Cybernetics, semiotics and meaning in the cinema

Keyan G Tomaselli

THIS paper builds on Gene Youngblood's use of cybernetic theory in film analysis. It combines the cybernetic method with Peircian-derived semiotics in an attempt to derive a meta-theory of social process and film textual structure. An attempt is made to resolve the more deterministic elements of Youngblood's theory, developing a more probabilistic approach. The paper ends with some conjecture on how the cyber-semiotic theory developed can be combined with Lacanian psychoanalysis and Marxist approaches developed by the scholars contributing to the British journal Screen.

Keyan Tomaselli

The study of film texts since the first publication in English of Christian Metz's (1974a, 1974b) seminal works almost a decade ago has largely been couched within a broad semiological framework. More recent analysis has tended to move in the direction of psychoanalysis (Metz, 1982; Heath, 1981) while a major school represented by the British journal, *Screen,* attempted to exploit the theoretical space created by Louis Althusser (1969, 1970) for a fusion of Marxism and Lacanian psychoanalysis (*Screen,* ±1974ff; Coward, 1976; Heath, 1981; Lovell, 1980; Kuhn, 1982). While this meta-theoretical Marxist-psychoanalytical problematic has come under fire from not a few critics (see, eg., McDonnell and Robins, 1980), Althusser's influence on cinema studies in Europe, Britain and America has been undeniable, whether from a purely ideological perspective or from the more complex position of psychoanalysis.

It is not the intention of this paper to pursue the Marxist-psychoanalytical strand here, but merely to signpost it for it does have relevance for the present discussion. This paper investigates a different, largely under-theorised strand of film theory which seeks to marry cy-

Professor Keyan G. Tomaselli is the Director of the Contemporary Cultural Studies Unit, University of Natal, Durban. The paper was written when he was a lecturer in the Department of Journalism and Media Studies of Rhodes University.

bernetics and semiotics. Although some work has been done in the field of a film cybernetics (Youngblood, 1970; Tomaselli, 1977), it remains for the cybernetic-semiotic connection to be made. It is hoped that the present analysis will in turn reveal a theoretical space for the injection of psychoanalytical postulates.

Since a previous article has already outlined the generic differences and enunciation of the respective disciplines of semiology and semiotics (Tomaselli, 1981a), the present exploration will begin with a discussion of a cybernetic application to film studies. What follows is an attempt to chart new theoretical territory and to provide a conceptual framework for a less formalistic and more complex social analysis than is evidenced in previous attempts which employ cybernetics.

Cybernetics: The control of communication

Whereas semiotics deals with the signs and codes of messages, cybernetics is concerned with the control and flow of communication encoded in messages. *Control* is defined as intervention which restricts deviations from system objectives to within pre-defined limits. A *system* is a set of inter-connected parts, each part a system in itself, each system contained within a larger system. In a cybernetic system control is effected by means of a feedback loop where the *output* of a system is linked to its *input* in such a way that variations in output from a pre-established norm results in compensatory behaviour that restores system output to that norm. Control on the basis of actual performance, rather than expected performance, is known as error-controlled regulation or feedback, and is indicated by sensory mechanisms which measure performance.

The system's actual performance is compared with its intended performance. *Information* is then returned to the decision-making point, so that inputs can be modified to correct the system output to within the limits set. Information is communicated by signalling systems. A signal differs from a sign in terms of both function and purpose. On the one hand a signal could be a physical electrical impulse which has no semiotic purpose. In this role, the signal is studied by information theory and has little relevance for the present discussion. At another level of analysis a signal is a pertinent unit of a system that may be an expression ordered to a content. When used as the recognised antecedent of a foreseen consequent it may be defined as a sign, in as much as it stands for its consequent as far as the sender is concerned (Eco, 1976:48). In order to understand this more clearly, we shall have to consider the notion of bit and hubit.

Shannon's (1948) contribution to the study of communication was the establishment of a universal model of communication systems. The elements of his model consist of an information source, a transmitter, a communication channel, a noise source which is an unpredictable interfering signal that alters or mutilates the desired signal, a receiver and a message destination. These six elements constitute the basis of any communication system, no matter how complex. Shannon was able to quantify both the information rate of the message source (a speaker, output of a television camera, a person writing) and the capacity of communication channels by introducing a measuring unit called a *bit.* This term, derived from 'binary digit', is a unit of uncertainty or choice; the undertainty between 'yes' or 'no' when both are equally likely, or the choice a person exercises in selecting unpredictably 'left' or 'right'. The numbers 0 and 1 can specify yes or no, right or left. The bits per message or bits per second establish a measure of the complexity of the message sources and the capability of the channel. Telephone wire (speech), for example, has a capacity of 60 000 bits per second, FM radio 250 000, and commercial TV, 90 million (Peirce, 1972:33). In this physical transmission, the signal has no power to signify, although there is a passage of information. Where the destination is a human being, a process of signification occurs. It is not axiomatic that the source of the transmitter be human, only that the system incorporates a system of rules known by the addressee, and provided that the signal is not merely a stimulus but has a capacity to arouse an interpretive response. This process is made possible through the existence of a code and can be theoretically measured in terms of *hubits* which account for the quantity and variety of information bits received per hour, multiplied by the number of man-hours devoted to their reception. Accord-

ing to Webber (1967:121) who enunciated the the term, a hubit is a measure of social accounting and represents a basis for the computation of the cultural value of information receipts. Hubits measure potential information *available* in a message and are therefore an index of the system's performance. Whether all the information is utilised by the receiver or not, is not, however, measured by hubits, but is accounted for by Peirce's notion of interpretants. A survey of television performances of *Macbeth* (or *Anna*) for example, would show that *Macbeth* transmits more content per minute than does *Colombo*. Successive episodes of *Colombo* become highly redundant, whereas repeated viewing of *Macbeth* would continue to reveal content that was not previously absorbed. Thus a signal (measured in bits) is communicative and informative (measured in hubits) if it expands the receiver's awareness or introduces him/her to something new. Whereas communication means 'meaningful for the sender', informative denotes 'meaningful for the receiver'. If the signal divulges to the recipient something he already knows, or conveys nothing, it is uninformative.

A cybernetic system monitors and controls the flow of information by means of a sensory mechanism which continuously assesses performance. This device must have the capacity to anticipate and measure disturbances which may arise from the system's environment. The decision-making apparatus will specify action which will effectively deal with the disturbances to keep the system viable and enable it to produce an output which coincides as closely as possible with the norm. The variety in the decision-making device must be at least equal to that of the disturbances. This mechanism controls the natural tendency of closed systems to deteriorate (according to the Second Law of Thermodynamics) and become disordered (or entropic, that is, lacking new information) by adjusting the system's parts to within narrow, pre-established limits or thresholds.

