on three levels: (1) The level of the locutionary, or propositional act, the act *of* saying; (2) the level of the illocutionary act or force, that which we do *in* saying; and (3) the level of the perlocutionary act, that which we do *by* saying.[13]

These actions of speech as discourse take place in the context of the dialogue, in which something is to be communicated.

The first level might be called the literal content of the spoken sounds. For example, in saying "I will go to the store at three o'clock", there is a declaration containing certain propositional elements. There is an action, 'going to the store', a time to go, 'three o'clock', and a reference to the one who will act. The second level is the degree of association of the speaker with the statement, in this case an intention that the speaker, himself, will go. This association or obligation incurred 'in saying' would be greater if 'will' is replaced by a stronger form such as 'I promise'. Another aspect of the illocutionary can be seen in the statement 'I will go there at three o'clock'. 'There' is the propositional place, but

the association of speaker to place may be reinforced by a physical pointing gesture, in the same way that the promise may be reinforced with a smile. The third level relates more to the emotional state engendered by the statement, i.e. what is done 'by saying'. In this case the one spoken to is convinced of sincerity or detects a note of falseness in the inflection. In the dialogue, such ambiguity can be potentially clarified by the spoken exchange.

To what extent does writing fix these three levels of speech discourse? The locutionary act exteriorizes itself in the sentence. The sentence and its propositional content is understood as that which is stated by those sounds. From discussion of the alphabet, it is apparent that the physical marks called letters are designed to represent those sounds. Thus, what is spoken can be materially fixed and identified as the original spoken sentence. Exact transcription depends only on the facility of the scribe.

The second level, likewise, can be transcribed through grammatical construction. From the earlier example, the subject's association with 'going to the store', can be indicated with the predicate 'I promise' preceding the proposition. In the case of 'I will go there..', a phrase such as 'where the road forks', can assist. However, if it is left without a phrase the gestural element is lost. In the first example, (assisted by the predicate 'I promise'), there is no indication whether the promise is uttered with a smile or a

frown. The difficulty of transcription, here, lies in the fact that the non-linguistic is intertwined with the linguistic. These gestural elements discernible in the speech-act are not made up of discrete, stable units, and are thus not quotable in the same way as the locutionary part of speech. Therefore, in the illocutionary act, there is possibility for incomplete transcription of the elements not codifiable in grammar. (This point will become significant later when we look at what is coded by digital audio and video).

At the third level we have the least transcribable aspect of speech discourse. This is not the gesture itself but the emotional state actually engendered by it. The phrase 'where the road forks' may indicate a place of great danger or an association from childhood. But as Ricoeur says this "...is the least discourse in discourse. It is discourse as stimulus. It acts not by my interlocutors recognition of my intention, but sort of energetically, by direct influence on the emotions and the affective disposition."[14] An emotional effect may be engendered in written discourse, but there is no way to know if it is the one intended by the author. Therefore, meaning can be contained in the written sentence to the degree "...that these three parts of the speech-act are codified, gathered into paradigms, and, where, consequently, they can be identified and re-identified as having the same meaning."[15]

Subjectivity

The source of the sentence is the speaking subject with the intention to communicate. In the grammatical structure of the sentence there are various indicators that refer back to the personality of the subject. In the speech-act the references are immediate through the presence of the speaker. To understand what the speaker means in the sentence is also to understand the speaker's intention. Mistake is possible, but because of the nature of dialogue the speaker can be questioned to bring the understood meaning of the discourse in line with his intention. Ricoeur cites the ambiguity of the English verb 'to mean' or even more so the French verb 'vouloir-dire'. "It is almost the same thing to ask 'what do you mean?' and 'what does that mean?'"[16]

The action of writing is to inscribe the event of discourse in a form that will probably outlast its author. What is actually 'said' in the written text becomes separated from what the author intended to 'say'. The sense of authorship is still retained in the text in that it is still presented with a singular point-of-view, that of the 'subject' of the discourse, but there is no living person to whom ambiguity can be directed as in the dialogue. "...written discourse cannot be 'rescued' by all the processes by which spoken discourse supports itself in order to be understood - intonation, delivery, mimicry, gestures."[17] Through transcription of speech the fleeting nature

of speech has been remedied, but at the same time a new weakness has been introduced. The text outlives the event of its inscription in the presence of the author, and only the text itself can reveal what it has to say. Ricoeur calls this separation 'semantic autonomy' attained by the text, but cautions against a notion of a totally autonomous text. In the text, as discourse, there is always a 'personality of the speaker' with an intention to say something, thus, there is always a 'point-of-view' apparent, that of the speaker. The author, as writer, is separated from the work and takes on the character of a 'first reader' rather than the specific individual who is the speaker of the discourse. The presence of the speaking subject varies according to the genre of the discourse. For example, the communicating source is more unified in the essay or diary than in the novel or play. The combinations of words and sentences also impart a discernible style of expression that anchors the text not only to a sense of personality but also to a sense of historical time. For example, Shakespearean dramas have a uniqueness attributable both to the author, and to the language of his situational present. The same would hold true for a contemporary text of Beckett or Pinter.

The World of the Text

The structure of discourse is such that someone speaks about something to another. The 'something' spoken about is the referent of the discourse. In speech discourse, it is common to the interlocutors, and can be indicated by gestures or demonstrative speech structures, such as tense of verbs, and adjectives and adverbs of time and place. This function of reference serves to "compensate, as it were, for another characteristic of language, namely the separation of signs from things."[18] Language symbolizes the objects and events of our world as linguistic signs. In the event of discourse, this function of reference returns the sign to a world of objects from which it was originally separated.

The 'world' referred to by Ricoeur is one that extends beyond the situational present of the interlocutors to include the collective memory of those present. In an 'oral' culture, the collective memory is dependent upon what can be kept in the minds of the living, and subsequently recalled. Whatever is retained must be relevant to the present situation of the cultural group. Thus the world of reference remains anchored to the 'here and now' of the event of dialogue, and references can be agreed upon to mean only one thing in the given context.

The written text extends the world beyond that of the author and any original hearer. It is not the world of the text, itself, but rather the world of 'man' as "the ensemble of

references opened up by the texts".[19] Ricoeur uses the example of the 'world of Greece'. It is not the world of classical Greece as lived by the Greeks of the time, but rather, the body of knowledge that we have accumulated about that way of life, that remains relevant to our lived-world. Thus, it might be renamed as 'our world of Greece'. It can be seen that the accumulation of texts offers the potential for a much larger world of reference than the one that can be retained in living memory.

The fixation of discourse in the written work and its extension beyond the author suspends the reference of the text. The fulfillment of reference awaits the connection of the text to its reader and the completion of the text as discourse. Without the reader to activate the writer's discourse the text floats in a relationship with other texts in a body of literature, outside of any world. This is somewhat similar to the way in which words that make up language exist outside a world of reference until they are used in the act of speech.

Ricoeur makes a distinction between two types of world referred to in texts. The first is contained in texts that

> merely restructure for their readers the conditions of ostensive reference. Letters, travel reports, geographical descriptions, diaries, historical monographs, and in general all descriptive accounts of reality may provide the reader with an equivalent of ostensive reference in the mode of 'as if' ('as if you were there'), thanks to the ordinary procedures of singular identification.[20]

Because of the historical commonality ('spatio-temporal network' - Ricoeur) of the writer and reader, the understanding of

textual references intended by the author can be accomplished by the reader. For example, description of events during the First World War can be understood by the contemporary reader because descriptions of land areas, clothes, food, weapons, etc., refer to places and types of articles that still exist, as well as to specific items that are still relevant to the cultural heritage of Europe and North America. If a specific reference indicates an unknown, such as the country of Serbia, a reader has recourse to other textual material that can locate the territory named at the time as one of common knowledge.

The second intention of reference pertains more to texts as literature than simply texts as written discourse. The way in which the suspension of reference was bridged in the first type, by the sense of an 'as if' style, is not possible in this mode.

> This type of reference can be seen in fictional narratives that are not descriptive reports, where a narrative time, expressed by specific tenses of the verbs, is displayed by and within the narrative without any connection to the unique space-time network common to ostensive and non-ostensive description. ...The effacement of the ostensive and descriptive reference liberates a power of reference to our being in the world that cannot be said in a direct descriptive way but only alluded to, thanks to the referential values of metaphoric and, in general, symbolic expressions.[21]

In other words, according to Ricoeur, all writing refers to a world known to both the author and reader. One type refers to it by describing it, the other, known more as literature, refers to that real world by alluding to it in references to a fictional world inside the text. In the latter, what is being explicitly referred to may not require the reader's understanding of the

exact, literal situation. Instead, it demands that the cultural connection between author and reader is such that the symbols resonate to bring alive a new relationship of the reader with the world alluded to. These are the multiple levels of understanding available in literature. It is the capacity of literacy that allows the reader to make the connection between the two worlds without mistaking one for the other.

The Reader

One of the largest discernible changes occurring with written discourse is the relationship between writer and reader. In the dialogue, the process of spoken exchange brings out the meaning of the discourse to the understanding of the listener in the situation of its initial formation. The audience is present to the speaker. On the other hand, the reader is no longer a living addressee of the text. The writer directs work to one or all of a body of reading public. The scope of that audience is the extent to which that society is a literate one and the extent to which social forces constrain access to the attainment of literacy.

In the process of this temporal suspension by inscription, the text takes on a semantic autonomy with respect to the author, but as discourse it must eventually conform to the characteristics of its spoken form. Although the receipt of the address may be suspended, it must at some point be read.

However, the speaker-listener model is not an exact one for the way in which a reader understands the meaning of the text. As the reference of the text goes beyond the world of the author, so too does the meaning of the text extend beyond the world of a single reader. The role of the reader is to fulfill the reference of the text by bringing it into the known present of that reader. Because the author is not present, the text is open to interpretation by the reader. In fact, the text is open to a multitude of interpretations dependent on the number of readers. "This opportunity for multiple readings is the dialectical counterpart of the semantic autonomy of the text".[22] This multitude of interpretations contributes to the sense of tradition that supports the text, as each reader approaches it and partakes of the possible world of reference opened up at the time of reading.

From what is 'said' in the text, and from the discernible references of the text to a 'world', the reader takes on the job of reconstituting the meaning of the discourse. In a sense, the suspension incurred by the initial inscription of the discourse is alleviated in the act of bringing the text and its meaning into a relationship with the present situation of the reader. It is to rejuvenate or re-present the act of describing, that began with the intention of the author but was intercepted and suspended by the action of fixing it in writing.

Separation of Speech and Text

The four traits of discourse used by Ricoeur and outlined above, characterize the way in which written discourse, the text, is derived from its antecedent form of discourse - speech. Although the initial intention for the alphabet was to create a means to alleviate the fragility of memorizing all knowledge, its other potentials were soon realized. The initial attachment of writing to speech is broken in the act of intending to write as opposed to record, and in the act of intending to read not as an intermediary to recitation. No anterior speech may exist and no audience is necessarily gathered to hear the oral delivery of the discourse. This is not to say that the spoken function is eliminated. As George Steiner points out in his collection of essays Language and Silence, the novel was read as a focus for social gathering well into Victorian times. This form of literature refers to the second type of 'world' described by Ricoeur, a fictionalized world. Steiner relates the emancipation of this form from spoken delivery to the rise of the social concept of privacy, in the late nineteenth century.

> The practice of reading a book to oneself, in silence, is a specific, late historical development. It implies a number of economic and social preconditions: a room of one's own or, at least, a home spacious enough to allow areas of quiet; the private possession of books, with the concommitant right to keep a rare book from the use of other men; means of artificial light during the evening hours. What is implicit is the style of life of the bourgoisie in an industrial, largely urban, complex of values and privileges. That complex crystalized later than is often supposed. It was still customary in the Victorian middle class to read out loud, one member of

the family being 'reader' to the rest, or the book being passed from 'voice to voice'.[23]

Intention forms a significant criterion in the creation of discourse and the form in which it is produced and ultimately fulfilled in reception. "The text is really a text only when it not restricted to transcribing an anterior speech, when instead it inscribes directly in written letters what the discourse means."[24] Writing liberates the creator of the discourse from dependence upon an event that actually happens in the lived world. Likewise the reading of the text is dissociated from a speech-event, a single, time-dependant experience of the meaning contained in the discourse. Both sides of the discourse are opened up to a world of greater complexity of conception. In the fixed symbols of language, extended linear argument and an analytical mode of thought is possible. In the preservation of discourse an extended archive is created. The world referred to expands beyond the world presentable in speech, from common memory and ostensive description, to include the imaginary world contained in the creations of preserved literature, an extra-somatic memory. With the electronic cinema there is a similar transition of intention taking place, from 'filming' the existing sensory world to 'filming' a world limited only by the imagination of the film-maker.

Footnotes

1. Paul Ricoeur, "The Model of the Text", from Hermeneutics and the Human Sciences, ed.& trans. John R. Thompson, (New York: Cambridge Univ. Press, 1981) p. 198.

