

III

Openness, Information, Communication

In its advocacy of artistic structures that demand a particular involvement on the part of the audience, contemporary poetics merely reflects our culture's attraction for the "indeterminate," for all those processes which, instead of relying on a univocal, necessary sequence of events, prefer to disclose a field of possibilities, to create "ambiguous" situations open to all sorts of operative choices and interpretations.

To describe this singular aesthetic situation and properly define the kind of "openness" to which so much of contemporary poetics aspires, we are now going to make a detour into science, and more precisely into information theory, hoping it will provide us with a few indications that might prove useful to our research. There are two main reasons for this detour. In the first place, I believe that poetics in certain cases reflects, in its own way, the same cultural situation that has prompted numerous investigations in the field of information theory. Second, I believe that some of the methodological tools employed in these investigations, duly transposed, might also be profitably used in the field of aesthetics (as we shall see, others have already done this). Some people will object that there can be no effective connections between aesthetics and information theory, and that to draw parallels between the two fields can only be a gratuitous, futile exercise. Possibly so. Before engaging in any kind of transposition, let us therefore examine the general principles of information theory with no reference to aesthetics, and only then decide whether there are any connections between the two fields and, if so, of what sort, and whether it might be profitable to apply to one the methodological instruments used in the other.

I

Information Theory

Information theory tries to calculate the quantity of information contained in a particular message. If, for instance, on August 4 the weather forecaster says, "Tomorrow, no snow," the amount of information I get is very limited; my own experience would have easily allowed me to reach that conclusion. On the other hand, if on August 4 the forecaster says, "Tomorrow, snow," then the amount of information I get is considerable, given the improbability of the event. The quantity of information contained in a particular message is also generally conditioned by the confidence I have in my sources. If I ask a real estate broker whether the apartment he has just shown me is damp or not and he tells me that it is not, he gives me very little information, and I remain as uncertain as I was before I asked him the question. On the other hand, if he tells me that the apartment *is* damp, against my own expectation and his own interest, then he gives me a great deal of information and I feel I have learned something relevant about a subject that matters to me.

Information is, therefore, an *additive* quantity, something that is added to what one already knows as if it were an original acquisition. All the examples I have just given, however, involved a vast and complex amount of information whose novelty greatly depended on the expectations of the receiver. In fact, information should be first defined with the help of much simpler situations that would allow it to be quantified mathematically and expressed in numbers, without any reference to the knowledge of a possible receiver. This is the task of information theory. Its calculations can suit messages of all sorts: numerical symbols, linguistic symbols, sound sequences, and so on.

To calculate the amount of information contained in a particular message, one must keep in mind that the highest probability an event will take place is 1, and the lowest is 0. The mathematical probability of an event therefore varies between 1 and 0. A coin thrown into the air has an equal chance of landing on either heads or tails; thus, the probability of getting heads is $1/2$. In contrast, the chance of getting a 3 when rolling a die is $1/6$. And the probability that two independent events will occur at the same time is the prod-

uct of their individual probabilities; thus, when rolling a pair of dice, the probability of getting a 1 and a 6 is $1/36$.

The relationship between the number of possible events in a series and the series of probabilities connected to each of them is the same as that between an arithmetic progression and a geometric progression, and can be expressed by a logarithm, since the second series is the logarithm of the first. The simplest expression for a given quantity of information is the following:

$$\text{Information} = \log \frac{\text{odds that addressee will know content of message after receiving it}}{\text{odds that addressee will know content of message before receiving it}}$$

In the case of the coin, if I am told that the coin will show heads, the expression will read:

$$\log_2 \frac{1}{1/2} = 1.$$

Information theory proceeds by binary choices, uses base 2 logarithms, and calls the unit of information a "bit," a contraction of "binary" and "digit." The use of a base 2 logarithm has one advantage: since $\log_2 2 = 1$, one bit of information is enough to tell us which of two probabilities has been realized. For a more concrete example, let's take a common 64-square chessboard with a single pawn on it. If somebody tells me that the pawn is on square number 48, the information I receive can be measured as follows: since, initially, my chances to guess the right square were $1/64$, I can translate this into the expression $-\log_2 (1/64) = \log_2 64 = 6$. The information I have received is therefore 6 bits.¹

To conclude, we can say that *the quantity of information conveyed by a given message is equal to the binary logarithm of the number of possibilities necessary to define the message without ambiguity.*²