According to Eco (1976:42), information is a measure of the freedom of choice and is the probability of an event occurring within an equi-probable system. The probability is the ratio between the number of cases that turn out to be realised and the total number of possible cases. The relationship between a series of events and the series of possibilities connected to it is the relationship between an arithmetical progression and a geometrical one, the latter representing the binary opposition of the former. Thus, given an event to be realised among n different probabilities of realization, the amount of information represented by the occurrence of that event, once it has been selected, is given by:

$$\log n = x$$

In order to isolate that event, x binary choices are necessary and the realization of the event is worth x bits of information. This formula does not identify information with content but rather with the universe of alternatives required to define the occurrence without ambiguity (Eco, 1976:42). In this sense, information is the value of equi-probability among an array of combinational possibilities, a value which increases along with the number of possible choices: the greater the number of equi-probable events, the more highly informative is the system. Since information measures the equi-probability of a uniform statistical distribution at the source, information is directly proportional to the entropy of a system (Shannon and Weaver, 1949), since the entropy of a system is the state of equi-probability to which its elements tend (Eco, 1976:42). That is, information may be defined as being inversely proportional to entropy, or *negentropic*.

In order to transmit this information in a finished message form, a reductionist argument must be applied to generate a new type of source imbued with particular informational properties which may be subject to a semiotic analysis. This is done by imposing upon an equi-probable event of a system of constraints which specify the possiblity of certain combinations over alternatives. As the universe of original information diminishes, the possiblity of transmitting unambiguous messages increases (Eco, 1976:44).

The following formula offered by Shannon (1949) accounts for information I which implies N choices among h symbols:

$$I = N \log_2 h$$

Messages can be formed and transmitted by reducing the values of N and h. This results in the transmission of a message which provides information about a system of elements whose combinations are governed by a system of

care 4(1): 48 - 62

eaning

as been undeni-
ideological per-
nplex position of

paper to pursue
strand here, but
s have relevance
is paper investi-
under-theorised
eks to marry cy-

or of the Contemporary
Durban. The paper was
tment of Journalism and

rules. The fewer the alternatives, the easier the communication and the more probable the message. This reduction in choice in terms of the notion of equivalence (the selection of paradigmatic elements) restricts the universe of selection and combination thereby limiting and possibly even excluding the process of art which is, by definition, highly informative, low in probability and negentropic. Entropy, then, not only measures the disorder of a system, but also the lack of information about the structure of the system. An adequately informed system generates sufficient energy to facilitate change and assert progress. Energy is defined as "the capacity to re-arrange elemental order" (Youngblood, 1970:63) and runs counter to entropy which has no such capacity as no new information is returned through the input channels. The amount of energy generated is directly proportional to the quantity of information available about the system. Norbert Wiener, the originator of cybernetics, explains how the concept of entropy can be expanded to include human communication:

> ... it is possible to treat sets of messages as having an entropy — like sets of states of the external world ... the information carried by a set of messages is a measure of organization. In fact, it is possible to interpret the messages as essentially the negative of its entropy ... (Wiener, 1954:21).

The less anticipated the message, the more information it gives. Choice is thus a condition of meaningfulness or hubit potential. If the sender is constrained to one path of behaviour or response and unable to choose between alternatives, nothing will be transmitted.

Entropy, cinema and video

Film, art and entertainment constitute a cybernetic system in the following terms: *structure of the system,* measured in hubits and which is an index of the performance which may be expected from it refers to the 'human condition'. The latter is precisely defined in terms of the variety and amount of information received and decoded by an individual or society. The degree of perception of incoming information measures the state of the human condition. It will be remembered that the amount of information is directly proportional to the degree of available choice. Where choice is limited, information is restricted and the individual's perception is constrained within the limits set by the system. Entropy refers to the degree of humankind's ignorance about its condition. Ignorance is a state of increasing chaos (or entropy) due to misinformation or lack of information about the structure of the system. Plot, story, genre, drama and convention are the decision-making and control devices which restrict choice, and thereby information, and enable the commercial entertainer to adjust the inputs (signs ordered to a content) and so manipulate the output (information) in terms of pre-conditioned audience needs. The potential for manipulation depends on the receiver's recognition of the sender's communicative intention and upon his making an appropriate behavioural response to it.

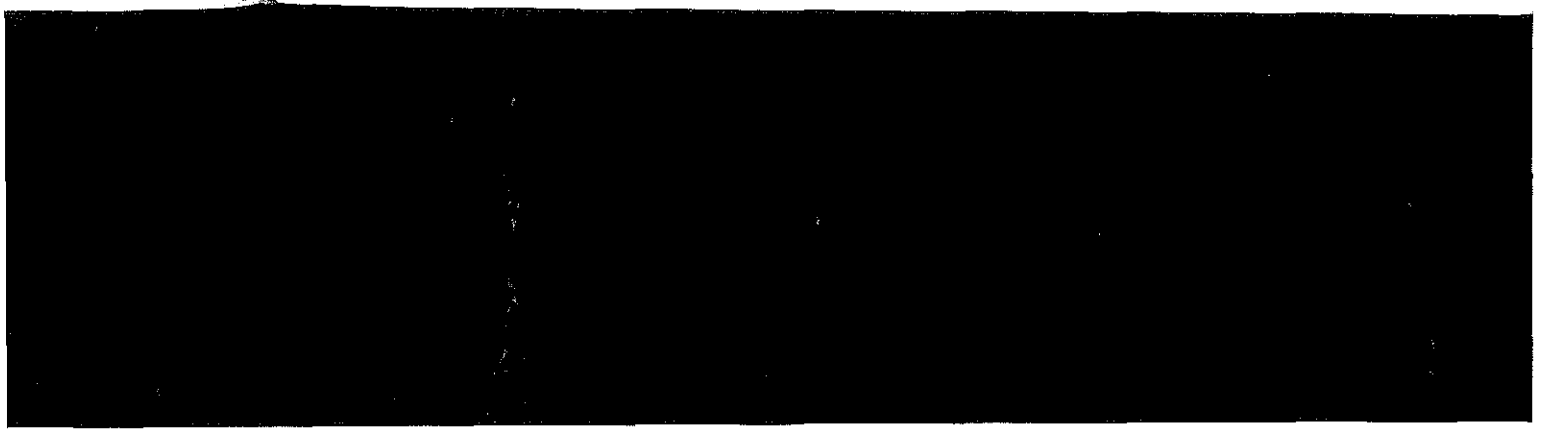
The purpose of a cybernetic-semiotic analysis in this context is to determine what inputs (formulas, genres, conventions and codes) are required to achieve pre-determined outputs (profit, understanding or ideological effect) given a set of goals. Three basic processes are at work here — homeostasis, evolutionary and revolutionary change — and will be developed in more detail than is evident in previous work (see Tomaselli, 1977:9-15; Youngblood, 1970).