2. ibid p. 199

3. Charles F. Hockett and Robert Asher, "The Human Revolution" in Culture: Man's Adaptive Dimension, ed. Ashley Montagu, (New York: Oxford Univ Press, 1968). This essay details the theories of language origins. The authors speculate on the probabilities that speech-language emerged either from gestures or from animal calls.

4. Alexander Marshack, "The Art and Symbols of Ice Age Man", Human Nature: Sept. 1978, Vol. 1, No. 9, p. 33.

5. ibid, p. 36.

6. It may be noted here that Harold Innis, in The Bias of Communication, relates the structure of society and the availability of a medium for inscribing the alphabet as additional factors that would affect the spread of literacy. Because of the unavailability of economical papyrus and the consequent reliance on parchment, the monastic tradition of the Christian Empire returned to a state of craft-literacy despite the use of the Roman alphabet.

7. Eric Havelock, The Origins of Western Literacy, (Toronto: The Ontario Institute for Studies in Education,1976) p. 2

8. Havelock, Origin..., p. 23

9. ibid p. 29.

10. ibid, The following is a summary, beginning on page 39, of Havelock's discription of various coding techniques.

11. ibid p. 42

12. J.L. Austin, How To Do Things With Words, (New York: Oxford Univ. Press, 1965). Especially lecture VIII.
John R. Searle, Speech Acts: An essay in the philosophy of language,(Cambridge: At The University Press, 1970). Especially chapter 2, p. 22.

13. Ricoeur, "Model of the Text", p 199

14. ibid p. 200,

15. ibid p. 200

16. ibid p. 200

17. ibid p. 201

18. Ricoeur, "What is a Text?" p. 148.

19. Ricoeur, "Model of the Text, p. 202

20. Paul Ricoeur, Interpretation Theory: Discourse as surplus of meaning, (Fort Worth, Texas: Texas Christian Univ. Press, 1976) p. 36

21. ibid p.38

22. ibid p. 32

23. George Steiner, "Literature and Post-History", Language and Silence, (New York: Atheneum, 1967) p. 383.

24. Paul Ricoeur, "What is a Text", p. 146.

III. The Fixation of the Cinematic

In the previous chapter, four characteristics of fixed discourse were elaborated. These can now be applied to a notion of 'electronic cinema'. Three things should be kept in mind from the previous chapter concerning the difference between alphabetic writing and other scripted forms. First, the symbols themselves are complete in linguistic sound coverage - they are few in number and thus simple to memorize, and each symbol is unambiguous in what it represents. Second, the simplicity of the code leads to widespread use throughout society, resulting in a spreading common literacy. Third, alphabetic literacy is characterized by a world-view based on a form of fixed discourse called the "text".

In writing there is a close relationship between particular units (the code) and the way in which they are organized and interpreted (the syntactic rules), and this supports the process of human communication. In this chapter I will consider the similar relationship between code and rules of expression in electronic cinema.

Like speech and text, the cinema externalizes in the process of communication a relationship between the subject of the discourse and a world. As viewers, our senses of sight and hearing are guided by the subject to re-experience that relationship. We will see in the next chapter that in the

experience of the cinema some of the limitations that were inherent in writing as a means of fixing speech are overcome in the possibilities of the cinematic discourse.

Before examining the categories of discourse as they relate to cinema, it is necessary to explore the techniques of coding light and sound through digital computers that are at the core of the electronic cinema. Attributing numerical values to the intensity of sound and light striking a surface is a simple concept. However, understanding the way that these numbers must be organized echoes the accomplishment of the Greeks, in their shift from analyzing what sounds are produced to how they are produced. In this sense the scientific understanding of sound is superior to that of light, partly due to the greater inherent simplicity of sound.

Maturation of the Cinema

The most recent form of the cinema is the result of a long developmental process that began with early scientific analysis in the 14th century. Its development began in earnest with the invention of photography and the experiments in electricity that led to the telegraph, both in the early 19th century. Essentially, these techniques were the first stage of fixing sound and picture in a form that would preserve them through time, as well as represent what is seen and heard in a more realistic way than was possible through writing and the visual

arts. As Andre Bazin expressed in an early essay titled "The Myth of Total Cinema", the early visionaries of the cinema carried in their heads a vision of what was the ideal, and for them logical, final form of the cinema:

> ...it was at the very height and summit that most of them were aiming. In their imaginations they saw the cinema as a total and complete representation of reality; they saw in a trice the reconstruction of a perfect illusion of the outside world in sound, color, and relief.[1]

The most recent developments in digital sound and animation technology brings the first two of these goals toward realization. The techniques exist to both record as well as synthesize perfect illusions of the outside world in sound and color. In fact, the possibilites are greater in that perfect illusions of the inside world can also be created. (The third goal, 'relief', may result from developments in holography, but that is not a concern in this essay.)

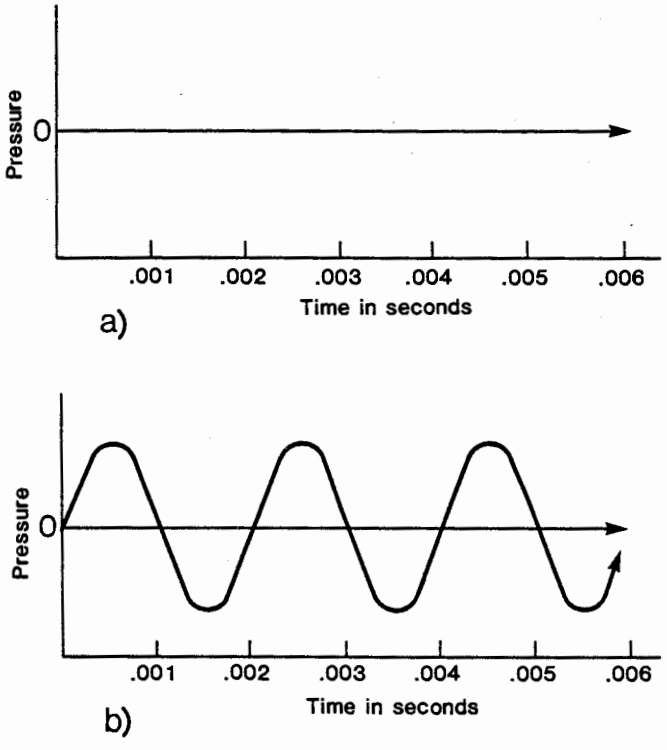
The Digital Coding of Sound

Before it is possible to discuss the coding of sound, it is necessary to gain some understanding of the nature of sound. Digital coding is possible because sound energy can be transformed into electrical energy as an analogue of the pattern of sound waves. The electrical current is coded into numerical representations for storage and later replay, or else the current can be originated from numbers generated by the computer and reproduced as audible sound through a loudspeaker.

Sound is a rapid changing of the pressure of the air. It is heard as a series of compressions and relaxations of air molecules against the membrane of the ear (the ear-drum). The particular qualities of any sound depend on the nature of the pressure vibrations. A tone such as the sound of a single piano note, or a pure electronic tone, causes a constant vibration of air molecules, and forms a series of smooth pressure waves in the air, much as a stone causes a series of smooth waves when dropped into a still pond. The shape of the water waves is called the waveform and the distance from crest to crest is the wavelength. If the number of crests that pass a point in one second or one minute are counted then the frequency of the wave current or vibration is known. Sound can be represented in the same way.

A sound originates at a source and results from the rapid vibration of a surface caused by friction or impact. This, in turn, causes the adjacent air molecules to vibrate physically at the same rate. Energy is transferred as a series of pressure waves outward from the source. This is easily seen in the vibration of a plucked guitar string. The string itself cannot be seen: only the length of the wave set up in the string, and the degree of movement in each direction from its still position is visible.

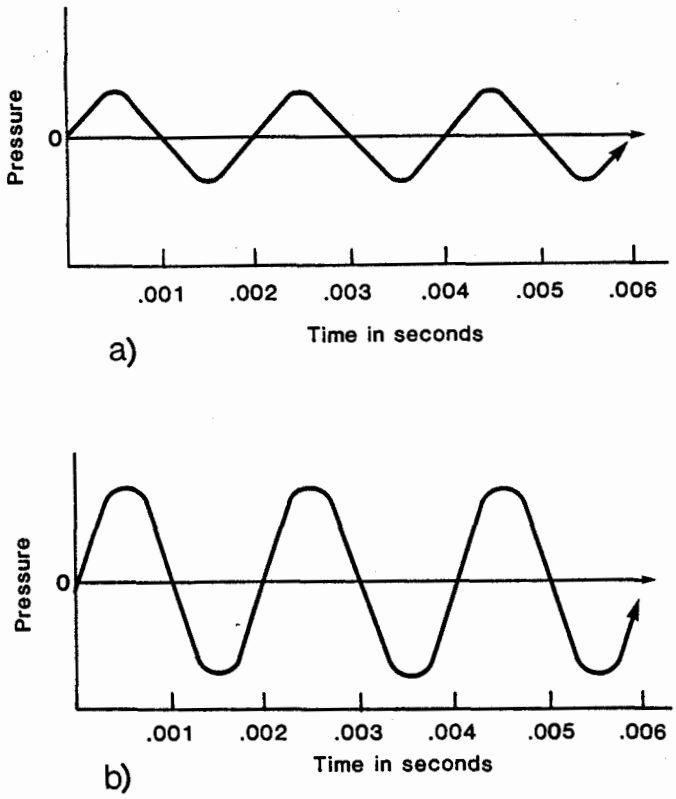
The resultant pressure wave can be represented in a mathematical diagram: (from Mathews p. 3)



(fig 3.) Simple pressure functions:
a) silence b) 500Hz sinusoid

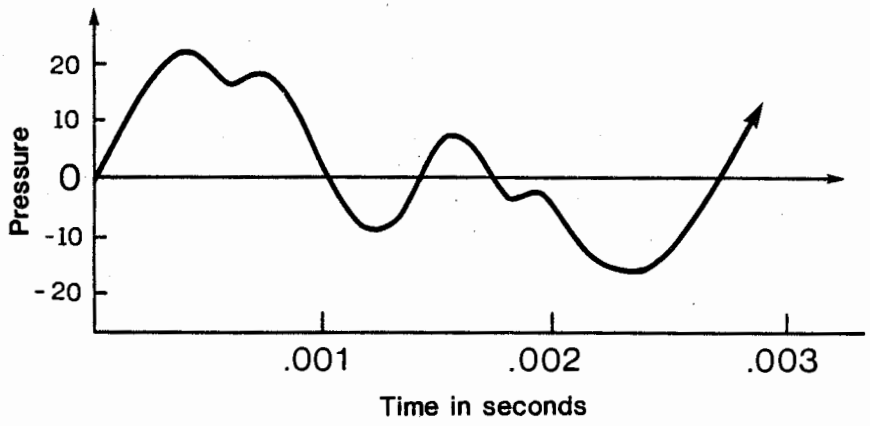
In the first diagram the absence of vibration or movement in the air results in no sound - silence. The second diagram shows a pure tone generated electronically. It takes .002 seconds for one complete oscillation or wavelength to pass a point. Thus, 500 waves would pass a point in one second. This is the frequency, in this case, it is 500 cycles per second or 500 Hertz(Hz). We hear these different frequencies as pitch. The shorter the wavelength, the higher the frequency of the pressure wave, and the higher the pitch that is heard. The loudness of

the sound is perceived as a variation in the intensity of the pressure of the wave. The same frequency could be represented with two different amplitudes or intensity levels as in figure 4. (from Mathews p. 3)



(fig 4.) Variable intensity levels

Most of the sounds that are present in the world have multiple frequencies as well as great variations of acoustic properties over time, more like a stone thrown into rough water. A representation of a sequence of sound that might be heard would look more like figure 5.



(fig 5.) Representation of Environmental Sound

Sound as an Electrical Voltage

If the sound wave stikes a medium such as a microphone instead of the ear, then the sound can be transferred into electricity. When an electrical conductor moves in a magnetic field a current is generated in the conductor. The diaphragm of a microphone is designed to cause such a result. It is attached to a small wire coil close to a magnetic field inside the microphone. How it creates an electrical current from the sound of the human voice is clearly described by R. Thom in Audiocraft:

> ...when you speak into a microphone, the sound waves of your voice strike the diaphragm, causing it to vibrate. The pitch (frequency) of your voice's sound waves cause the vibration to be at a certain rate (frequency): the higher the pitch of your voice, the higher the frequency. The volume of your voice determines the intensity of the vibration.