To measure an increase or a decrease in information, theoreticians have borrowed a concept from thermodynamics that by now has become an integral part of the lexicon of information theory: the concept of entropy. The term has been bandied about long

enough for everyone to have heard of it and, in most cases, to have used it somewhat loosely. We should therefore take a fresh look at it, so as to divest it of all the more or less legitimate echoes it has carried over from thermodynamics. According to the second law of thermodynamics, formulated by Rudolf Clausius, although a certain amount of work can be transformed into heat (as stated by the first law), every time heat is transformed into work certain limitations arise to prevent the process from ever being fully completed. To obtain an optimum transformation of heat into work, a machine must provoke exchanges of heat between two bodies with different temperatures: a heater and a cooler. The machine draws a certain amount of heat from the heater but, instead of transforming it all into work, passes part of it on to the cooler. The amount of heat, Q , is then partly transformed into work, Q_1 , and partly funneled into the cooler, $Q - Q_1$. Thus, the amount of work that is transformed into heat will be greater than the amount of work derived from a subsequent transformation of heat into work. In the process, there has been a degradation, more commonly known as a consumption, of energy that is absolutely irreversible. This is often the case with natural processes: "Certain processes have only *one direction*: each of them is like a step forward whose trace can never be erased."³ To obtain a general measure of irreversibility, we have to consider the possibility that nature favors certain states over others (the ones at the receiving end of an irreversible process), and we must find a physical measure that could quantify nature's preference for a certain state and that would increase whenever a process is irreversible. This measure is entropy.

The second law of thermodynamics, concerning the consumption of energy, has therefore become the law of entropy, so much so that the concept of entropy has often been associated with that of consumption, and with the theory stating that the evolution of all natural processes toward an increasing consumption and progressive degradation of energy will eventually result in the "thermic death" of the universe. And here it is important to stress, once and for all, that although in thermodynamics entropy is used to define consumption (thereby acquiring pessimistic connotations—whether or not it is reasonable to react emotionally to a scientific concept), in fact it is merely a *statistical measure* and, as such, a mathematically neutral instrument. In other words, en-

ropy is the measure of that state of maximal *equiprobability* toward which natural processes tend. This is why one can say that nature shows certain preferences: nature prefers greater uniformity to lesser uniformity, and heat moves from a warmer body to a cooler body because a state in which heat is equally distributed is more probable than a state in which heat is unequally distributed. In other words, the reciprocal speed of molecules tends toward a state of uniformity rather than toward a state of differentiation, in which certain molecules move faster than others and the temperature is constantly changing. Ludwig Boltzmann's research on the kinetic theory of gases demonstrated that nature tends toward an elemental disorder of which entropy is the measure.⁴

It is, therefore, important to insist on the *purely statistical* character of entropy—no less purely statistical than the principle of irreversibility, whereby, as proved by Boltzmann, the process of reversion within a closed system is not impossible, only improbable. The collisions of the molecules of a gas are governed by statistical laws which lead to an average equalization of differences in speed. When a fast molecule hits a slow one, it may occasionally happen that the slow molecule loses most of its speed and imparts it to the fast one, which then travels away even faster; but such occurrences are exceptions. In the overwhelming number of collisions, the faster molecule will lose speed and the slower one will gain it, thus bringing about a more uniform state and an increase in elemental disorder.

As Hans Reichenbach has written, "The law of the increase of entropy is guaranteed by the law of large numbers, familiar from statistics of all kinds, but it is not of the type of the strict laws of physics, such as the laws of mechanics, which are regarded as exempt from possible exceptions."⁵

Reichenbach has provided us with the clearest and simplest explanation of how the concept of entropy has passed from the theory of energy consumption to that of information. The increase in entropy that generally occurs during physical processes does not exclude the possibility of other physical processes (such as those we experience every day, since most organic processes seem to belong to this category) that entail an organization of events running counter to all probability—in other words, involving a decrease in entropy. Starting with the entropy curve of the universe, Reichen-

bach calls these decreasing phases, characterized by an interaction of events that leads to a new organization of elements, *branch systems*, to indicate their deviation from the curve.