Homeostasis: The Basis of the Genre Film

Homeostasis involves repetitive action which eliminates deviation through negative feedback, thus maintaining the system as it is. It is a self-adapting closed system which suppresses change in both the system and the code structure. Such information systems maintain a stable level of organization and begin to degenerate unless new information communicated by new signs and codes is fed in to counteract disturbances. When and if change does occur, it follows a chain-like pattern and is imperceptibly slow. Some scholars who misunderstand the nautre of art unwittingly restrict their interpretations to this phenomenologically derived, superficial category.

Stephenson and Debrix (1970:17), for example, define art as follows:

> ... art is a process in which the artist makes use of his experience, intuition or inspiration, selecting and arranging it to create beautiful and true artistic objects which to a greater or



lesser extent imitate reality and through these objects he communicates his experience to an audience.

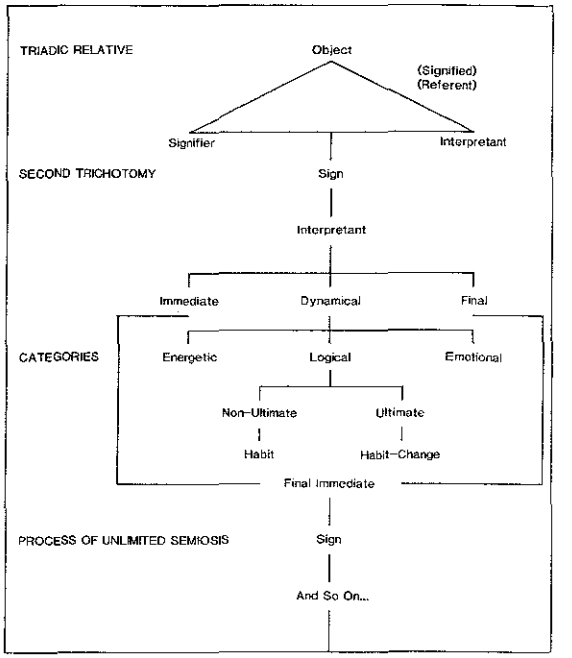
Three issues of cybernetic-semiotic importance concern us here.

a) "... beautiful and true ..." suggest a static interpretation at the level of appearances. The aesthetic code is neither extended nor broken and the signs remain highly motivated and iconic. Such signs, according to Peirce (See Hartshorne and Weiss, 1931-35; 1958) are *degenerate* for their relationship with the signified is independent of any cognitive act. These signs have no external meaning or immediate object, since iconic signs do not represent anything. If they did there would be a way of signifying their objects beyond merely resembling them (Peirce, 8.119 in Hartshorne and Weiss, 1931-35)*. The effect produced in the interpreter of "beautiful and true" signs corresponds to Peirce's concept of the immediate interpretant which simply reveals correct understanding of the sign itself (Fig. 1). It does not produce a reaction in the interpreter since it satisfies the conditioned expectations of the audience whose interpretation is controlled by the feedback or memory of past performance. In cybernetic terms, if art communicates the human condition, and this condition is not necessarily beautiful or conform to the prevailing perception of reality, the negative feedback will eliminate such unwanted information.

(b) "... imitate reality ..." Imitation is the result of inadequate information and is informed by degenerate iconic signs. It is repetitive and stable and such 'art' makes no attempt to reassess or extend human experience or to expand choice or develop new signs and syntagmatic combinations (and paradigmatic selection) to identify relationships where none were seen before. The conceptual design of this type of message restricts the quantity and variety of information available from it. Consequently, no new information is returned via the feedback loop. Signs remain highly codified and conventional and are in constant danger of lapsing into cliche. No cognisance is taken of outside disturbances and no change in system behaviour results. The system, both the structure and its codes which give its information form in terms of content, is unable to develop or match the variety of the disturbances which may occur.

(c) The definition offered by Stephenson and Debrix excludes many films or works of art which occur outside of "imitated reality", or what Peirce (8.184) calls the final interpretant which accounts for that "which *would finally* be decided to be the true representation if consideration of the matter were carried so far that an ultimate opinion would be reached". An image is not necessarily inexorably tied to antecedent reality. Artists can create a different kind of

Figure 1 Outline of Interpretants and the Process of Unlimited Semiosis



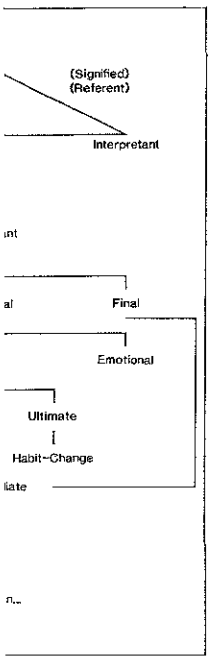
Tomaselli, 1981: 47

reality by a richer application of the trichotomy of signs in relation to their interpretants. The 'reality' created stands autonomously as a rival codified totality to the "imitated reality" or the physical nature of the 'real world'. To imitate reality even through the artist's "use of his experience, intuition or inspiration" is to deny the coherence of the reality within the mind of the artist, the objective nature of ideology and ignores the capacity of icons to act as sign-vehicles or to acknowledge Peirce's irreducible triadic relative where the sign determines the interpretant (the idea to which the sign gives

*Further references will refer to Peirce and the paragraph number in Hartshorne and Weiss.

/ Stephenson and
: or works of art
tated reality", or
final interpretant
h *would finally* be
ɛntation if consid-
ried so far that an
:ched". An image
ied to antecedent
different kind of

s of Unlimited Semiosis



of the trichotomy
ıterpretants. The
ımously as a rival
ɔd reality" or the
vorld'. To imitate
's "use of his ex-
ɔn" is to deny the
ı the mind of the
ideology and ig-
to act as sign-
ɛirce's irreducible
ı determines the
:h the sign gives

the paragraph number

rise). Signification is therefore restricted to first order iconic self-contained signs and little potential exists for the full use of second and third order signs. Imitation further confines the process of unlimited semiosis through which signification continually shifts by referring signs back to other signs where the interpretant which initially determines something else becomes itself a sign, and so on *ad infinitum*. This disturbing influence is therefore eliminated from the communication (or 'art') process. However, the nature of the disturbances which may impinge on the system may cause it to decay at a greater rate than it can reconstitute itself. For example, it became evident that the silent film of the Soviet montage directors had evolved toward a dead end, its capacity for adaption and mutation restricted through its stubborn adherence to over-specialised codes and an inability to cope with a new disturbance (a different kind of code), that of sound.