> Since the coil is an electrical conductor, its vibration (back and forth movement) in the magnetic field causes a current to flow. Again , the rate (number of vibrations per second) determines the frequency of the electrical signal. The intensity determines the 'force' or volume. And because the diaphragm moves alternately back and forth, the electrical current which it generates like-wise moves back ('negatively', or -) and forth('positively' or +) and for that reason is called an alternating current or 'AC'. Thus, the microphone has created an electrical analog of an acoustic event.[2]

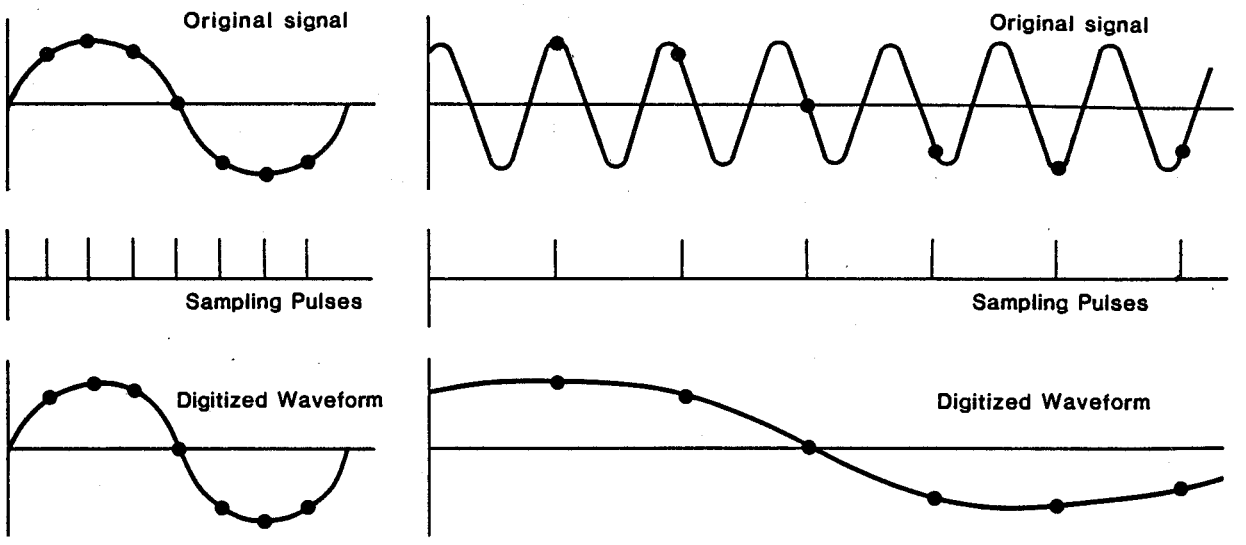
The electrical analogue is the basis for most audio technology. The resulting current can be amplified and projected through a speaker,(the opposite of a microphone), or it can be stored as magnetic patterns on tape, grooves on vinyl records or various sized holes on a laser optical disc.

Digital Sound

Instead of storing electrical voltage as an analogue of the waveform, a digital computer can be used to store a representation of the voltage as a series of numbers in the computer's memory. Voltage can be transformed into numbers for storage through an 'analogue to digital converter'. The analogue waveform is a continuous representation of the sound wave. With the computer, the sound wave is stored as a series of discrete numerical values called 'samples'. The more samples used to represent a sound wave the more accurate the waveform stored or generated will be. Each numerical value is a measurement of the intensity of the pressure wave at the instant sampled. Individually, the numbers are meaningless because sound is only

produced as a change of values (pressure intensity) with time. Thus, a sequence of numbers is required to store or produce sound. However, once these numbers are stored in the computer they can be manipulated to change the nature of the sound that will be heard. If the sound is being generated from the computer, it is a matter of constructing a computer program that will govern the sequence and values that must be generated and subsequently converted into a voltage function in the audio system. This conversion can occur in 'real-time' if a simple waveform is constructed: or more often it is generated onto tape or disc for later playback.

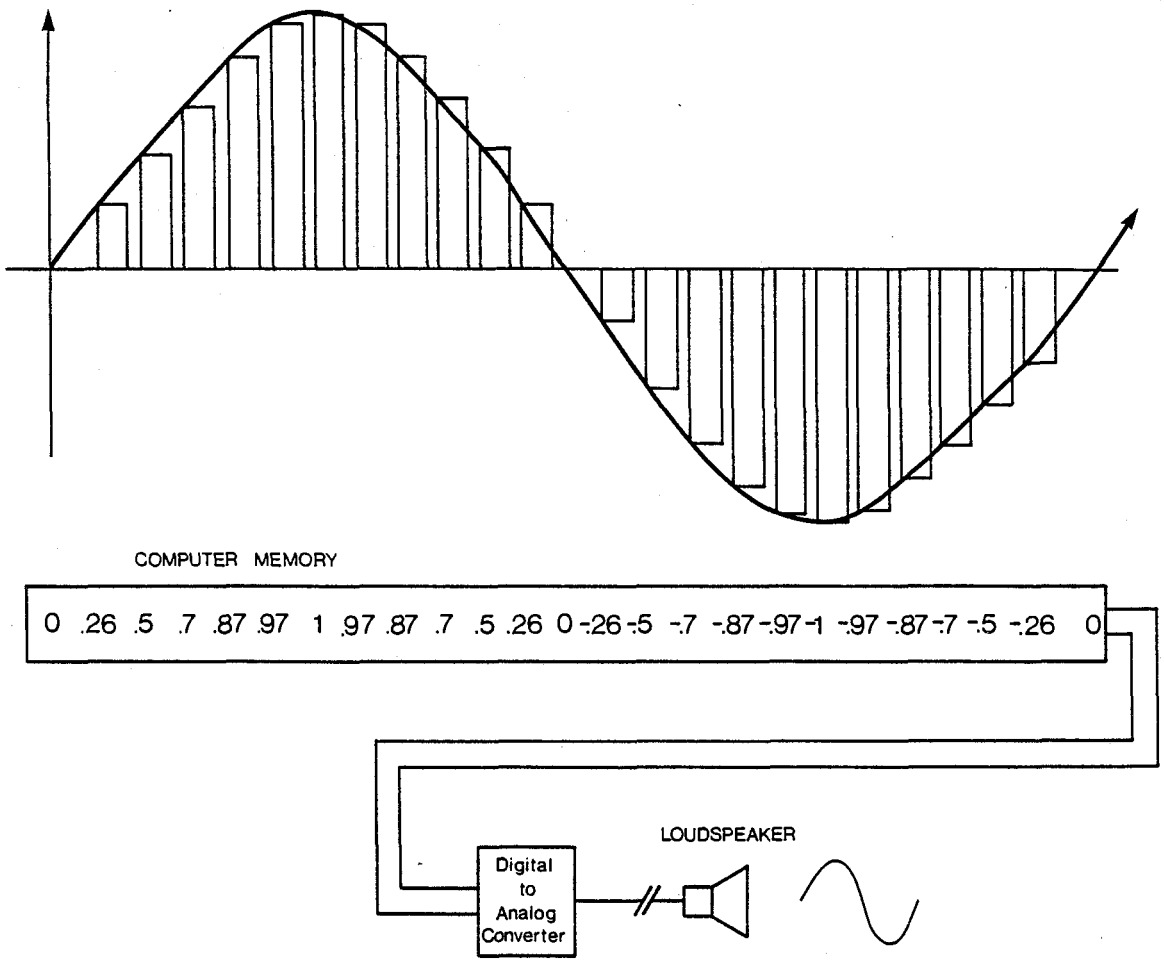
The sampling of numbers for either analysis or synthesis must be carried out at a frequency that insures an adequate approximation of the waveform being represented. The general rule is to sample at a minimum of twice the highest frequency that is to be reproduced . Good sound fidelity covers a frequency range of approximately 20Hz to 16,000Hz. A good approximation of this range would require a sample rate of at least 32,000 samples per second. This provides at least two samples per cycle of the highest frequency. If the rate is less, it is possible to lose the upper frequencies of the sound spectrum, or to hear them reproduced as unwanted lower frequencies (as distortion or noise). This is because the digital samples are converted to the simplest continuous waveform that passes through all the values generated. This can be seen in figure 6. (from Moorer p.35)



(fig. 6) Sampling Rates and Resultant Waveform

In a) many samples per cycle are taken and the digitally produced waveform is an accurate replica. In b) there are less than two per cycle. The resultant digital waveform can include all the values provided at a lower frequency than the original. This error in sampling is called 'foldover' (or aliasing errors).

Each sample pulse is an approximate value of the sound pressure at each point in time sampled. The more memory that can be devoted in the computer to each value the more accurate can be the approximation of the waveform. For example, if the computer can store numbers of three decimal digits then a number with four digits such as 52.64 will have to be rounded off to a value of 52.6.



(fig. 7) Digital to Analog Conversion

Computers work with binary digit numbers (combinations of 1 and 0) and the ability of these numbers to approximate the exact values of the waveform is equivalent to the signal to noise ratio of analogue audio systems (the separation between the loudness of the desired sound and the unwanted low level background noise). A 10 digit binary number, for example 1000101101, produces a signal to noise ratio of 66dB, a 12 digit

number produces 78dB.[3] This is more than sufficient for most commercial audio playback systems. (figure 7, from Moorer p. 33)

Sound is synthesized in a computer by writing a program that tells the computer how to generate the pattern of values. The sequence of rules are called algorithms or procedures, and are equivalent to the syntax of a language that is comprehensible to the computer. These procedures are essential to provide good control over the process of synthesis. As we have seen earlier, the computer must cope with sample rates of about 30,000 numbers per second for good sound. It would be impossible for an individual to itemize each of these numbers in sequence. Good procedures and 'languages' can be used by many people, and they form a repertoire that can be used to synthesize sounds with many different qualities. For sound synthesis the repertoire of techniques has been growing for at least a decade, and is the result partly of the relative simplicity of sound and partly from the long history of sound analysis that has resulted in a thorough understanding of the physical basis of sound production. From this analysis, precise coding in discrete abstract values can follow. Recalling Havelock's criteria for the alphabet, we can see that in this case the coding of intensity values as exact numbers is unambiguous, complete in coverage, and easy to memorize. Its efficiency produces high quality sound reproduction. The technique of coding is well understood. The problem now is to develop the control procedures for recording, transforming or

synthesizing almost any sound event of the imagination.[4]

The Digital Coding of Light

The problems of picture synthesis are substantially greater than those of sound. The creation of efficient abstract code depends first upon an adequate analysis of the physical properties of what is to be coded. The analysis of light poses far greater problems than that of sound, which responds according to the models of classical physics. Energy is transferred through collisions at the molecular level. The physical waveform can be directly transformed into an electrical analogue and sampled at a rate that is reasonable for contemporary computers. Sound can be synthesized by generating specific sine functions (single frequencies), random patterns, or other established algorithmic sequences.

Light does not respond in such a 'reasonable' manner. The problems here fall into two areas: physics and economics. In the first, there are difficulties in mathematically representing how light interacts with different kinds of surfaces. Energy is transferred at the sub-atomic level and this involves the problems of particle physics. Without an adequate mathematics of light in three dimensions, transformation into a 2D screen representation cannot be standardized into a useful or reliable vocabulary of procedures. The second area involves the sampling of waveforms. Complex 2D picture images require about 1000 times

as many samples per second as sound. This strains the limits of existing computers. When complex images can be produced at the rate of one frame every four minutes on sophisticated Hollywood computers (30 frames are needed for every second of finished product), the economics of pure animation are prohibitive for most uses.

The abstract analysis of light has lagged far behind the more accessible analysis of sound. The search for models that display the effects of light on surfaces for coding purposes is a major undertaking at present. In other words, the form of expression and what can be expressed are parallel investigations. This is similar to the way in which the analytical mode of thinking and the abstract analysis of the vocal tract, which taken together led to the alphabet, came into being simultaneously in Greece about 700 to 400 BC.

The Physics of Light

For the electronic cinema (digital code), the concern is to record or generate a 2D image of light that is reflected off various surfaces in the physical world. We will first look at the production of the analogous screen image and secondly the coding of this image. Synthesis is a reversal of this coding process. With sound, we are concerned with energy emanating from a source, and the effect of its reflections off various surfaces in the environment, whereas with light it is the reflections

themselves that are are of interest, for only rarely do we look at light emanating directly from an illuminating source such as the sun or a bright light bulb.

Sound is created from surface vibration that causes a pressure wave to travel through the air. Light is a similar vibration but at the microscopic level. Atoms have a charged nucleus that attracts oppositely charged electrons. In stable atoms the charges balance each other. If the atom is bombarded by other sub-atomic particles, electrons may jump to higher energy levels. This excited state is not sustainable and the electron either falls back to its former condition or leaps off to a new atom. In both cases there is a release of energy in the form of 'photons'. Regular bombardment of the atoms causes regular release of photons as a wave-like emission of energy. The higher the excitation level and subsequent release, the higher the frequency of photon emissions (and the shorter the wavelength of each cycle of the photon wave). Substances tend to have characteristic emmissions in particular frequency ranges.