Consider, for example, the chaotic effect (resulting from a sudden imposition of uniformity) of a strong wind on the innumerable grains of sand that compose a beach: amid this confusion, the action of a human foot on the surface of the beach constitutes a complex interaction of events that leads to the statistically very improbable configuration of a footprint. The organization of events that has produced this configuration, this *form*, is only temporary: the footprint will soon be swept away by the wind. In other words, a deviation from the general entropy curve (consisting of a decrease in entropy and the establishment of *improbable order*) will generally tend to be reabsorbed into the universal curve of increasing entropy. And yet, for a moment, the elemental chaos of this system has made room for the appearance of an order, based on the relationship of cause and effect: the cause being the series of events interacting with the grains of sand (in this case, the human foot), and the effect being the organization resulting from it (in this case, the footprint).

The existence of these relationships of cause and effect in systems organized according to decreasing entropy is at the basis of memory. Physically speaking, memory is a record (an imprint, a print), an "ordered macroarrangement, the order of which is preserved: a frozen order, so to speak."⁶ Memory helps us reestablish causal links, reconstruct facts. "Since the second law of thermodynamics leads to the existence of records of the past, and records store information, it is to be expected that *there is a close relationship between entropy and information.*"⁷

We shouldn't, therefore, be too surprised by the frequent use of the term "entropy" in information theories, since to measure a quantity of information means nothing more than to measure the levels of order and disorder in the organization of a given message.

The Concept of Information in the Work of Norbert Wiener

For Norbert Wiener—who has relied extensively on information theory for his research in cybernetics, that is, in his investigation of the possibilities of control and communication in human beings

and machines—the informative content of a message is given by the degree of its organization. Since information is a measure of order, the measure of disorder, that is to say, entropy, must be its opposite. Which means that the information of a message depends on its ability to elude, however temporarily, the equiprobability, the uniformity, the elemental disorder toward which all natural events seem destined, and to organize according to a particular order. For instance, if I throw in the air a bunch of cubes with different letters printed on their faces, once they hit the ground they will probably spell out something utterly meaningless—say, AAASQMFLNSUHOI. This sequence of letters does not tell me anything in particular. In order to tell me something, it would have to be organized according to the orthographic and grammatical laws of a particular language—in other words, it would have to be organized according to a particular linguistic *code*. A language is a human event, a typical *branch system* in which several factors have intervened to produce a state of order and to establish precise connections. In relation to the entropy curve, language—an organization that has escaped the equiprobability of disorder—is another *improbable* event, a naturally improbable configuration that can now establish its own *chain of probability* (the probabilities on which the organization of a language depends) within the system that governs it. This kind of organization is what allows me to predict, with a fair amount of certainty, that in an English word containing three consonants in a row the next letter will be a vowel. The tonal system, in music, is another language, another code, another *branch system*. Though extremely improbable when compared to other natural acoustic events, the tonal system also introduces, within its own organization, certain criteria of probability that allow one to predict, with moderate certainty, the melodic curve of a particular sequence of notes, as well as the specific place in the sequence where the tonic accent will fall.

In its analysis of communication, information theory considers messages as organized systems governed by fixed laws of probability, and likely to be disturbed either from without or from within (from the attenuation of the text itself, for instance) by a certain amount of disorder, of communication consumption—that is to say, by a certain increase in entropy commonly known as “noise.” If the meaning of the message depends on its organization accord-

ing to certain laws of probability (that is, laws pertaining to the linguistic system), then "dis-order" is a constant threat to the message itself, and entropy is its measure. In other words, *the information carried by a message is the negative of its entropy.*⁸

To protect the message against consumption so that no matter how much noise interferes with its reception the gist of its meaning (of its order) will not be altered, it is necessary to "wrap" it in a number of conventional reiterations that will increase the probability of its survival. This surplus of reiterations is what we commonly call "redundancy." Let's say I want to transmit the message "Mets won" to another fan who lives on the other side of the Hudson. Either I shout it at him with the help of a loudspeaker, or I have it wired to him by a possibly inexperienced telex operator, or I phone it to him over a static-filled line, or I put a note in the classic bottle and abandon it to the whims of the current. One way or another, my message will have to overcome a certain number of obstacles before it reaches its destination; in information theory, all these obstacles fall under the rubric "noise." To make sure that neither the hapless telex operator nor a water leak is going to turn my victorious cry into the rather baffling "Met swan," or the more allusive "Met Swann," I can add "Red Sox lost," at which point, whether the message reaches my friend or not, its meaning will probably not be lost.