Youngblood (1970) argues that commercial entertainment is non-creative, destroys the audience's ability to appreciate and participate in the creative process and works against art since it is a closed system where the feedback process is dominated by a lack of new information. A frequently used sign, for example, becomes conventionalised and the probability that it will be decoded similarly by different receivers is increased exponentially. Metz (1974a) shows how the white hat gradually became codified into the signifier of the 'good' cowboy, but then became a cliché and lost its power. This process is caused by the over-use of a sign. The signifier becomes drained of meaning. In cybernetic terms, the error-controlled regulation or feedback signal contains information which is highly repetitive and highly probable. In other words, the signs and codes which give the information a content have a low value of equi-probability. In terms of entertainment, to satisfy the profit motive the commercial entertainer has to give the audience what it expects which is conditional upon what this audience previously received. The fatuous arguments of movie executives that they are merely pandering to public taste has encapsulated them in an incestuous homeostatic argument which confuses cause with effect and which obscures economic and ideological determinants altogether. This attitude is epitomised in the viewpoint of Adolf Zukor, one of the founders of Paramount Pictures who tailored his company's productions to the conviction that "The public is never wrong" (Fadiman, 1972: 12). That commercial survival is dependent upon homeostatic formulas and the correct interpretation of the immediate interpretant only is further substantiated by Leo Rosten's analysis of Hollywood:

> The very success of Hollywood lies in the skill with which it reflects the assumptions, fallacies, and the aspirations of an entire culture. The movie producers, the movie directors, the movie writers and the movie actors work with stereotypes which are current in our society ... (they) reinforce our typologies on an enormous scale with overpowering repetitiveness. Whether the movies imitate life or whether life imitates the movies is for others to decide ... Some critics say that audiences complain about the movies because they do not reflect reality; it is this writer's suspicion that more people lament the fact that reality does not reflect the movies (Rosten, 1941).

This reiteration and imitation which is deliberately encoded into the genre film, can, according to Youngblood (1970:64), be compared to a level of probability: "The content of westerns, gangster movies, romances etc., is probable in that it can be identified and comprehended simply by classification". In other words, probability (or equi-probability) is intrinsic to a definition of the term 'genre'. Genre movies are only rarely disturbing, innovative or openly deviant. The accepted set of conventional genre parameters constrain movies towards a norm and thereby determine their level of probability. Audiences prefer to pre-monitor levels of probability because genres fulfill a stable function. Tudor (1974:180-182) argues that genres are a relatively fixed culture pattern which define the moral and social word as well as the physical and historical environment. The genre movie, by its familiarity, inclines towards reassurance. This involves a *feedforward* relationship where alternatives are acted out before they occur. For example, appropriate music superimposed on a two shot of a man and a woman pre-supposes a love scene even before they act out love-type gestures. Feedforward is a method of controlling a system by inserting

into it the expectations of future performance in terms of its past performance where choice, and hence change, is prevented.

It will be remembered that plot, story and drama are control devices by which the entertainer manipulates the audience. Youngblood (1970:64) argues that the phenomenon of drama is the most universal and archetypal of all the genres. Drama deals with a progression of events which create suspense. Suspense is dependent upon a range of known alternatives which create expectation in the mind of the viewer. Expectation measures a level of probability for one cannot expect the unknown. Where information is both expected and probable, the transmission signal is low in equiprobable value. Expectancy is dependent upon prior knowledge and is determined by the relative frequency with which the viewer has decoded such signals in the past. In other words, one of the components of an equi-probable system may be defined in terms of the knowledge that the spectator has gained from seeing other genre movies. Drama, suspense and expectation therefore are measurable probabilities and as such are non-informative since there is no feedback which is the precondition of negentropy. That is, the greater the signal's probability of occurrence, the less the information it contains. Where the incidence of a particular signal is totally predictable and carries no signal information it has a probability of 1 (one). The sign which transforms the bit information into hubits is demotivated through repetition while the arbitrary, conventional dimension increases. The weaker the motivation, the more determining is the convention. Convention, therefore, contributes to a genre's probability level.

Drama in film works through plot and its narrative codes and through the process of signification forces the viewer to make culturally and ideologically pre-conditioned observations about the film being watched. The plot restricts the free paradigmatic association of ideas and constrains the choice of syntagmatic combinations to within acceptable limits. This in turn cybernetically controls the art-process of equivalence and forces it to stay within set limits. This low value of equi-probable information ensures a passive audience which is hostile to thematic, structural or semiotic innovation. This 'I am here to be entertained' attitude effectively cuts off the feedback process, the channel along which negentropy must flow if it is to be effective. Feedback is a method of controlling a system by inserting into it the results of its past performance (Wiener, 1954:13). Where no feedback occurs no learning results, or conversely, in Wiener's words, "... if the information which proceeds backward from the performance is to change the general method and pattern of performance, we have a process which may well be called learning". Where the viewer or interpreter has learned something new or discovered a new dimension to an old reality, he or she has benefitted from negative feedback. Where the receiver learns nothing new, information is redundant (or low in equiprobability), entropic and solely dependent on reassurance of past experience, past performance and the conventional interpretation of signs and codes at the level of the immediate interpretant.

The genre, as a system of low equi-probability, is a synchronic closed system which can be frozen in one moment of time and revived in such a way as to obtain a total description of its operation and internal relationships. These can in turn be analysed in terms of audience response, that is, what changes *in* the system (i.e. the film-audience-society system) cause changes *of* the system (i.e. the genre, its probability level and its semiotic components which are ordered to a content).

Opposed to change, the entertainer who is only a craftsman, tries not to alienate his audience by employing a new language (ie. changes in the system) even if he were capable of it. The entertainment system is therefore a closed system where entropy dominates the feedback process. As Boultenhouse (1967:35) observes:

> The Hollywood director is usually surprised to discover that his art has been taken seriously ... (He) is a craftsman using all his skills to protect an investment by making as much profit as possible. If his skills are repeated and developed to the point where they can be identified, this does not make him an artist.

Even directors who have set out with an artistic intention have fallen prey to the Second

Law of Thermodynamics which have restricted the choices allowed in an equi-probable system. A pertinent example is Alfred Hitchcock's (1966:61) statements:

> In recent years ... I have become more commercially minded, afraid that anything at all subtle may be missed. I have learned from experience how easily small touches are overlooked ... the art of directing is to know just how far you can go.