Visible light is simply a particular band of frequencies emitted by a source out of the total spectrum of possible emissions. The lower frequencies are emitted as heat, a narrow mid-range is emitted as visible light, and the higher frequencies are ultra-violet and beyond. Within the spectrum of visible light, narrower frequency bands are seen as individual colors. The lower ones appear red and the higher ones appear blue. The exact color produced by the photon emission depends on

the very precise way the electron falls from one energy level to another. Particular substances produce their own particular colors. When the electrons are excited sufficiently to produce random emisssions, then various color frequencies blend in appearance to produce white light. This is the normal production of light emitting substances such as the sun.

Color is not usually seen by the eye until the white light is reflected from a surface. The properties of the surface then determine which frequencies are re-emitted as colored reflection. The images formed in our eyes and on the tubes of television cameras are formed by the light arriving from these physical surfaces. The quality of the light reflected depends on the intensity of the illuminating source and the texture and pigmentation of the surface.

Light from the source acts as the bombarding particles to excite the electrons of the surface in view. If we think first of a perfectly smooth surface, the brightness of the light striking it causes photons to be emitted from the surface atoms at the same angle as the striking photons and of an equal intensity. Thus, bright waves will appear bright while dark ones will appear dark. This is the property of mirrors. If texture is added to the surface, for example paper or cloth, the striking photons can penetrate into the surface and will reflect off fibres at different angles than that of the overall surface. The reflection is not a coherent image, as it is with a mirror but rather an averaged, overall brightness.

The last thing to consider is the pigmentation of the surface. Pigment causes certain frequencies of the source illumination to be absorbed , and others to be emitted, thus causing the actual coloration that we see. A white surface, such as paper, reflects the full frequency range of arriving light and almost 100 percent of its intensity. Gray reflects all frequencies but only a certain percentage of the intensity. Black absorbs all of the intensity of the striking photon wave. Black causes the energy of the excited electron to be dissipated throughout the energy field of the neighbouring atoms so that when the electron falls back to a stable state a low frequency photon wave is emitted in the infrared range or lower, and this is perceived as heat.

Rarely are objects in the world perceived as black or white. Pigmentation usually causes photons of particular frequencies to be absorbed, reflecting others of a particular color when emitted in the visible range. Pure colors have a single reflected frequency, as do pure sound tones. Other colors are a mixture of frequencies. Through experimentation it is known that light of the pure colors (primaries) of red, blue and green can be combined in varying intensities to produce all colors of the visible spectrum. This is the key to the reproduction of color images in all photographic related processes. For example, purple can be produced by a surface that reflects the single frequency of purple or else by one that reflects equal quantities of red and blue. Varying the

percentages of red and blue will vary the shade of purple that is seen.

Before considering the nature of the image formed by colored light that is reflected from a surface or scene, it is necessary to break color into some physical properties that allow it to be turned into an analogue electrical wave function.

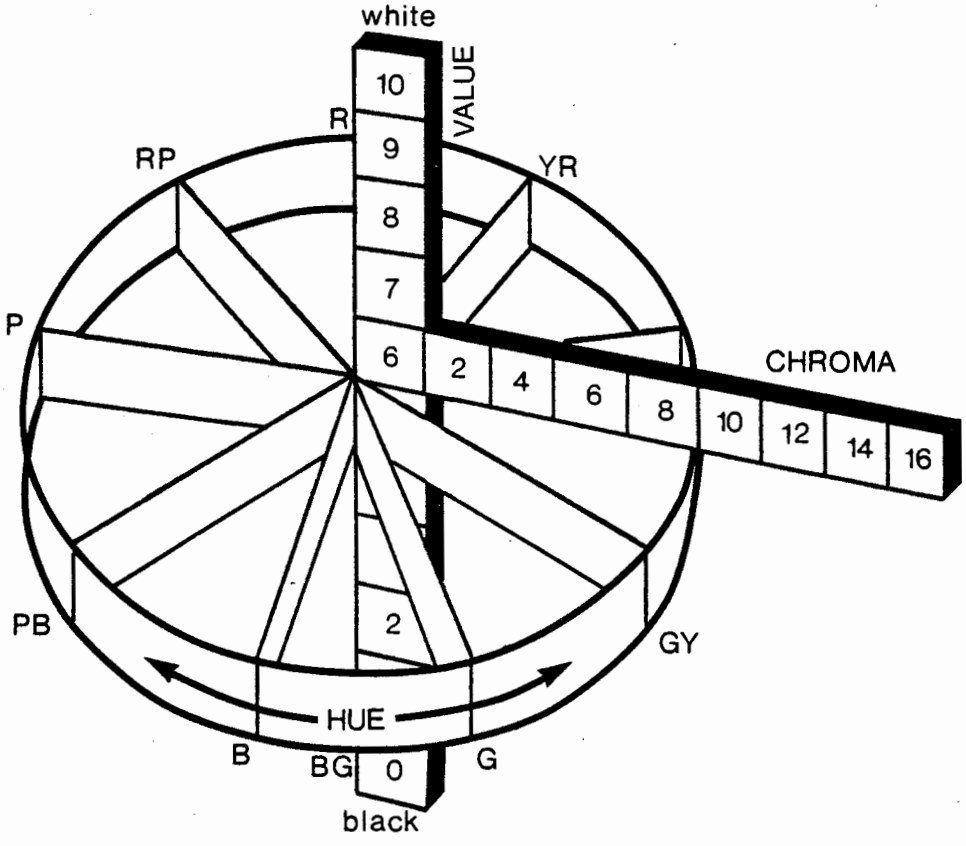
Color

One of the clearest images of color relations was formulated by Albert H. Munsell around 1900: (see figure 8)

> This image is best produced by using a sphere to represent the world of color. With white at the North pole and black at the South pole; and its axis between these points a measured scale of grays, we have a decimal neutral scale which painters call Value. The middle point of this axis must be a middle gray and a plane passing through to the equator must contain colors of a middle value. If therefore the equator be spread with a color circle of Red, Yellow, Green-Yellow, Blue-Green, Purple-Blue, Red-Purple, we have the equator as a decimal scale of hues merging gradually from one to the next and returning upon itself at Red.
>
> Each of these hues is supposed to grow lighter until it merges into the North pole at white, and darker similarly to black, and these are called the values (light) of color. They may also be magined as passing inward until they disappear in the gray axis. Should there be still stronger colors they will continue upon the same radii outside the sphere. These we call the Chromas (strength) of color. In this way every point inside of the sphere and some upon the outside are arranged in three scales as follows: a vertical scale of light values, a horizontal scale of Chromas, and a circular scale of hues;...[5]

These three scales of color components can perhaps be better related to through the familiar dials of a television set. The value scale is controlled by the 'brightness' and

'contrast' knobs, the black and white qualities of the picture. The chroma scale is controlled by the 'color' knob, which can be turned down until the image is purely black and white or up to full where the chroma level almost vibrates.



(fig. 8) Munsell Color Space(from Greenberg et al, p.82)
Plane of five equally spaced hues:
red, yellow green, blue, and purple,

The hue scale is controlled by the 'tint' knob and determines the balance of warmth or coolness in the overall hue. With

television the actual scope of hues have been predetermined by the original broadcast picture. What we call 'natural' coloration depends on the way we refer the screen colors to what they represent in the physical world. The difficulty of tuning a television properly, (and the joy resulting from the development of automatic tuning!) give some small idea of the task facing the computer animator, who has to select from the full range of color relations rather than from a pre-broadcast picture range. The need for automatic code-generating procedures is evident.

The Digital Code

It is now possible to describe the transfer of physical coloration into an electric voltage. This analogue image is produced by a video camera. The camera is designed to register light from physical surfaces as a 2D tracing of a view or scene. The 3D textural surface reflects light of a particular color. This color is a percentage of its red, green and blue primaries. For example 3 parts red : 2 parts green : 1 part blue will give a reddish-orange hue. The fact of at least one part of each primary will shift the chroma toward gray, and the intensity (or brightness) of the three components will determine whether the gray is more white or more black in tone. It is possible, then, to produce a screen image as a field of small colored dots, like a photographic image, and to determine the color at each dot as a proportion of the three primaries, each with a particular

intensity. This is how a camera or a video screen works.

In the camera, light from a scene is focussed through a lens and separated into three primary colored images. These scene images strike the receptive surfaces of electronic tubes, where the scene is read and turned into a flow of electric current. The surfaces of the tubes are coated with microscopic dots of photosensitive material. When light strikes the dot, electrons are driven out causing the dot to acquire a positive electric charge of varying intensity. The brighter the light at that point, the higher the charge. The screen is laid out like a grid. It has a series of rows and columns, dividing the screen into units called 'pixels' which contain several dots each of the photosensitive material. At the back of the tube an electron emitting gun aims a beam at the grid and scans from left to right and from top to bottom. In North America there is a standard of 480 picture lines and 512 columns. Thirty complete images are scanned each second.[6]

As electrons from the beam strike each dot, the positive charge absorbs the free electrons (as many as it needs to balance the charge). As long as light strikes the tube surface, there is a continual alternating charge and discharge process. The remaining electrons flow back to a receptor as a negative value of the brightness of the dot, (i.e. the brighter the dot the fewer the electrons that return). This resultant sequential flow of current is an electrical analogue of the brightness values of the rows of primary colored dots. The total of the

three primary currents would represent the total picture. Each scan line of each primary image can be displayed as a waveform of electrical voltage much as the waveform of sound.

Picture Synthesis

Once a sequential electric voltage has been created it is possible to sample the waveform and code each unit of the grid (pixel) for hue, intensity and its X and Y coordinate on the screen. The transfer of electrical voltage into binary values, or its creation from those values, is a process comparable to that of sound coding, but at a quantitatively higher level. For example, to animate a picture for a standard video screen, numbers must be generated at the rate of 512 columns X 480 lines X 30 screens per second X 3 primary hues = approximately 21 million samples per second (compared to 40,000 for sound). To produce images for film, which requires higher resolution than video, the computer must generate more than 430 million samples per second. This quantity requires a long computation time for each frame of final image. For theatrical film this could run to three or four minutes for each frame, requiring almost a year at enormous costs to produce one animated feature length film of about 90 minutes.[7]

In the same way that sound could not be generated sample by sample, so too picture synthesis requires a vocabulary of standardized procedures. These must be able to describe light,

surface qualities, and ways of transforming those properties in the computer. These tasks fall into three broad categories: Mathematical models that can describe locations in space and on the screen; the determination of visible and hidden surfaces; and the calculation of color and intensity values (i.e. surfaces).[8]

The first task is to build mathematically a 3D model of the object or scene and to code it into the computer. Most techniques rely on geometric constructions that begin with very simple elements such as points, lines or polygons, and build them up into more complex object descriptions. Point by point description is too time consuming so most tend to work from graphs of mathematical functions or from procedures that lay out the basic description ahead of time and require only the specific parameters to be incorporated for the specific object.[9] Most of these procedures are developed for the task at hand or for a particular discipline, and are only early stages in the development of any generalized language of graphics and animation.

The second task is a problem of sorting in the computer. From all the overlapping polygons created, there must be a calculation of which surface is to be rendered visible at each point. For each pixel of the screen, the depth of each polygon (Z coordinate) is compared and the shallowest one is retained. It is often possible to make these calculations over large areas rather than one pixel at a time. This saves expensive computer

time.

Finally the calculations of intensity for each primary hue can be made. These depend on accurate models of how surfaces reflect light, i.e. whether the highlights are specular on bright surfaces or diffused by textures. It was only about three years ago that it became possible to render polished metal surfaces as metal instead of vinyl, like all previous images in computer graphics.[10] The combination of intensity values for each primary hue at each visible pixel will determine the color of surfaces in the final image.

The final task after the image is formed is to cleanup the approximation errors. The most common of these are jagged lines on curved boundaries or diagonals, resulting from insufficient samples being generated especially on low resolution systems. This is the same type of 'aliasing' error that resulted in the synthesized harmonics of sound being heard at lower pitches. In both cases 'filtering' techniques are required to eliminate the sampling problem.

Preconditions for Cinematic Literacy

Does the digital code support the expansion of cinematic literacy? Using Havelock's criteria for written literacy, two things are necessary for such a development: a simple code and its widespread use, particularly with regard to readership. In the case of the electronic cinema, sound and picture are formed

by a conceptually simple code. However, the technology for actualizing this code is complex and not well developed. Digital technique itself is a recent phenomenon, but on the other hand it is an ensemble of techniques that have developed over the last 100 years. Essentially, it is the application of numerals to symbolize quantities (arithmetic). These quantities are derived from the way in which light and sound energy, changing in time, can be represented as a sequential flow of electric current. Discrete values are assigned to the current at a high enough rate to achieve high quality storage and reproduction of the electrical analogue. These coded symbols give precise instructions for the production of comprehensible patterns of communication. In this case the patterns are recognizable in the forms of sound and picture media.

What begins as a highly efficient storage medium, in a sense a mnemonic device, eventually becomes a synthesizing medium. It would be possible to synthesize in analogue forms but the effort required to create actual models is prohibitive. As Max Mathews points out it would involve absurd actions similar to chiselling by hand the precision grooves of a phonograph record. What the digital computer enables is a high speed process of accomplishing this synthesis. It is a machine that makes 'virtual' models.