According to a more rigorous definition, "redundancy," within a linguistic system, results from a set of syntactic, orthographic, and grammatical laws. As a system of preestablished probabilities, language is a *code of communication*. Pronouns, particles, inflections—all these linguistic elements tend to enrich the organization of a message and make its communication more probable. It might be said that even vowels can contribute to the redundancy of a message, because they facilitate (and make more probable) one's ability to distinguish and to comprehend the consonants in a word. The sequence of consonants *bldg* suggests the word "building" more clearly than the vowels *uii*; on the other hand, the insertion of these three vowels between the consonants makes the word easier to utter and to understand, thus increasing its comprehensibility. When information theorists say that 50 percent of the English language consists of redundancy, what they mean is that only 50 percent of what is said concerns the message to be communicated, while the other

50 percent is determined by the statistical structure of the language and functions as a supplementary means of clarification. When we speak of a "telegraphic style," we generally refer to a message that has been stripped of most of its redundancy (pronouns, articles, adverbs)—that is, of all that is not strictly necessary to its communication. On the other hand, in a telegram the lost redundancy of the message is replaced by another set of conventions also aiming at facilitating its communication by constituting a new form of probability and order. Indeed, linguistic redundancy is so dependent on a particular system of probability that a statistical study of the morphological structure of words from any language would yield an x number of frequently recurring letters which, when arranged in random sequences, would reveal some traits of the language from which they have been taken.⁹

Yet this also means that the very order which allows a message to be understood is also what makes it absolutely predictable—that is, extremely banal. The more ordered and comprehensible a message, the more predictable it is. The messages written on Christmas cards or birthday cards, determined by a very limited system of probability, are generally quite clear but seldom tell us anything we don't already know.

The Difference between Meaning and Information

All of the above seems to invalidate the assumption, supported by Wiener's book, that the *meaning* of a message and the *information* it carries are synonymous, strictly related to the notions of *order* and *probability* and opposed to those of *entropy* and *disorder*.

But, as I have pointed out, the quantity of information conveyed by a message also depends on its source. A Christmas card sent by a Soviet official would, by virtue of its improbability, have a much higher information value than the same card sent by a favorite aunt. Which again confirms the fact that information, being essentially additive, depends for its value on both originality and improbability. How can this be reconciled with the fact that, on the contrary, the more meaningful a message, the more probable and the more predictable its structure? A sentence such as "Flowers bloom in the spring" has a very clear, direct meaning and a maximal power of communication, but it doesn't add anything to what we already

know. In other words, it does not carry much information. Isn't this proof enough that *meaning and information are not one and the same thing?*

Not so, according to Wiener, who maintains that information means *order* and that entropy is its opposite. Wiener, however, is using information theory to explore the power of communication of an electronic brain, in order to determine what makes a message comprehensible. He is not concerned with the differences between information and meaning. And yet, at a particular point in his work, he makes an interesting declaration: "A piece of information, in order to contribute to the general information of a community, must say something substantially different from the community's previous common stock of information." To illustrate this point, he cites the example of great artists, whose chief merit is that they introduce new ways of saying or doing into their community. He explains the public consumption of their work as the consequence of the work's inclusion within a collective background—the inevitable process of popularization and banalization that occurs to any novelty, any original work, the moment people get used to it.¹⁰

On reflection, one sees that this is precisely the case with everyday speech, whose very power of communication and information seems to be directly proportional to the grammatical and syntactic rules it constantly eludes—the very same rules deemed necessary to the transmission of meaning. It often happens that in a language (here taken to mean a system of probability), certain elements of disorder may in fact increase the level of information conveyed by a message.

Meaning and Information in the Poetic Message

This phenomenon, the direct relationship between disorder and information, is of course the norm in art. It is commonly believed that the poetic word is characterized by its capacity to create unusual meanings and emotions by establishing new relationships between sounds and sense, words and sounds, one phrase and the next—to the point that an emotion can often emerge even in the absence of any clear meaning. Let's imagine a lover who wants to express his feelings according to all the rules of probability imposed on him by his language. This is how he might speak: "When I try

to remember events that occurred a long time ago, I sometimes think I see a stream, a stream of smoothly flowing, cool, clear water. The memory of this stream affects me in a particular way, since the woman I then loved, and still love, used to sit on its banks. In fact, I am still so much in love with this woman that I have a tendency, common among lovers, to consider her the only female individual existing in the world. I should add, if I may, that the memory of this stream, being so closely connected to the memory of the woman I love (I should probably mention that this woman is very beautiful), has the power to fill my soul with sweetness. As a result, following a procedure that is also fairly common among lovers, I like to transfer this feeling of sweetness to the stream that indirectly causes me to feel it, and attribute the emotion to it as if the sweetness were really a quality of the stream. This is what I wanted to tell you. I hope I have explained myself clearly." This is how the lover's sentence would sound if, afraid of not being able to communicate exactly what he wants to say, he were to rely on all the rules of redundancy. Although we would certainly understand what he says, we would probably forget it shortly thereafter.