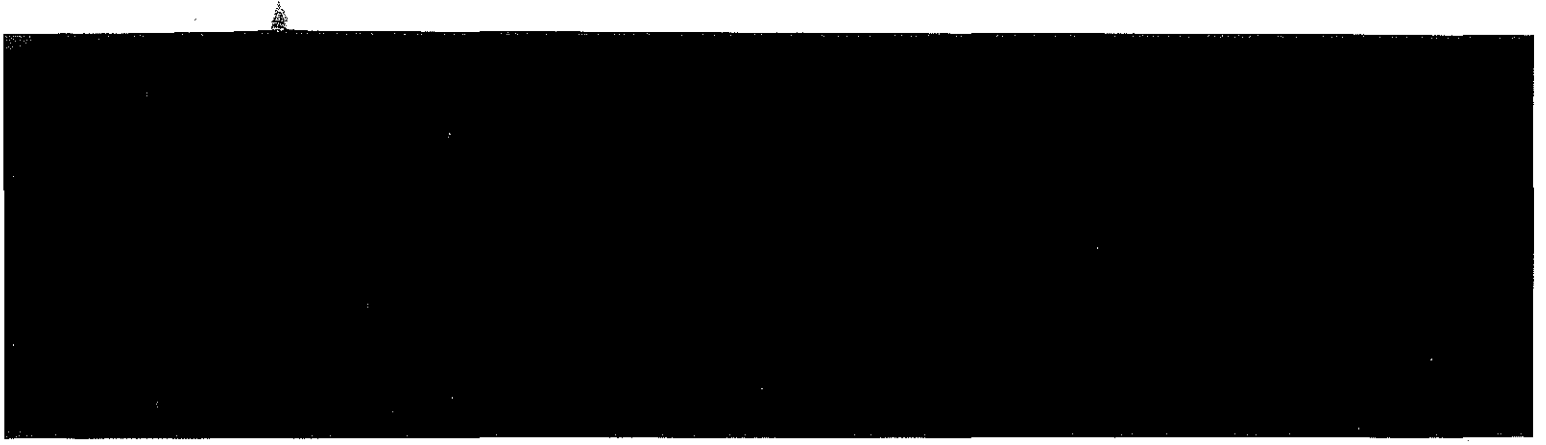
The information contained in such systems of significance tend to be static, repetitive and stable. The internal systemic workings of the genre are entrenched, repeated and refined, often to the point of cliché.

Evolutionary Change: The Outer Limits of the Genre

The signification systems employed by some directors even within the rules of the genre are open to change and may transcend, to a small but noticeable extent, pre-established convention and rules. This process has a capacity for self-transformation into new and different styles and semiotic components through introducing a variety which permits constructive change. This evolutionary growth extends beyond the meaning of the sign as embodied in the immediate interpretant and is mediated through the dynamical interpretant which is the "... actual effect which the Sign as a Sign really determines" (Peirce, 4.536); that is, the direct effect actually produced by the sign upon an interpreter of it. Signs at this level of organization produce new interpretants, new representations which refer to the same object. Such signs can be indexical and operate at the second and third orders of signification. They are able to move beyond a merely iconic representation from the dynamical object to the immediate and from denotation to connotation. This occurs through the process of unlimited semiosis where in order to establish what the interpretant of a sign is, it is necessary to name it by means of another sign, and so on. Fiske and Hartley (1978:59-60) discuss the idea of semiotic growth in the following manner:

> Most codes are dynamic systems, continually evolving to meet the changing needs and practices of their users. The English language, our most sophisticated code, is constantly evolving. New words are added (paradigmatic change) as are new conventions and rules by which we combine them (syntagmatic change). So in any dynamic or evolving code, there is a constant tension between tradition and innovation or between convention and originality.

Dynamical interpretants are of three kinds: emotional, energetic, and logical. (see Peirce, 5.475). This sub-division derives from the fact that a sign can leave the interpreter with a mere feeling or it can perform an external or internal action. The emotional interpretant accounts for the feeling produced by the sign and can range from the first feeling of comprehension of linguistic or semiotic signs to the apprehensive emotion that is generated by viewing a Hitchcock movie. In the latter case, the emotional interpretant is normally the only effect of a sign, although in terms of negentropy Hitchcock (1966:61) can say, 'I am freer now to do what I want than I was just a few years ago". In other words, where a director encodes a sign with extra information, there will occur a further interpretant mediated via the emotional interpretant. This second dynamical interpretant, the energetic, involves an inner mental effort. It is not concerned with the meaning of an intellectual concept but rather with single acts like the filming or editing of a scene. Physical action is not necessary, an act of imagination is sufficient effort to bring the energetic interpretant into play. This explains the process that allows Hitchcock to state that he is "freer" now than he was in the past. It also explains why films which seem incomprehensible on first release are understood better some years afterwards by the same audiences who have, in the interim, benefitted from the regenerative negative and cumulative feedback. This implies also that the interpreter has advanced beyond the quality of impression produced by signs of the immediate interpretant, through the first proper effect of a sign accounted for by the emotional interpretant, to the inner or external action or act of imagination described by the emotional interpretant, the latter two being sub-divisions of the dynamical interpretant. In other words, the audience has increased in film literacy, and new signs and codes, meaningless at first, eventually become widely employed and recognised. The signs contained in the new code eventually



become conventionalised and are more easily decoded by a greater number of people. The variety of disturbances (cultural, semiotic, etc) in the external world are matched by the variety in the decision-making device and the system (entertainment) learns to predict from the feedback process and make compensating adjustments. Fadiman (1972:81), for example, states that, "Should American audiences change ... Hollywood will promptly change as well". well".

Communication, whether by film or any other means, is subject to the inexorable tendency for entropy to increase, for codes to become conventionalised and for information to leak or distort in transit unless certain external devices are programmed to control and monitor its transfer. The popular genres (including drama) perform this function. Their set of codes, conventions, narratives and images are extended by means of addition, selective emphasis and re-emphasis on a simple trial and error basis. But sometimes this self-adapting system is unable to match the changes occurring in the encompassing system (society) and consequently become redundant. One example is the horror movie. Universal Studio's elementary formula was sufficient for most of the 1930s: simple seek and destroy narratives featuring Dracula, Frankenstein, Werewolf or a Mummy. But after a while familiarity breeds contempt, information becomes entropic and the disruption of homeostasis is rapidly reflected in declining box office returns. The film maker consequently becomes subject to commercial and aesthetic pressures which demand the introduction of new information, new signs and new codes. The new information, signs and codes are tested over a period of time and are either subsumed into the genre (measured in terms of probability) which elevates itself to a higher level of order and purpose, or it is discarded and the genre remains at a lower level of organization and a higher degree of probability and redundancy. Alternatively, notes Tudor (1974:170), some development occurs through the normal unguided process of evolution, a response to a combination of social pressure, belief, whim and personal preferences which leads to a continuous process of amendment, re-emphasis and alteration. Even then, unless the receiver has an interpreting structure (or set of interpretants) capable of decoding incoming information, a loss of meaning or rejection may work against any action (mediated by the dynamical interpretant) on the part of the interpreter. That is, the interpreter must be able to make a distinction between information processed at the immediate interpretant level, that which is fed into the system (genre), and the information that is left once the narrative has worked itself out. This residual information (measured in hubits), when further filtered by the dynamical interpretant produces an effect on the interpreter where the remaining information can be effectively acted upon by the interpreter. According to Wiener (1954:93-94) it is not the quantity of information sent that is important for action, but rather the quantity of information which can penetrate into a communication and storage apparatus sufficiently to serve as a trigger for action. To a pre-literate Bushman, for example, a genre film (eg., a Western) has little meaning, but for a person who has seen more than one Western, the genre becomes the interpreting structure (or interpretant) which measures the level of probability that a film will be understood. Wiener (1954:94) calls this process the Cybernetics of semantics and offers the following example:

> When I hear a passage of music, the greater part of the sound gets to my sense organs and reaches my brain. However, if I lack the perception and training necessary for the aesthetic understanding for musical structure, the information will meet a block, whereas if I were a trained musician it would meet an interpreting structure (or a set of interpretants) which would exhibit the pattern in a significant form which can lead to aesthetic appreciation and further understanding ... From the point of view of Cybernetics, semantics defines the extent of meaning and controls its loss in a communication system.

Semantically significant information is brought about by the triadic process where a sign is only a sign if its signifier is an interpretant, where one thing is brought about for the sake of another. Semantically significant information operates at the level of the dynamical interpretant, is negentropic, leads to growth, change and extension in a system.

Established rules and semiotic components

may be redefined, extended or even broken by introducing new interpretations of traditional characters. Sam Peckinpah's Westerns have utilised such techniques in *The Wild Bunch* (1969) and *Ride the High Country* (1962). If these films which explore new ideas, new signs and new codes meet with box-office success, then the new information introduced is semantically significant. The new signs and codes are less conventional and less constraining than those they have supplanted and the quality of impression is designed to produce both an emotional and an energetic effect in the interpreter. Where the new information finds rapport with the interpreting structure or receiver (i.e. a set of interpretants) the message will be understood and acted upon despite human and/or nature's attempt to subvert it in terms of the Second Law of Thermodynamics.

This brings the discussion to the consideration of the third component of Peirce's definition of the dynamical interpretant, the logical interpretant. This third kind of dynamical interpretant is a sign (or habit) which allows for future translations and for future development, whereas a feeling or activity do not. Peirce (5.476) divides the logical interpretant into two further sub-divisions, the non-ultimate and the ultimate:

> Shall we say this effect (the logical interpretant) may be a thought, that is to say, a mental sign? No doubt, it may be so; only, if this sign be of an intellectual kind — as it would have to be — it must itself have a logical interpretant; so that it cannot be the *ultimate* logical interpretant of the concept. It can be proved that the only mental effect that can be so produced and that it is not a sign but is of a general application is a habit-change ...

An effect which is itself a sign is a non-ultimate effect, since it would itself require an interpretant. The ultimate logical interpretant is a resting place which allows for the natural termination of the process of unlimited semiosis; it is not in itself a source for a further state of flux. Peirce asserts that a habit-change is the non-ultimate logical interpretant and covers variations of any kind in a person's habits. A response to a sign need not create a wholly new habit. A habit is a disposition to act or react in a certain manner under specific conditions. A habit is conditional, the exercise of a habit being conditioned by the presence of a proper stimulus. If certain conditions are given, and if a result of a particular kind is desired, the habit functions. Habits have to do with the activity of thought. This is linked up with what Peirce (5.481) calls mental experiments in which: "We imagine ourselves in various situations and animated by various motives; and we proceed to trace out the alternative lines of conduct which the conjectures would leave open to us". In other words, the habit governs the activities in the attainment of some goal or effect. It is the process of habit-change which accounts for films which disregard genre conventions altogether and which create an audience response conducive to change and innovation. Such change is of an intellectual nature. It is based on conditionality, the 'would be' species of future tense of the logical interpretant. The non-ultimate logical interpretant or habit-change is conditional upon the triadic process; it is the result of an act of enquiry and the interpretant produced is assumed to be a modification of consciousness. This notion of a habit is comparable to the cybernetic concept of control where change is brought about to attain desired goals under certain conditions. It will be remembered that a habit functions where conditions are given and where a certain result is required. In films like Orson Welles' *Citizen Kane* (1941) and Jans Rautenbach's *Jannie Totsiens* (1970) self-transformation is facilitated through the effect of the dynamical interpretant, and in particular, its logical dimension. Films which are negentropic explore and enquire. They seek to cause a habit-change, particularly where intellectual concepts are concerned. Enquiry through film (or video or drama or science, etc) must be through icons, indices and symbols. In addition, such films must be capable of bringing about the formation of a habit. The habit created is the springboard to progress and change and provides the basis of another dimension of the semiotic process.

It often happens, however, that the codes of film are in advance of the audience's propensity for a habit-change. In such instances, for example, Stanley Kubrick's *2001: A Space Odyssey* (1968), the film struggles at the box office on initial release, but is later declared a classic. That audiences have increased their film lite-

racy in the interim is often evidenced by a identifiable lag between release and profitability. Coupled with semantically significant information, the result is an audience more able to accept change *of* the system. Such change is conditional upon the effect of the ultimate logical interpretant which causes a habit-change. The evolutionary kind of film operates at a higher value of equi-probability than the genre, and unlike the synchronic closed system of relationships which characterizes the genre at a fixed point in time, evolutionary movies may be subjected to *diachronic* analysis which traces the development of a system *through* time. It emphasises the changes that elements of the system undergo. Film movements, for example, demand change (or a habit-change) and are a direct challenge to the homeostatic genres which tend to operate only marginally further than the level fo the immediate interpretant.

Often, however, the reverse process can occur. The Soviet films of the 1920s, for example, unlike the cinema of the French New Wave or Italian neorealism which were predicated upon continuing change and open ended objectives, eventually lost their inner dynamic for change due to an external need for stability and the absoluteness of their objectives. The process of unlimited semiosis was constrained in terms of Soviet ideology and negentropy gave way to entropy as a regression backwards from the ultimate logical interpretant to the basic immediate interpretant progressively restricted the hubit flow of content, which in turn narrowed the consciousness of Soviet society.