Examples of synthesis are widespread in music. There is a collection of samples on a UNESCO document of 1978, which ranges from computer-determined abstract patterns, through synthesized

orchestral instruments to an example of human vocal speech by Charles Dodge. Animated pictures, particularly realistic human images, are more difficult. If smooth surfaces such as metal pose problems, then the surface quality of human skin would provide an even greater problem. There is not much latitude for error before skin begins to look artificial and objectionable. Abstract forms have been more successful, some examples of realism in film are the 'Genesis' sequence in 'Star Trek II' and a long sequence in 'The Last Starfighter', released in 1984.[11] Modification of pre-filmed, live-action sequences using a digital optical printer involve less computer power and control over animation coding, than full synthesis. Such actions as replacing the Coit tower in a picture of San Francisco with shrubbery and sky have been done, and it would be possible to remove Elizabeth Taylor from the Nile barge sequence of 'Cleopatra' in order to reuse expensive footage. Much of this sort of development is being pushed by Hollywood because of the large market for fantasy that forms a mainstay of American film, and it offers some potential for return on the enormous initial investments required.[12]

It would be premature to say that the achievements in sound and picture synthesis of electronic cinema mean that we are literate in a new form of discourse. However, the techniques of digital synthesis exist, and music composition shows the possibilities of complete control as well as spontaneous innovation for the composer. In the development of analogue

technology, sound has always led the process of invention due to its greater simplicity, and it has provided a model for investigations in picture technology (e.g. radio and television). This continues to happen in digital technology.

There is no doubt about the impact of television and motion pictures in our lives. Up to now they have illustrated all that is derogatory in the term 'mass media' - production by an elite, consumption by undifferentiated audiences (This is not to say that they are not loved!). The medium itself has functioned as a recording or 'tracing' of events in the world, much as writing began as a way to record the events of speech. Digital coding means something more. At the point of creation it means not only efficiency and wide scope of control but also the possibility of introducing randomness and chance invention through the capabilities of the machine to test hypothetical worlds - virtual realities. This is a new conceptual power.[13] At the 'viewing' end, there is more than the choice of whether to watch or not. There is a wide range of intervention possible with the capabilities of computers and laser discs. It is possible to re-edit or re-interpret the cinematic experience in a way similar to the flexible use we make of the written text.

We have seen that digital coding techniques support the potential of the electronic cinema as a flexible discourse, with at least the same scope for expression as that of the written text. A comparable coding technique to alphabetic writing exists, but its use is only in the early stages. In the next

chapter I will use Ricoeur's four categories of text to examine the characteristics of a discourse that is unique to the electronic cinema, and show how that discourse represents a transition from analogue cinematic techniques to digital synthesis. The results of this transition holds great implications for a concept of digital literacy.

Footnotes

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2. R. Thom, Audiocraft, an Introduction to the tools and Techniques of Audio Production, National Federation of Community Broadcasters, 1982.

3. Max Mathews, The Technology of Computer Music, (Cambridge Mass: MIT Press, 1969) P.7

4. Barry Truax, "Timbral Construction as a Stochastic Process", unpublished, June 1980.

5. Albert H. Munsell, A Grammar of Color, (New York: Van Nostrand Rheinhold Co., 1969) p.9

6. Greenberg, Donald, et al, The Computer Image (Reading, Mass: Addison - Wesley, 1982), p 12

7. Jerry Barenholtz "Digicom 83", p 11, and Peter Sorenson, "Movies, Computers, and the Future" American Cinematographer, Jan 1983. p. 69 - 78,

8. Greenberg et al, p. 13

9. ibid, p. 13

10. Barenholtz, p. 12

11. Peter Sorenson, p. 69 - 78

12. Chuck Champlin Jr., "The Electronic Optical Printer", American Cinematographer, April 1983, p. 98.

13. Barry Truax, "Timbral Construction..."

IV. In the Realm of the Cinematic

The storage and generation of sound and picture images through an abstract notation system has passed the realm of mere possibility. It exists and is being used in its infant forms. As a medium of discourse its rapid expansion is assured, if only due to the fascination of our society with mechanized reality and the microprocessor-based, high technology industries that are at the centre of this medium. The notation system is conceptuallly similar to the alphabet which lies at the core of our written language systems, as has been been demonstrated in the last chapter. It is now possible to expand the four categories of linguistic discourse and see how they apply as a general format that can include the electronic cinema.

The general categories apply in a structural sense, but it is useless to attempt to fit one style of discourse into rigid criteria established for a different one. Ricoeur's model of the text provides an adequate, loose framework to look at the electronic cinema without dealing closely with the particulars of each medium. The codes for each medium are not the same, but they are similar in concept - one is linguistic while the other is mathematical. In other words, the cinema can parallel the text as fixed discourse, but it is not the same. As the digital cinema is not an isolated invention, but part of a long progression in the development of a cinematic outlook,

discussion of its development will necessitate constant reference to the already existing cinematic discourse of film and television. The digital format is a possibility for new invention as well as an expansion of these older forms.

Temporality: The Nature of Fixation

Considered as fixed discourse, what does cinema fix? We have seen that writing fixes speech, but the fixation remains incomplete. In addition, when writing becomes the primary intention of an author, it is only modelled on speech; it is created 'as if' there is a speaker. This is a result of its derivation from linguistic form. Cinema expands on this role of the speaker, in both the completeness of fixation and the degree to which it is modelled on the speaker. It is similar to the text in that it is a 'fixed' discourse, but its relation to speech is only partial. Rather than attempting to fix what is uttered by a speaker, it is an attempt to fix the mental outlook of a speaker. The thoughts of the speaker can be fixed as they might be uttered in the speech-event, but it is also possible to include a sound and picture image of the world as it might be formed in the imagination of the 'speaker'. It is this composite sound and picture image that is presented as cinematic discourse.

Until the recent advent of the digital computer as a way of synthesizing sound and picture, the cinema as a medium was

restricted to fixing or recording what could be acted out in the physical world. Actual light and sound objects were needed to form an image. Film, video and audio acted as 'tracings' of something that existed prior to the event of recording . Either the recording fixed a spontaneous event, or else it was fabricated from a pre-conceived script - in effect from a prior text. Thus filming may be a means to fix thought, but only in so far as it is expressed in the intermediate form of the text, whether written or in the form of a spontaneous event. The structure of the latter, as Ricoeur has shown, conforms to that of the text.[1]

How is the meaning of the discourse fixed? At the centre of both there is a discrete coding system. In both, the discourse is a continuous process, but is broken down into a sequence of units for coding. For the text, it is the units of the alphabet which must be read as a sequence of sounds for the meaning to be elicited. In the digital cinema, numbers are the core and come from the concept of calculus, where continuous processes can be thought of as a sequence of discrete instants.

The letters of the alphabet are marks on paper or other solid media, and when read they become meaningful as words or sentences of the discourse. If they are not read, they exist simply as objects on a page. In the electronic cinema, the scanning of the code takes place at two stages, once by the electronics of the machinery and once by the viewer in the comprehension of the discourse. The units of meaning, the

'signs' of the cinema, exist only while the machinery is in motion. Energy must pass through the luminescent screen or the moving diaphragm, whether apprehended by a person or not. The objective signs of the text become 'signs in motion' of the electronic cinema. This aspect of 'motion' could also be attributed to texts as they are embodied in word processing systems. However, in this case, the computer and the screen are simply being used as a sophisticated typing system to manipulate alphabetic characters. The discourse of the text and its alphabet are being imposed onto a system that is numerical in character (i.e. the alphabetic code is itself being coded as numbers in the digital format). The text itself is not derived from anything inherent in the digital technology of the word processor. As cinematic discourse comes to dominate our media of communication, Ricoeur's model of the text as a metaphor for meaningful social action would have to be modified. Meaningful action now takes on a sense of the experience of motion in the electronic world, rather than an objectivity of the text dominated world. His use of the text as a model for social action shows the intense relationship between a culture and its predominant media of communication. This would still hold in a world of cinematic expression. What we are experiencing at this time can be seen as a culture of one mind but of more than one way of expressing itself. The discord we experience is located at the very core of our cultural experience.

To what extent does the electronic cinema fix the intended thoughts and ideas of the subject of the discourse? To discern this we can return to the theory of the speech-act and its three levels. Because locution is only a small part of the general form of discourse, these categories can be used only in a general sense as guideposts. The first level was the locutionary, which was also called the propositional; the second level was called the illocutionary, which could be called the associative; the third level was called the perlocutionary, which could be called the reactive, as it pertains to the emotional impact of the discourse.

As it was with the text, the first level exteriorizes itself in the units of meaning derived from the sequences of symbolic coding. In other words, the units of notation are designed to fix the propositional content of the discourse. For the text the alphabet was able to fix the sequence of sounds that exist as the sentences of the speech-act. In the cinema, binary code is designed to store a sequential representation of the way we perceive light and sound in the natural world. As discourse originates in the thoughts of the thinking subject, this code can also be used to generate images in moving sequences of pictures and sounds, in the same form as their configuration in the mind. As discourse is about a subject's relationship with the surrounding world, thoughts about that world can be externalized in the aural and visual images of cinematic forms, rather than in spoken or written sentences. The

digital code is designed to fix those images, in a 'material' form.

A particular discourse may involve a display of the natural world such as the forests of B.C., picturing tall trees and dense undergrowth, and the sounds of wildlife, rivers and winds. These may be shown as panoramas to locate the viewer in geographical space, or as a group of travellers passing among the trees. There may also be elements of spoken narrative. Another style of discourse may involve abstract sounds and the high-speed flight of space fighters through the canyons of a fortress, in a film such as 'Star Wars'. Even more abstract acoustic and visual images of dancing colour patterns are also possible.

The second level involves the relationship of the 'speaking subject' with what is 'said'. In the text this meant that the elements of inflection and physical gesture coded in the forms of grammar, gave an indication of the source of the discourse - the subject. In the cinema there are various stylistic devices that indicate similar relationships. In the first person narrative, the sound of the voice acts as the speaker, the picture is the vision and the other sounds are what is heard. The speaker may be one of the people passing through the forest and able to participate in the action while showing the group experience. Gestures of direction, memory, and so on, can be indicated pictorially or acoustically.

In the second person discourse, the speaker can appear in the picture speaking to us as the viewer. This is actually a device used to take advantage of the eye contact of the dialogue. The true source of the discourse is still in the position of the observer - the third person narrative. The point of view is temporarily shifted from the direct discourse of the creator to a character within the scene. The creator uses the 'authority' of another identity to add impact to his own discourse, in effect, to quote a reliable source.

The third person narrative is that of the omniscient narrator of the text, the silent observer of the cinema. Here, the speaker seemingly watches and listens, allowing the viewer to draw out the meaning without making any direct linguistic comments. The subject of the discourse has no discernible identity beyond that of the first viewer of the work. This observer is the true source of the discourse referred to in the second person narrative. All three of these forms are techniques already developed in film and television production. None of the three are truly the subject of the discourse, but function as a 'disguise' through which the subject can speak coherently, without deviating completely from the model of speech as discourse.

Digital technology opens up the possibility of illustrating non-existent worlds, ones that exist only in the imagination and may be prohibitive to construct for the camera. In the earlier discussion of the text, the sentence 'I will go there at three

o'clock', was used to illustrate the illocutionary part of the speech-act. The place indicated by the gestural word 'there' could be substituted by a grammatical phrase indicating a particular place. Similarly in the electronic cinema such a place could be indicated as an exact visual representation and its associated sounds, as long as they can be conceived by the mind and expressed as a mathematical model. This includes the inflections and imperatives of narrative speech, using any voice quality. This is an enhancement of the written gestures of place and time, but like writing it is still impossible to fix the non-linguistic actions of the speaker, such as a smile, frown or nervous eye movement, when the subject is not visible. Because of this, transcription still has the possibility of incompleteness due to the impossibility of interrogating the speaker. However, this form of ambiguity is a fact of fixing discourse, a process that separates it from the embodied source.

The third level is the emotional response and has a lot to do with the conditions of reception of the discourse. To some extent, this is controllable by the the subject for the mass audience cinema but will probably become less so as the audience fragments into smaller groups and individual 'readers'. Control of the intended effect is greatly enhanced through the emotive power of music and the drama of vivid visuals. For example, if a bear is introduced into the passage of the forest group, its effect on the audience will vary depending on the visual editing style and the tone-setting sound track.