But if the lover were Petrarch, he would do away with all the conventional rules of construction, shun all logical transitions, disdain all but the most daring metaphors, and, refusing to tell us that he is describing a memory but using the past tense to suggest it, he would say: "Chiare, fresche e dolci acque—dove le belle membra—pose colei che sola a me par donna" ("Clear, fresh and sweet waters where she who alone to me seems woman rested her lovely limbs").¹¹ In fewer than twenty words, he would also succeed in telling us that he still loves the woman he remembers, and would manage to convey the intensity of his love through a rhythm whose liveliness imbues the memory with the immediacy of a cry or a vision. Nowhere else have we thus savored the sweetness and violence of love and the languor of memory. This communication allows us to accumulate a large capital of information about both Petrarch's love and the essence of love in general. Yet from the point of view of *meaning*, the two texts are absolutely identical. It is the second one's originality of organization—that is, its deliberate disorganization, *its improbability in relation to a precise system of probability*—which makes it so much more informative.

At this point, of course, one could easily object that it is not just

the amount of unpredictability that charms us in a poetic discourse. If that were the case, a nursery rhyme such as "Hey diddle diddle / The cat and the fiddle / The cow jumped over the moon" would be considered supremely poetic. All I am trying to prove here is that *certain unorthodox uses* of language can often result in poetry, whereas this seldom, if ever, happens with more conventional, probable uses of the linguistic system. That is, it will not happen unless the novelty resides in what is said rather than in how it is said, in which case a radio broadcast that announces, according to all the rules of redundancy, that an atomic bomb has just been dropped on Rome will be as charged with news as one could wish. But this sort of information does not really have much to do with a study of linguistic structures (and even less with their aesthetic value—further evidence that aesthetics cares more about *how* things are said than about *what* is said). Besides, whereas Petrarch's lines can convey a certain amount of information to any reader, including Petrarch, the radio broadcast concerning the bombing of Rome would certainly carry no information to the pilot who has dropped the bomb or to all those listeners who heard the announcement during a previous broadcast. What I want to examine here is the possibility of conveying a piece of information that is not a common "meaning" by *using conventional linguistic structures to violate the laws of probability that govern the language from within*. This sort of information would, of course, be connected not to a state of order but to a state of disorder, or, at least, to some *unusual and unpredictable non-order*. It has been said that the positive measure of such a kind of information is entropy; on the other hand, if entropy is disorder to the highest degree, containing within itself *all* probabilities and *none*, then the information carried by a message (whether poetic or not) that has been intentionally organized will appear only as a very particular form of disorder, a "dis-order" that is such only in relation to a preexisting order. But can one still speak of entropy in such a context?

The Transmission of Information

Let us now briefly turn to the classic example of the kinetic theory of gas, and imagine a container full of molecules all moving at a uniform speed. Since the movement of these molecules is deter-

mined by purely statistical laws, the entropy of the system is very high, so that although we can predict the general behavior of the entire system, it is very difficult to predict the trajectory of any particular molecule. In other words, the molecule can behave in a variety of ways, since it is full of possibilities, and we know that it can occupy a large number of positions, but we do not know which ones. To have a clearer idea of the behavior of each molecule, it would be necessary to differentiate their speeds—that is, to introduce an order into the system so as to decrease its entropy. In this way we would increase the probability that a molecule might behave in a particular manner, but we would also limit its initial possibilities by submitting them to a *code*.

If I want to know something about the behavior of a single molecule, I am seeking the kind of information that *goes against* the laws of entropy. But if I want to know all the possible behaviors of any given molecule, then *the information I am seeking will be directly proportional to the entropy of the system*. By organizing the system and decreasing its entropy, I will simultaneously learn a great deal and not much at all.

The same thing happens with the transmission of a piece of information. I shall try to clarify this point by referring to the formula that generally expresses the value of a piece of information: $I = N \log h$, in which h stands for the number of elements among which we can choose, and N for the number of choices possible (in the case of a pair of dice, $h = 6$ and $N = 2$; in the case of a chessboard, $H = 64$ and $N =$ all the moves allowed by the rules of chess).