Revolutionary Change: Beyond the Code

The nature of art is defined by revolutionary change in which signs, codes, languages and relationships are transformed. Whereas the immediate interpretant is really the sign itself, the dynamical interpretant is the actual effect produced and the third category of interpretant, the *final interpretant,* is that "which *would finally* be decided to be the true interpretation if consideration of the matter were carried so far that an ultimate opinion were reached" (Peirce, 8.184). It is the "effect the sign *would* produce upon any mind upon which circumstances should permit it to work out its full effect." (Fitzgerald, 1966:79-80). The final interpretant is is reached through the working of the dynamical interpretant. According to Peirce (8.315), "the Dynamical Interpretant indefinitely approaches the character of the (Final Immediate) Interpretant". Peirce is not concerned with what does happen as a result of the sign, but rather with the sign as law and with what is destined because of the sign. This final interpretant is concerned with an ideal, that which would be produced, the *legisign.*

The freedom of art to break its own codes is made possible through the process of unlimited semiosis, the continuous production of interpretants. Sometimes a new artform or style appears meaningless when first produced. This occurs because some signs which are capable of producing an ultimate logical interpretant do not do so because the interpreter may be unable to carry the semiotic process far enough to establish or change a habit. Code switching or extension occurs in conjunction with interpretant production and reaches its highest value of equi-probability in the final interpretant. This freedom of going beyond the code is discussed by Culler (1976:100-101) in the following terms:

> ... aesthetic expression aims to communicate notions, subtleties, complexities which have not yet been formulated, and therefore, as soon as an aesthetic code comes to be generally perceived as a code ... then works of art tend to move beyond this code. They question, parody, and generally undermine the code while exploring its possible mutations and extensions. One might even say that much of the interest of works of art lies in the way in which they explore and modify the codes which they seem to be using; and this makes semiological investigation of these systems both highly relevant and extremely difficult.

Here, the artist, a visionary, a catalyst of change, is always engaged in writing a detailed history of the future (that which would be, the legisign) because he is one of the few people aware of the nature of the present (i.e. the law which acts as a guiding principle). The artist often produces new signs, new codes and new structures in his attempt at diagnosis, definition and rationale of the human condition. The extension of a code is possible because the highly motivated nature of the aesthetic sign imposes

a necessary relationship between the signified and the signifier, where the signified is of a subjective, interior order of reality. At issue here is the difference between aesthetic signs and conventional signs. A commerical TV director, for example, is constrained by the conventional nature of the medium and its audience expectation. The paradigmatic and syntagmatic choices (codes) have been pre-established by the medium which exhibits a low value of equiprobability, almost to the point of cliché. Television relies heavily on the use of conventional signs which are low in information and dominated by entropy. In contrast, aesthetic signs are less conventional, rich in information and consequently, negentropic. Such signs have recourse to the final interpretant through the immediate and dynamical and the choices available are determined by a high value equiprobable system. Under these circumstances negentropy is at its highest, and the potential for change at its greatest. Or as Youngblood (1970:65) expresses it: "The notion of experimental art ... is meaningless. All art is experimental or it isn't art. Art is research." This dynamic conception of art may be compared with Peirce's notion of science as a living thing, a process of enquiry whose purpose is to develop new habits, to work for progress and not merely to hold on to what has already been attained. habits and attitudes are important in the pursuit of the 'ultimate opinion. Since growth is attained through the acquisition of new habits (eg., methods of testing, film production, critical perspectives), it is the framing and testing of new hypotheses which serve as the goal of enquiry ratner than the reworking of what has already been settled (as is the case with genre films).

At this stage of the analysis it is necessary to examine in more detail Peirce's second trichotomy of signs in relation to the cybernetic elements of film. The concepts of icon and index taken together are able to account for most of the content which is seen in homeostatic and evolutionary film, both features and documentaries. In revolutionary film, however, the abstract, the non-realistic, the non-representational, both within narrative and outside it must be accounted for. Revolutionry art denies absolutes and emphasises the relational reality described by modern physics (Tomaselli, 1981b: 5). While the images projected may be neither indexical nor iconic, they may nevertheless have clear relationships to both. Forms, colours, shapes, set designs and so on may acquire significance during the unfolding of the film which transport the viewer beyond the basic iconic/indexical interaction or narrative relevance. It is at this level that the third kind of sign, the symbol, dominates. According to Peirce (3.360), "Such signs are always abstract and general, because habits are general rules to which the organism has become subjected". In other words, the symbol functions to bring generality to the sign process. Peirce (4.464) states:

> Every symbol is *ens rationis,* because it consists in a habit, in a regularity; now every regularity consists in the future conditional occurrence of facts not themselves that regularity.

That is, the facts that will be influenced are the images, the concepts and the action of the interpreter. Or, as Peirce (4.464) expresses it:

> The being of a symbol consists in the fact that something surely will be experienced if certain conditions be satisfied. Namely, it will influence the thought and conduct of the interpreter.

Peirce also defines the symbol as law, or regularity of the indefinite future. The future conditional effect of the symbol is explained by Fitzgerald (1966:63-64) as follows:

> The law, which is the primary meaning of the symbol, operates in such a way that upon the hearing or seeing of a token of the symbol, the interpreter will associate a mental icon with the objects which are denoted by the context in which the symbol is used. It is this habit of association which is the symbol ... The generality, then, lies neither with the Icon itself, nor in the token, but in the habit of association in the speaker or hearer.

Symbolism in film occurs whenever an image or sound or both stand for more than and other than their immediate indexical referents or references.

Context is all important here, for different contexts constrain the production of interpretants in terms of cultural and ideological parameters. The term, 'revolutionary', for example, means different things in different contexts.

Revolutionary Art: A Note on the Artist as 'Subject'

Although my use of the term revolutionary does not exclude art designed to stimulate a revolutionary consciousness in a political or social sense, in the present context the term applies mainly to what Neville Dubow (1982:6) calls the art of 'formal radicals'. This type of art is inherently revolutionary in terms of a new stance or attitude it proposes in terms of its own self-reflexive references. The two — the social and the formal — are nevertheless interlinked because form cannot be separated from content, though the emphasis may differ.

Revolutionary art, whether formal or social, has the potential of eliciting a response through to the final immediate interpretant, and beyond it. While both forms stimulate the process of unlimited semiosis, the nature of their signs and codes is largely different. Artists or film directors working in a revolutionary mode are not defined in terms of the subject matter of their work, but rather by the way they carry out their endeavours, or what Althusser calls 'social practices'. The formal radicals differ from the social revolutionaries in terms of the politico-economic *contexts* of their practice (and work). Where the latter are forced to rely on explicit referential forms — some degree of realism which calls on conventional pictorial codes — the former are able to move into the abstract and the inner consciousness. Where the one deals with the relations of objective reality, the other is an expression of metaphysical space-time relations beyond objective reality, though often consequent upon its imagined relationships.