At all three levels, what is intended to be said must be capable of being coded into paradigms of comprehensible cinematic procedures, much like a grammar. Thus meaning in the digital cinema relies heavily at this stage on the conventions of the existing film and television vocabulary. Recent film theory (for example, the work of Peter Wollen and Christian Metz) has been an attempt to apply the concepts of speech language to the cinema. This has presented great difficulties. As Wollen noted in his early work, the nature of symbolization in texts and analogue cinema is not the same. Text relies on the alphabet and the word as an arbitrary symbol. As discussed earlier, the alphabetic letters C-A-R are instructions for producing a sound 'car'. Neither the sound nor the alphabetic transcription have any direct connection to the object in the world that provides transportation, other than through general agreement that the object will be represented by these arbitrary symbols. In the cinema, a symbol is created by tracing something that will act as the symbol, and thus always bears some resemblance to the original, even if the depth of meaning is beyond the descriptive. This is an iconic relation of the sign.[2]

Digital coding brings the arbitrary sign to the cinema. Words are symbols of general types. The words 'car' or 'forest' are signs that represent classes of objects. They can be made more specific by adding modifying adjectives or phrases, such as dense, green forest, etc. Film, however, begins from the particular. If a forest or a grassland is to be shown, a

particular one is picked out to be recorded as a representative of the class. Digital technology brings the symbolizing system of the cinema into the realm of the linguistic - to the generality of the arbitrary symbol. Characteristics of surfaces and sounds are available for use in standardized procedures that can be modified to suit the particular conditions at the time. For example an algorithm for enamel reflection can be coupled to one for a tight curve and one for the color of red, and so on, producing a red billiard ball.

Since the possibilities of digital coding, the metaphor of the text for analysis of the cinema becomes an even more useful one. However, it is only a metaphor and problems arise when it is used in too strict a sense. Its use is also open to the biases of textual literacy. Metz cites five channels of sensory perception in the cinema: text graphics, speech, music, sound effects and the visual.[3] In this list there are four separate channels of aural forms showing Metz's bias toward sound and language. The complex visual channel is an undifferentiated collection of such things as microscopic closeups, panoramic pastoral scenes, still lifes, motion, visual abstraction, and human faces, with or without significant eye contact to the viewer.

In the generalization of symbols that exists in fixing the cinematic through digital synthesis, there is a demonstrable comparability with the text. Cinema as a fixed discourse is slightly more complete in its fixation of the thought of a

speaking subject than is writing, which is modelled on speech. This is due to the vividness of representing gestures, having both an aural and visual component. It is also more engaging in its effect. However, due to the nature of fixation, like that of the text, it is not free from ambiguity.

Subjectivity in the Cinema

In the text, the source of the meaning is the simulated speaker. We read the voice of the author. In the cinema, the discourse is not based in speech, so there is no speaker as such. We are one stage prior to this and elicit the meaning from the thinking subject, who is in the world as an active spectator, able to comment verbally if needed, depending on the style of the discourse.

The sense of coherence necessary for comprehension is achieved by the existence of the subject as a 'point-of-view'. More than an individual identity, the point of view is a vehicle for the author or 'collective creator' to unify the source and it allows us to participate in the theme without confusion. It is a vehicle derived from the text, and the individual author whose name is attached to the discourse. It must be emphasized, however, that as Ricoeur points out, the identity of the textual subject is not necessarily that of the author, but is a contruction by the author. The 'physical and psychological presence' of the author is separated from any 'speaker' in the

text. In speech, the subject and speaker are one and the same. This can be extended in the cinema - the subjective point of view is separated from the collective group that participates in the creative process of film-making. The construction, in this case, is that of a coherent, thinking subject.[4]

The coherent outlook in cinema is maintained through the strength of the visual component. The frame is often called a window onto the world of the film, but the window is a metaphor derived from still photography where the observed scene is preserved in its singularity, as if watching through a rectangular opening. In the cinema, the frame is in motion and changes its location, acting as a device that seems to focus the thoughts of the observer-subject, through the visual sense. The sound sense acts as an accompaniment to the visual focus, as well as a general ambience of environment. The rectangle is the conventional shape of visual representation since the Renaissance and the invention of clear glass.

Occasionally the point of view can shift from the observer to a character within the action. For example, we see a character who looks off-screen, then we see what is looked at from the viewpoint of the character. This is an easily comprehensible form of indirect discourse familiar to a literate viewer.

Throughout the past fifty years of film history there has been a need to find some figure who could stand in the same capacity as the author of the text. In the early days of

Hollywood the producers did the hiring and firing and had the final say in how a film would reach the audience. The film star was the main attraction, the director was one of many employees on the crew. This is film as an economic enterprise. In the 1950's the French cinema tried to return authorship of the film to the genius of the creative source. This became the 'auteur theory' of Andre Bazin and the writers of the Cahiers du Cinema magazine.[5] The true film-maker wrote and directed his own film, the producer looked after the business of the money. This was the beginning of the fame of directors such as Godard and Truffaut, and spilled over into American film criticism. In the development of television, however, the director has remained relatively anonymous. It is the personality of the performing actor that carries the weight, much as early films and most contemporary mass audience films in America still do.

In experimental films of the 60's and 70's collaboration and improvisation was attempted, inspired by such figures as John Cage who allowed chance to play a large part in his musical work. But it was always John Cage's work and so too the collaborative films were ultimately the responsibility of the director. The concept of the individual artist is at the core of western thinking.

The digital cinema is a further advance in the desire to bring the cinematic product under the control of a single creative source. With the concept of audio and video synthesis and manipulation through the computer, the importance of the

camera as a recording tool is diminished (and equally so are the actors as producers of material to be recorded). The emphasis shifts more into the realm of the editor in the post-production phase. The efficiency of the computer also allows fewer people to participate in editing, and special effects require fewer people to construct models. The electronic cinema is the world of the 'virtual' model which the director can generate and test. Writing is a solitary act, while the cinema has usually involved the team-work of many. There has always been a strong emphasis on the presence of the visible human actor recorded through a camera, but perhaps the world of the solitary film-maker is approaching.

The presence of the subject changes with the genre of film or television. Fiction is the realm of the impersonal, omniscient narrator. In the documentary, the subject can come closer, as if some actual author exists whose presence is displayed either as narrator (also possible in fictional cinema, though not as successfully as in the novel), or else by motion in the visual style implying participation in the action. Jean-Luc Godard, as 'auteur', has used film both as descriptive narrative and as commentary or 'essay' in the same piece.[6] His attempts have proved difficult for audience acceptance because he is bridging traditional genres. However in the continuing work of a director like Godard, John Ford or Nicholas Roeg there is a coherence of personality or style. A Godard film is recognizable as such (to the afficionado probably without

credits or prior warning). A John Ford western is recognizable both from its technique, and for a sense of historical time of production, conveyed in the black and white film stock. This location of creation in time is similar to the way that style of language and even visual style of script anchors a text in a period of history.

For the individual involved in the creation of cinema, the computer extends the possibility and power of control over the image as well as extending the possibility of loosening rigorous craft mastery and allowing the computer to take some of the activity of image generation. In computer synthesis this depends on the style of program used and its interactive relationship with the programmer. This is what Barry Truax has called the 'relation between generality and strength'.[7] At one end of this range is the generation of abstraction: timbral variation in sound, pattern generation in picture. In much of this the computer carries out general, variable manipulations, based on the instructions in a program and a small amount of input from the programmer or image creator. The result generated cannot be directly specified by the author but can be interactively sampled at successive stages in order to guide the result in a favourable direction. The focus of discourse in this case is on the medium of computer generation itself. The intentions of the author are embodied in the inventions of the computer.

At the other extreme, the intention is to produce a result of great specificity. For this, the program code must be capable

of carrying out specific manipulations based on a large amount of careful data input by the author. This is the realm of realistic images - human faces, landscapes and speech. Program strength is also required if the desired abstract image is of a very particular type. In certain types of cinematic animation in Hollywood, the specificity of the desired result and the repetitive nature of the computer actions have caused some programmers to think in terms of building computers to carry out one function only, and bypassing the need for complex and time inefficient software.[8] This has its drawbacks in initial expense and inflexibility, in a medium that is constantly updating its capabilities.

Exploring The New World

Discourse is about something. The text speaks about a world beyond the situational present, and the past that is common to the interlocutors of the dialogue. It is a world held in the sum total of all literature. In a like manner the cinema refers to a larger world than that of the oral exchange. It is not extraneous to the world of the text but participates in the description of a world that is common to both. The difference lies in the form of that description, and the age of the ancestry peculiar to cinematic discourse. References within the world of the text can flow back to the time of Plato, but the cinema is not even 100 years old. Therefore the structure of the

product of cinema is reliant on the richness of the forms of the text.

The genres of literature are also the genres of cinema. The detective novel hero Sam Spade is translated into the screen character by Humphrey Bogart; a decade later, Jean-Paul Belmondo in 'Breathless' mimics Bogart in the styling of a detective character; and later still, Woody Allen seeks advice from a Bogart-as-Sam Spade look-alike. And in the digital cinema the criteria for synthesizing power is held to be the recreation of Bogart or Clark Gable in new roles with new co-stars of different time periods. Within a thirty year period, the world of the cinema begins to open up on its own terms.

The two types of world Ricoeur uses to categorize the reference of the text hold up for the cinema as well. The first type contained "all descriptive accounts of reality...in the mode of 'as if'". In cinema this is the propositional content of the aurally and visually presented discourse. The viewer stands in the place of the observer, possibly hearing the observer's voice, and seeing and hearing the described world as if he or she were physically there. Through the same spatio-temporal network as the text, common to both the producer and the viewer, the intended meaning can be brought to light. News reports of Lebanon can be communicated with the same vividness of present action in the world as can old film footage of World War I, the inside of arteries or the synthesized animation of the DNA molecule. This also pertains to the descriptive level of

fictional texts, where, as Roland Barthes comments in the 'Pleasure of the Text', the pages of the discourse fall from the hands and the reader is transported to experience the fictional reality as if it were real.[9] The cinema is particularly conducive to this vivid other-worldly experience.

The second type of world is beyond the presence of the descriptive propositions. Worlds are alluded to in the multiple levels of symbolic expression. This experience of the poetic resonance is possible when the cinema achieves the subtlety of those written works usually included in the term 'literature'. At one level it exists as commentary on the medium itself - the self-awareness of the particular discourse, and the experience of the reader or viewer who participates in the style of that medium. At another, it comments on the human condition, and comes from the author's manipulation of time and place to construct a shared experience of being in the world, whether the experience is intellectual, emotional or an appropriate balance of both. The great works already produced in the cinema will no doubt carry the same timeless longevity as the great works of literature.

The strength of a great work is that it falls within the framework of the audience's expectation as well as pushing the boundaries of what is usual. It is the level of audience literacy and the inventive imagination of the creator that determines the degree to which these boundaries can be pushed in any single effort and still remain comprehensible. The resonant

work changes the relationship between the form and what is expected; the purely descriptive falls within these expectations. Through what Jauss calls 'announcements, overt and covert signals, familiar characteristics or implicit allusions', the connection of a work to a familiar genre is maintained sufficiently that it places the new meaning in a context capable of being understood.[10]

When we speak about the capabilities of the electronic cinema to synthesize audio and video images, we are speaking about a medium capable of synthesizing virtual worlds, ones that exist only within the relationships of the digital code. The non-existent or the physically impossible worlds of the imagination can be conjured up in simulated aural and visual realness. A genre is a category of known discourse in any historical time. A work is anchored to it in some expected way and is thus understandable. If it escapes the known categories or genres of a time, a work may have no audience. Digital cinema, then, initially seeks to create meaningful discourse within the genres of the rich worlds of the text and analogue cinema, as they have unfolded for centuries. At the same time, it causes the boundaries of the expected to be expanded. As such it augments 'imagination power' in all the present modes of discourse. This has been shown in the field of music and will surely follow in the cinema. For electronic cinema to open up a new world it is not necessary for it to burst on the scene in a completed form. Historical development is a give and take that

creates a receptive audience for a new form of discourse in the process of its formation.

Although computer animation has tended strongly toward abstract representation, this is not a genre unique to computers. Abstraction is part of the trends of twentieth century modern art. In each discipline there has been a search for what constitutes the essence of each form. Most of the traditional media reached the 'minimal' essence in the late 60's or early 70's - John Cage's 'silent' music piece, Robert Morris's unfinished plywood cubes in visual art, and so on. The disciplinary lines have grown muddied in the last decade. Computers are young on the scene and need their burst of concentrated abstraction to explore the capabilities of the form, but pluralism is a fact of art and electronic cinema will be part of that. Analogue cinema is generally a medium of realism and the computer is part of that world. At the same time realistic picture and sound synthesis are part of the computer world. As computing power and the efficiency of algorithms increase, great access to realistic image-making will open up. This results in a wide spectrum of creative possibility between pure abstraction and realism, or even what Jean Baudrillard calls the 'hyperrealism of simulation'.[11]

Audience and Reception: the cinematic pocketbook

In the forms of the analogue cinema, the concept of 'reader' moves away from the notion of a single individual and takes on the sense of an 'audience', a group viewing. Film draws large audiences to darkened halls while television attracts millions to a network broadcast. This is the source of the concept of mass media. However, new inventions in the technology of image storage change the context in which cinema is experienced as well as the nature of the cinematic content that is possible. In the transition toward the digital cinema, the scale of experience is reduced. Just as the sign returned to the arbitrariness of the linguistic sign, so too does the audience member return to the individual willful reader or interacter.

The role of the 'reader' of cinema is the same as that of the reader of the text. Through fixation of discourse, meaning is separated from the author, and the reader takes on the job of bringing the discourse and its meaning into a relationship with the present. This completes the action of communication initiated by the author or producer. Because of the scope of cinematic discourse , meaning is elicited in a range of methods between two general avenues of understanding. The first is non-fictional, in that it is distancing and analytical. It is a reading for content, both structure and meaning, as in the essay-style documentary. The second is more engulfing and experiential, a reading for the experience of the content. It

holds a vividness of sensuality beyond the possibility of even the great works of written fiction. These are experienced in synthesized extensions of dramatic film and in computer-based simulation. Generally, a combination of both levels would appear in most forms of discourse.

Before exploring these two avenues of discourse as they have been displayed in recent productions, it is worth examining developments in the technology of image storage that have brought about this change in the relation between audience and the cinematic product. The most important of these are the digital computer disc for the storage of computer generated data and the laser optical disc for storage of audio and video signals.[12]

The computer disc functions as a memory for the algorithms and files of numerical values used to synthesize the audio and video signals. The digital information is magnetically stored and changes can be made at any time in the processing instructions or the values to be processed. As discussed in the previous chapter, animating detailed visual images requires vast amounts of data to be moved from storage to the screen and it is thus beyond the capacity of most computers to generate sophisticated visuals in real-time. Complex animation for Hollywood films such as 'The Last Starfighter' are usually transferred from computer disc storage to film stock, each frame taking several minutes to generate. In order for the screen display to respond interactively to cues from the viewer, only

low-resolution cartoon-like graphics are presently possible. This style of graphics is used in airline pilot training simulators. What this kind of storage loses in potential image quality is gained in flexibility and response-time.

The videodisc has an advantage not available in computer-discs. The laser disc is not correctible, but its attraction is high fidelity of the stored image, admirably displayed in the new 'compact' audio disc music recordings. In addition it can be coupled to a computer and every frame of image on the disc can be displayed to the viewer in a searching time of about one second for a half-hour sequential program, or series of shorter segments. Material stored on a single disc can take a variety of forms. It can range from a single feature length film to an educational package consisting of short segments of film, sound, still photographs, computer graphics, or textual information and instructions. Interaction is only possible with blocks of pre-recorded sequences. Frame by frame animation is pre-determined. As the sophistication of magnetic computer-discs and the quality of images increases, the flexibility of frame by frame control would probably outweigh any advantage the videodisc now holds. An ideal storage disc would incorporate the best of both.

The interactive disc provides a flexible experiencing and learning environment parallel to the text in style but expanded in scope. The printed book has been the most flexible container of information we have known. Its format contributed to

widespread literacy in the European cultures following the invention of the printing press about 1450. As Havelock has indicated, it is the significance of a wide readership more than the ability to write or create that leads to a literate society. With the interactive format of the computer and laser disc, the 'pocketbook' of cinema comes into being. Like the book, the disc is a mass production format. Production expenses are high until large quantities can be produced from a single 'master'. In the early stages of development this poses a problem. There are very few consumers to buy expensive playback equipment when there are very few programs available, and few programs are produced if there is no one to buy them. The market for such things builds slowly as its advantages become apparent to those who can afford the initial expenses. As costs come down, educational use of audio-visual material, plagued by the inappropriateness of playback technology for classroom use, will probably benefit from the flexibility of interactive discs.[13]

The modes of perception and reception of cinema are expanded over those of the text. To the visual field of the text is added the aural and even the tactile element of keyboard contact and the control switches of the simulators. The personalized format of the videodisc and computer terminal is added to the spectacle of the theatre-style film and the network broadcast. There is small likelihood that visits to the cinemascope and six-track Dolby movie-hall will disappear as a social outing, though halls the size of Radio City in New York

may be a thing of the past.

We can turn now to examine the individual 'reader' experience of digital cinema made possible through these technologies. In the analogue cinema, an event such as film is attentively watched from the beginning to the end (unless one leaves the room). Television can be the same, but is more likely to be a distracted viewing of a flow of programming; the continuity of any single program is subservient to the continuity of the general flow of programs, ads, announcements and intermittent activities of the viewers, such as making a cup of tea or a bowl of popcorn.[14] Meaningful content requires later reflective analysis in order to be drawn out. New forms of technology change the context in which cinema is experienced. With computer and optical disc, analytical viewing styles become possible. While experiencing the program, it is possible to stop, to recheck, or to watch or listen to a special section several times or even to introduce new material into a sequence. In other words, the cinema discourse can be worked with to maintain understanding at each stage of the argument, and the vividness of cinematic illustration enhances the reader's conception of the author's intention. The essay-documentary becomes truly possible in the cinema, and not simply a self-conscious experimental form that must rely on fulfilling criteria such as entertainment value for appeal to a large audience. What this makes possible is a flexible learning environment in which cinematic products join textual products in

easily accessible libraries of information.

The Public Archives of Canada is transferring its collection onto videodisc and will make copies of the disc available to schools and libraries. Each frame of the disc can hold one page of text or one visual image whether painting or photograph. Each side of a disc the size of a long-playing record can hold 54,000 frames. So the whole National collection could be held in many locations across the country. This is also true for collections from other countries. Good paper copies of individual items could still be ordered from the central source, but researching the files would not require a trip to Ottawa.

The Metropolitan Opera is recording its 'Live from the Met' series onto disc. Although intended for an audience of opera listeners, the capability to freeze and almost instantly replay any section would offer vivid aural and visual study material on techniques of singing or staging. Obviously, this analytical capactity could be applied to any field and could include any material whether intended for such study or or not, just as we dissect novels for style and meaning though their first intention is to be read for the expeience.[15]

Another example of this first avenue of use is computer-assisted design. Models of possible structures are built in the computer and displayed on a screen. The model can be turned, viewed, and tested for problems before the real construction begins. Architects use such techniques to test out designs. A new building can be inserted into a model of the

projected site and viewed from various angles. An engineering company in Vancouver has a 3D digital model of the City. It can be 'rented', and buildings inserted into their projected site to be assessed for potential problems. The model is being extensively used for designing B.C. Place and Expo 86. Utimately, designs could be checked for wind effects, traffic and pedestrian flow, and so on. Car designs can be checked for aesthetic lines, aerodynamics and structural safety before the first prototype is built. Future ease of design and animation will allow the test model to be even more realistic.

The second avenue moves into the world of simulation of both aural and visual fields. In the symbolic capacity of the text, simulated worlds are built up in the language of the novel, poem, or drama and the meaning resonates in such a way that the reader is transported to a world of imagery and action of the author's creation. We play a type of simulation game with the text. The electronic cinema opens up new realms of interaction with the simulated world contained in the discourse. Along with the vividness of the aural and visual presentation there is a tactile interaction through the body (or perhaps in the future through the voice) that allows control of what is presented in the discourse. The computer can couple rational action to the sensory experience of a simulated reality.

Realistic simulation is expensive to produce and finds its first interest in areas where some economic justification can be made. One of the first uses of simulators was airline and marine

pilot training, where a 12 million dollar simulator can be justified against the risk of training on a 9 million dollar airplane, and the loss of life. At Boeing's flight training centre in Seattle there are realistic simulators for each of the company's current planes. Customers can send pilots for training or upgrading courses. Some airlines that own several of any single kind of plane would probably own their own simulator, such as CP Air in Vancouver or Air Canada in Toronto.

The simulators themselves are made by a company in England and consists of an actual plane cockpit mounted on hydraulic control arms. Several linked computers relate the control switches in the cockpit to the gauges, the 16 speaker sound system, five screens of synthesized visuals, and the gravitational orientation of the cockpit. Flight conditions to be tested are typed ahead of time and determine such things as cloud cover, turbulence at any altitude, rain or even engine failure. The pilot must respond to these unexpected occurences during the flight. At takeoff, the pilot pushes the throttle forward, the sound indicates acceleration of the engines, the visuals show the plane gaining speed on the runway, the foot pedals steer the course, dials indicate speed change, and the gravitational pull against the body increases as the cockpit rotates back on the hydraulic arms. The vividness of sound and picture tricks the mind into believing that the body is accelerating forward not simply tipping back in a box. At the right speed the stick is pulled back, the visuals indicate

takeoff while the vibration changes from the roughness of the cement runway to airborne smoothness. Careful coordination of sensory elements creates the cockpit environment of an airplane-sized mass, virtually indistinguishable from the real one.

The only drawback at present lies in the daylight visuals. The point lights at night and the gray outlines at dusk are extremely realistic and feasible with the available computer power. Daylight visuals, however, have to contend with the problems of rendering detail discussed in the earlier chapter. The cartoon-like quality is adequate for the job of flight training, but the challenge of realism holds fascination to the programmers and technicians in the field.

Sophisticated and expensive simulators such as Boeing jets may someday find their way into video game arcades where games can be housed in more elaborate boxes than the home computer makes possible, and has the possibility of repaying the investment to build the equipment. Some recent games such 'MACH 3' and 'Firefox', based on the film of the same name, uses sequences of filmed footage (Firefox uses footage originally shot for the film). The filmed sequences are stored on a videodisc and are coupled with computer graphics of such essentials as bullets, missiles, firing sights and explosions. These are laid over the filmed sequences and controlled by the firing buttons and flight control stick. Coupled with some appropriate sound, the experience is designed to thrill like a

rollercoaster while imparting some sense of control over the ultimate direction of the experience.

Intention to Write or to Digitize

As a medium of discourse matures, a creator uses the form to communicate directly, rather than using it to record the discourse of an anterior form. This was the case with writing, which separated itself from the intention of recording the speech-act for later oral recitation. The general intention of writing has been to communicate directly with a reader. The digital version of cinema has the same intention as writing. The earliest cinema was an unmoving camera recording a theatrical style event from a written script, to be played to an audience in a theatre-style hall. As the form has been explored, its uniqueness in acting, camerawork, sound, and editing has been brought out. The most recent and probably the most significant change is the possibility of the digital coding of light and sound. The creator of cinema can generate the desired images without reliance on models that exist in the world. The intention is to cinematize, not to film or televise.

Footnotes

1. Paul Ricoeur, "The Model of the Text: Meaningful action as a text", Hermeneutics and the Human Sciences (Cambridge: Cambridge University Press, 1981)

2. Peter Wollen, Signs and Meaning in the Cinema, (Bloomington, Ind: Indiana University Press, 1969).

3. Christian Metz, Language and Cinema, (The Hague: Mouton & Co., 1974)

4. Ricoeur, "Model of the Text:...", P. 201

5. Frank D. McConnell, The Spoken Seen (Baltimore: Johns Hopkins University Press, 1975) p. 174

6. McConnell p. 170. Also Godard's recent film 'Passion'.

7. Barry Truax, 'The Inverse Relation Between Generality and Strength in Computer Music Programs', Interface, vol 9 (1980) pp49-57.

8. Peter Sorenson, 'Movies, Computers and the Future' American Cinematographer Jan 83, p. 73.

9. Roland Barthes, The Pleasure of the Text, (New York: Hill and Wang, 1975), p.12.

10. Hans Robert Jauss, Toward an Aesthetic of Reception, trans Timothy Bahti, (Minneapols: University of Minnesota Press, 1982), p. 23. Jauss's theory of genre resembles Ricoeur's theory of discourse. He uses a similar range of four categories: author and text, form of representation, construction and levels of signification (unities of the represented), and reception and social function. Within the world of the text or cinema there would be several genres of expression.

11. Jean Baudrillard, 'The Ecstasy of Communication', The Anti-Aesthetic: Essays on the Post-Modern, (Port Townsend, Wash: Bay Press, 1983)

12. For details of disc technology see the following sources:
    a. Charles M. Goldstein, 'Optical Disc Technology and Information', Science 215 82:869 Feb 12.
    b. Greenberg, Donald, et al, The Computer Image:...

Chapter 1.

c. Mark Heyer, 'Computers and Video: Finding the New Edison', Videodisc/Videotext, Vol 3 No 3, Summer '83.

d. Bob Paulson, 'Quo Vadis, Videodisc?', ibid, Vol 3 No 4, Fall '83.

13. See the report of Simon Fraser Education Faculty experiment in the use of videodisc, in the public school system's 'Active Health Program'. In Videodisc/Videotext vol 2, no. 4, Fall 82.

14. Raymond Williams, Television: Technology and Cultural Form, (London:Wm. Collins and Sons Co., 1974)

15. The Public Archives report was presented in Videodisc/Videotext vol. 2, no. 4 Fall 82. The Met announcement was contained in an 'Arts Report' broadcast, CBC Stereo, June 13, 1984.