It may be that the links between the two distinct practices could best be identified and accounted for by means of the psychoanalytic problematic, particularly in terms of their differing ideological positions. Pertinent questions relate to the Lacanian/Althusserian postulates of the 'imaginary', the 'symbolic' and the role of artist/film make as 'subject', for it may be hypothesised that where the social radicals seek to exploit the contradictions of social practice, the formal radicals have the ideological effect of closing off the contradictions through their search for unity. This unity, or totality, is often characterised by 'non-object' art where the object and its subject are collapsed into each other. The resulting symbolism describes a mode of relation of which the imaginary is an inflection. In other words, the symbolic is "an order that is intersected but not resumed by the ideological (ideology works *over* the symbolic *on* the subject for the imaginary" (Heath, 1976: 255). The formal radical therefore, despite Dubow's (1982:8) conclusion to the contrary, is not immune to ideological pressure. It is impossible to work in "socially appropriate terms because he feels that way" without being influenced by ideology. Coward and Ellis (1977:77) explain the problem of the subject thus: "The imaginary identity of ideology ... puts the subject in the position of a homogeneous subject in relation to meaning, a subject who thinks him/herself to be the point of origin of ideas and actions". The film maker or artist who takes the latter view remains unaware of the economic contexts of their social practice and imagine their work to be 'free' of ideological determinations, that the language of the unconscious is the result of a discourse structure separate from economic structures.

The point of this section on the 'subject' is to point to the complexities that need to be taken into account in the search for appropriate conceptual frameworks to account not only for the content of a film (or a work of art), but of the social practices and economic determinations which inform those practices. While this paper has primarily dealt with the former it has also intended to indicate directions for possible future research and likely areas of theoretical connection. Previous research employing cybernetics has tended towards technological determinism and a theoretical base which excludes the contribution of materialist theories of language, the question of ideology and the role of the individual as subject. This section is but an initial attempt to resolve these exclusivities.

Concluding remarks: From description to prediction.

Göran Kindem (1979:65) has identified some unresolved semiotic problems which he lists in the following passage:

> Semiotics is a descriptive science, not a predictive one. It can describe the probable sources of meaning in general, but it cannot predict what meaning will be conveyed in a

specific context by a specific sign for a specific individual. An understanding of the semiotic sources and possibilities of meaning based upon a semiotic, typological analysis can be of value to both the film maker and the film viewer, critic and theorist. A more complex model would be required to predict the probable reaction of a specific audience to a specific sign at a specific time and place, since this would involve all the social science factors (economics, ideology, psychology, etc.) which must be considered in any predictive model or theory of meaning in human culture.

A number of points arise out of this statement on the status of semiotics at the time of publication, and more recent advances. First, while semiotics was, for a long time, non-predictive, it is more than a purely descriptive science. As my article has shown, it is primarily explanatory in character, deductive and concerned with prediction. The way Peirce's theory is structured suggests that it has this capacity. Second, the more complex model that Kindem speaks of "to predict the probable reaction of a specific audience", has been outlined in the aforegoing pages. The marriage of semiotics and cybernetics as evidenced in this study will meet the basic needs of Kindem's "more complex model or theory". The third point relates to the question of a theory of semiotic production. It would seem that such a theory would have its roots in Lacanian psychoanalysis, ideology and materially-based theories of discourse.

References

Althusser, L. (1969) *For Marx,* Harmondsworth: Penguin

Althusser, L. and Balibar, E. (1970) *Reading 'Capital'.* London: New Left Books.

Boultenhouse, C. (1967) The Camera As God, in Battock, G. (ed.) *The New American Cinema.* New York: Dutton

Coward, R. and Ellis J. (1977) *Language and Materialism.* London: Routledge and Kegan Paul

Culler, J. (1976) *Saussure.* London: Fontana

Dubow, N. (1982) Art and the Politics of Power. *Quarterly Bulletin of the South African National Gallery,* No. 9:4-9.

Eco, U. (1976) *A Theory of Semiotics.* London: MacMillan

Fadiman, W. (1972) *Hollywood Now.* London: Thames and Hudson

Fiske, J. and Hartley, J. (1978) *Reading Television.* London: Methuen

Fitzgerald, J.J. (1966) *Peirce's Theory of Signs as Foundation for Pragmatism.* The Hague: Mouton.

Hartshorne, C., and Weiss, P. (eds.) (1931-35; 1958) *The Collected Papers of Charles Sanders Peirce Vols. I-VI, Vols VII-VIII* edited by Burks, A. Cambridge, Mass.: Harvard University Press.

Heath, S. (1976) On Screen, In Frame: Film and Ideology. *Quarterly Review of Film Studies,* Vol. 1, No. 3

Heath, S. (1981) *Questions of Cinema.* London: MacMillan

Hitchcock, A. (1966) Direction, in McCann (ed.) *Film: A Montage of Theories.* New York: Dutton.

Kindem, G.A. (1979) Peirce's Semiotic and Film. *Quarterly Review of Film Studies,* Vol. 4, No. 1:61-70.

Kuhn, A. (1982) *Women's Pictures: Feminism and the Cinema.* London: Routledge and Kegan Paul

Lovell, T. (1980) *Pictures of Reality: Aesthetics, Politics and Pleasure.* London: British Film Institute

McDonnell, K. and Robins, K. (1980) Marxist Culture. London: Allison & Busby:157-231. screen, in Clarke, S., Lovell, T., McDonnell, K., Robins, K. and Seidler, V.J. *One-Dimensional Marxism: Althusser and the Politics of Culture.* London: Allison & Busby:157-231.

Metz, C. (1974a) *Language and Cinema.* The Hague: Mouton

Metz, C. (1974b) *Film Language: A Semiotics of the Cinema.* New York: Oxford University Press

Metz, C. (1982) *Psychoanalysis and the Cinema: The Imaginary Signifier.* London: MacMillan

Peirce, J.R. (1972) Communication. *Scientific American,* Vol. 227, No. 3:30-41.

Rosten, L. (1941) *Hollywood: The Movie Colony — The Movie Makers.* New York: Harcourt and Brace

Shannon, C.E. (1948) The Mathematical Theory of Communication. *Bell System Technical Journal,* July and October

Shannon, C.E. and Weaver, W. (1949) *The Mathematic Theory of Communication.* Chicago: University of Chicago Press

Tomaselli, K.G. (1977) A General Theory of Intermedia Communications, in Van Zyl, J. and Tomaselli, K.G. (eds.) *Media and Change.* Johannesburg:

Tomaselli, K.G. (1981a) Semiotics, Semiology and Film. *Communicare,* Vol. 2, No. 1:42-61

Tomaselli, K.G. (1981b) The Collapse of Referentials: The Artist as Design Scientist. *Quarterly Bulletin of the South African National Gallery,* No. 6:5-7.

Tudor, A. (1974) *Image and Influence.* London: Allen and Unwin.

Webber, M.M. (1967) The Urban Place and the Nonplace Urban Realm, in Webber, M.M. (ed.) *Exploration into Urban Structures.* Philadelphia: University of Pennsylvania Press.

Wiener, N. (1954) *The Human Use of Human Beings.* Revised edition. London: Eyre and Spottiswoode.

Youngblood, G. (1970) *Expanded Cinema.* London: Studio Vista