V. Conclusion

The Value of Ricoeur's Model of the Text

The intention of this thesis was to examine a new medium of communication that has been evolving rapidly for the past thirty years. The written text has been the predominant mode of discourse in our society for centuries and the history of its developmnent reaches back to the classical Greek era. Only in the past century have cinematic forms made an appearance. Difficulties arise in the examination of cinema through the cultural filter of a written tradition. The two media are not wholly compatible, and it is impossible to say that a cinematic culture has evolved at this time. However, both film and television, the basic forms of cinema, have had a profound impact on an essentially print oriented culture.

I have attempted to compare the new cinema directly to the fundamental characteristics of the discourse of writing and the text. If the electronic cinema contains certain elements that are comparable to the core elements of the text, then it would be possible to say that what makes the written text such a potent cultural force also supports the potency of synthesized cinema. How the cinema is actually incorporated in society is a different question. From a good descriptive model of the text,

the impending development of cinema could be deduced and assessed. The model would have to allow not only for structural comparison, but also for historical change in the cultural context that is being impacted by any medium during the process of transition. In other words, once electronic cinema has begun to make significant marks on a print biased society, then the biases will of necessity begin to shift to incorporate the new form of expression. The present view-point is transitory.

Paul Ricoeur's model of the text provides just such an adequate model to work from. The elements of a 'text' are laid out in a structural way that compares very closely to the models of an information system - sender, receiver, medium, message - but the expression of these elements is so much more elegant. It incorporates a notion of 'world-view' as a relationship of nature and society formed in a context of history, a balancing of structure and transformation.

Ricoeur's philosophy is in the tradition of hermeneutic phenomenology, in which the role of language plays an increasing part. In recent decades, a trend in social theory has been to expand the importance of communication in the essentially economic models of social relations based on production and consumption.[1] Ricoeur expands this further by recognizing, within communication in general, the key role of the physicality of the available medium of communication. His European bias is to see 'medium' as 'text'. This notion of the centrality of medium, in a sense that is wider than 'written', was first

developed by Canadian theorists Innis and McLuhan in the fifties and sixties. Their work anticipates the growing importance of the cinematic media, although at the time of their work the incredible development and impact of the digital computer on cinema, and human communication processes in general, could only be glimpsed.

Discourse in our culture is not just an exchange in the present, it is also a discourse fixed in time, and the fact of that fixation is significant to an understanding of the formation of society. What we are experiencing in the late twentieth century is a transition to a new way in which intersubjective exchanges are made permanent. Therefore, the notion of physicality is of fundamental significance to an understanding of the importance of an electronic cinema in a hitherto text-monopolized culture. From Ricoeur's model of the text, we can assess the electronic cinema as a unique process of communication. It is not simply a particular form among many others, all of which are, in turn, subservient to the power of the written text in a literate culture. A comparison of cinema and text shows an equivalence of the two as discourse and should lead to a new appreciation of an expanded communication potential through cinematic means.

The Comparison

Twice in history there has been a fundamental reconceptualization of the techniques for recording human communicative processes. The first was the alphabet, accomplished by the Greeks. Its impact on their culture has been documented in the work of Eric Havelock. The second is the experience in contemporary society of the transition from analogue to digital cinema.[2]

The Greek invention was significant because it changed the basic concept of speech notation. Formerly scripts had used a symbol to stand in the place of a sound of speech. The Greek symbols, borrowed from the script of the North Semitic people and extended, were instructions for the formation of a sequence of actions in the vocal tract that would produce the desired sequence of speech sounds. The symbol itself no longer resembled the sound. The contemporary invention of digital notation is of the same order. The digital code is a sequence of numerical symbols that are instructions for the formation of a sequence of actions (in this case electrical) that would produce the desired image in sound or picture. Neither codes were isolated inventions but were a refinement of existing analogue techniques.

A notation system is used to externalize and fix in time the process of human communication. Both the 'text' and the 'electronic cinema' are forms of fixed discourse derived from

comparable types of coding techniques. Ricoeur's model of the text has four categories derived from linguistic models of speech discourse. The text is similar to speech as it is derived from the linguistic sign, but it is also different as the author is separate from the text and meaning must be gained from the text alone - there is no author present to clarify ambiguity as there is in the spoken dialogue.

A comparison of the text and cinema shows similarities in all four categories: 1) The discourse is made permanent through a code theat uses arbitrary symbols. 2) With fixation, the creator and subject are no longer the same, singular individual. 3) The discourse opens up a world-experience beyond the living memory of participants in a spoken dialogue to encompass all recorded production in the storehouses of literature or cinema. 4) The reader or viewer experiences and interacts with the material of the discourse in the present, as if engaged in a dialogue with the creator.

Discourse is an exchange of meaning, coded and interpreted as a system of signs - language is such a system. The sign system of the electronic cinema is derived from the same concept as the arbitrary, linguistic sign of the text. In both, the meaningful sign is created from a sequence of discrete symbols, bearing no intrinsic similarity to whatever is being symbolized. The alphabetic sign is a sequence of shapes (letters) representing spoken sound. The cinematic sign is a sequence of shapes (numbers) representing an electrical voltage which

generates pictures or sound. In both, the sign represents a general class of objects in the world such as a representation in word or picture of a car, rather than using a specific object such as a particular car to stand as a symbol for the class. (The latter is the usual technique of film and television). The abstract sign system of digital cinema can be seen as a logical outgrowth of the system of language-based discourse already present in society. The cinema is capable of synthesizing meaning and of being understood within the existing framework of possible communication processes - within our 'horizon of understanding'. In this sense we are developing a discourse of greater efficiency within an already existing context.

The nature of the cinematic sign, however, is not strictly linguistic. Writing is ultimately a direct recording of thought in a speech derived form. Electronic cinema begins with the same image-forming thoughts as speech and writing and externalizes those thoughts immediately as fixed discourse. However, fixation in the cinema uses a new form of the sign. It is electronic, mathematical and is existent only in the electronic scanning process. It is both permanent and a 'sign in motion', not linguistic as such but still arbitrary, like a new language form.

If the alphabet was part of a new analytical concept of the relation of humans and nature that made an impact in all aspects of Greek culture, and if it sowed the seeds of a world-view that flourished in the Renaissance, then one is led to speculate

whether there is a similar slow restructuring in that relationship taking place in the present.

Implications for a Concept of 'Cinematic Literacy'

What does this new notation system mean for the process of communication? Writing in the early stages of the Greek alphabet was a tool used to record what already existed in spoken form. In the oral tradition, the mythic poets were the source of knowledge about the world. Early philosophy imparted ideas and principles by showing how they were embodied in heroic actions of the mythic past. Writing displayed its initial value when it could accurately record the epic tales. From this first use we have inherited the works of Homer and Hesiod, rare examples of the pre-literate Greek epic tradition.[3] Later, Socrates in the context of dialogue showed principles, such as justice, acting within the process of reasoned reflection. Plato's written dialogues referred themselves to this already existing oral context for significant expression. He used the indirect discourse of the Socratic dialogue to illustrate the direct discourse intended in his texts.

In Plato's time the myths of the oral tradition no longer conveyed an adequate moral basis for human social action. However, Plato could not simply explain a new philosophy because there was no context for understanding such an explanation. In his 'Republic', ejecting the poets from the city, symbolically

ejected the old discourse, that of the epic poem, while at the same time Plato's dialogue stood as a new discourse of reason initially portrayed in the understandable form of the dramatic tale. It was a particular type of poetic tradition that was being ejected, one that taught the basis for life in society and the human relationship to nature through the struggles of gods and heroes. In the new myth, Socrates carried the role of the 'mythic hero' whose reasoned actions embodied the principles to be illustrated. The epic itself was no longer the content. It took a gradual process of change before the direct discourse of the essay and the intentional essay writer could be an acceptable genre in which to express 'what had to be said'.

The dialogues of Plato act as a type of transcription in the same way that film and TV act as transcriptions of novels and theatre, or of original screenplays. The invention of the new medium comes out of an already existing conception of what it means to express, in a meaningful way, a relation with the surrounding world in which we exist. In this sense, cinema is invented within an existing context of expressive means and initially partakes in the modes of discourse developed in the novel, the travelogue, the poem, and so on. Even the 'talking head' and the narrated 'essay' documentary can be considered illustrated texts. There is not really any common style of cinema that could be called a discourse unique to that medium.

We can make an analogy today to Plato's dilemma. The 'myths' of scientific objectivity no longer offer a satisfactory

explanation of the natural world. There is a new physics of 'matter in motion' that seeks to bring meaning to a reconceptualized universe. Explanations of this universe are built in mathematical structures that collapse when an attempt is made to formulate them within the constrictions of language. On the other hand, the major obstacle to generation of 'signs in motion' in the electronic cinema is the lack of adequate mathematical models of what is to be expressed. There would seem to be a reciprocal problem existing between the two spheres. At the same time there seems to be a possible solution in the formulation of a world-view through the 'virtual' modelling of synthesized cinematic forms, restricted only by our own horizon of understanding. The 'space and time' described need no longer be physical but can be conceptual and capable of transformation outside the bounds of a traditional 'view' of time.

The experience of this new physical universe is the experience of the simulation of the relation of human and nature. Plato barred the poets because they mimicked 'social truth' but could not impart an 'ideal truth'. Plato's reasoning man, however, was a 'simulation' of the social paradigm of objectivity that grounded a scientific quest for truth, and that has formed the basis of a Western cultural world-view. The electronic cinema is a primitive form in which our conception of the physical universe can evolve as a new myth, experienced sensually in the sound, colour and relief of the cinema image.

The growth of new discourse and the development of understanding demands meaningful exchange within the context of that new discourse. Ricoeur calls this dialogic process a 'hermeneutic circle'. In the cinematic sense this circle of understanding and interpretation would require cinematic discourse to be experienced and responded to within the system of the cinema, and without a constant need to rescue meaning through a recourse to language. The existence of an interactive experience of cinema discourse would give a sense of what constituted cinematic 'literacy'.

The notion of an electronic cinema with the conceptualizing power of linguistic forms holds major implications for a theory of literacy and communication. Contemporary social theory revolves around a concept of the power of a language base and the ability of humans to partake of language - "Man lives in and through language".[4] Anthony Giddens, in his survey of various theories, quotes Gadamer but he also refers to others such as Heiddeger, Husserl and Ricoeur, as well as to the followers of Wittgenstein in English sociology. Should digital cinema be treated as a new 'language' form, or is it a new manifestation of the capacity of humans to formulate thinking in an external, communicable form, language being merely one of these? The digital sign is of the same order of generality as the linguistic or alphabetic, thus cinema is experienced in the same mode as language. However, thought is formed in the mind in cinematic likenesses rather than linguistic. Language is a

discourse that describes thought, that speaks about thought, whereas cinematic symbols are a direct representation of the sensory images of thought. The relationship of cinema to thought is more like that of alphabetic writing to speech. Perhaps language is a more primitive translation of the imagery of the mind than cinema. Just as sound in the cinema is the first to develop and provide a model for subsequent development of the visual, perhaps language is the sound form that provided the conceptual model for the development of a visual and ultimately cinematic mode of discourse.

In terms of the extension of cinematic literacy in society, it is apparent that written literacy is not a necessary prerequisite, but that the ability to generate language-type communication is. A detailed examination of this topic is beyond the scope of this thesis, but a reasonable groundwork has been laid in the exploration of the sign system of the electronic cinema. Ricoeur's notion of discourse as a 'text' is adequate to examine other media, but the use of text as a model of social interaction may be inadequate. 'Language' as such, no longer gives a completely adequate sense of a model of communicative processes in society. Understanding of discourse as 'cinema' is essential.

If sound and language have been the precursors of picture images and ultimately of cinema itself, perhaps a new synthetic sensory mode will begin to emerge in the future. 'Relief' was the third fundamental trait that Bazin attributed to the

earliest visionaries of the complete cinema. The code of the electronic cinema is derived from three-dimensional mathematical modelling. It is the lack of technological sophistication and the economics of production that restrict the forms of presentation to two-dimensional media. Inventions such as holography (or even forms presently unconceived) may bring this to fulfillment.

Footnotes

1. Jauss, Hans-Robert, Aesthetic Experience and Literary Hermeneutics, trans. Michael Shaw, (Minneapolis: U of Minnesota press, 1982). In the preface, Jauss refers to the Habermas-Gadamer debates and his own theory of aesthetic reception.

2. Other abstract notation systems have been invented. These would include music notation and Laban notation for dance. The codes are abstract but they have never formed a paradigm for conceptualizing and accurately communicating the relationship of humans to their surrounding universe. Music and dance appeal to abstract experience. Writing speaks about the world through language. Music and Laban notation systems speak about music and dance, but they can only allude to the world and its experience.

3. The subject of the early use of alphabetic writing to record the epic tradition is dealt with exhaustively in Eric Havelock, "Preliteracy and the Pre-Socratics", The Literate Revolution in Greece and Its Cultural Consequences (Princeton: Princeton University Press, 1982), pp. 220- 260.

4. Giddens, Anthony, Studies in Social and Political Theory, (London: Hutchinson and Co., 1977) p. 176.

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