Now, in a system of high entropy, in which all the combinations can occur, the values of N and h are very high; also very high is the value of the information that could be transmitted concerning the behavior of one or more elements of the system. But it is quite difficult to communicate as many binary choices as are necessary to distinguish the chosen element and define its combinations with other elements.

How can one facilitate the communication of a certain bit of information? By reducing the number of the elements and possible choices in question: by introducing a code, a system of rules that would involve a fixed number of elements and that would exclude some combinations while allowing others. In such a case, it would

be possible to convey information by means of a reasonable number of binary choices. But in the meantime, the values of N and h would have decreased, and, as a result, so would the value of the information received.

Thus, the larger the amount of information, the more difficult its communication; the clearer the message, the smaller the amount of information.

For this reason Shannon and Weaver, in their book on information theory, consider information as directly proportional to entropy.¹² The role played by Shannon—one of the founders of the theory—in the research on this particular question has been particularly acknowledged by other scholars in the field.¹³ On the other hand, they all seem to insist on the distinction between information (here taken in its strictest statistical sense as the measure of a possibility) and the actual validity of a message (here taken as meaning). Warren Weaver makes this particularly clear in an essay aiming at a wider diffusion of the mathematics of information: "The word *information*, in this theory, is used in a special sense that must not be confused with its ordinary usage. In particular, *information* must not be confused with meaning . . . To be sure, this word information in communication theory relates not so much to what you do say, as to what you could say. That is, information is a measure of one's freedom of choice when one selects a message . . . Note that it is misleading (although often convenient) to say that one or the other message conveys unit information. The concept of information applies not to the individual messages (as the concept of meaning would), but rather to the situation as a whole . . . [A mathematical theory of communication] deals with a concept of information which characterizes the whole statistical nature of the information source, and is not concerned with the individual messages . . . The concept of information developed in this theory at first seems disappointing and bizarre—disappointing because it has nothing to do with meaning, and bizarre because it deals not with a single message but rather with the statistical character of a whole ensemble of messages, bizarre also because in these statistical terms the two words *information* and *uncertainty* find themselves to be partners."¹⁴

Thus, this long digression concerning information theory finally leads back to the issue at the heart of our study. But before going back to it, we should again wonder whether in fact certain concepts borrowed from information theory as tools of investigation can le-

gitimately be applied to questions of aesthetics—if only because it is now clear that “information” has a far wider meaning in *statistics* than in *communication*. Statistically speaking, I have information when I am made to confront all the probabilities at once, before the establishment of any order. From the point of view of communication, I have information when (1) I have been able to establish an order (that is, a code) as a system of probability within an original disorder; and when (2) within this new system, I introduce—through the elaboration of a message that violates the rules of the code—elements of disorder in dialectical tension with the order that supports them (the message challenges the code).

As we proceed with our study of poetic language and examine the use of a disorder aiming at communication, we will have to remember that this particular disorder can no longer be identified with the statistical concept of entropy except in a roundabout way: the disorder that aims at communication is a disorder only in relation to a previous order.

II

Poetic Discourse and Information

The example of Petrarch should have helped us understand that the originality of an aesthetic discourse involves to some extent a rupture with (or a departure from) the linguistic system of probability, which serves to convey established meanings, in order to increase the signifying potential of the message. This sort of information, characteristic of every aesthetic message, coincides with the basic openness of all works of art, as discussed in the previous chapter.

Let us now turn to contemporary art and the ways in which it deliberately and systematically tries to increase its range of meanings.

According to the laws of redundancy, the probability that the article “the” will be followed by a noun or an adjective is extremely high. Similarly, after the phrase “in the event” the probability that “that” will be the next word is fairly high, whereas the probability that “elephant” will be the next word is very low. At least, this is true for the type of English we commonly use. Weaver gives numerous examples of this kind and concludes by saying that, in everyday language, a sentence such as “Constantinople fishing

nasty pink" is quite improbable.¹⁵ And yet such a sentence could be a perfect example of automatic writing as it was practiced by the Surrealists.

Let us now look at a poem by Giuseppe Ungaretti, entitled "L'Isola" ("The Island").

A una proda ove sera era perenne
di anziane selve assortite, scese
e s'inoltrò
e lo richiamò rumore di penne
ch'erasi sciolto dallo stridulo
batticuore dell'acqua torrida . . .

On a shore where evening was for ever
Of woods enrapt and ancient, he descended,
And advanced
And the sound of wings recalled him,
Sound unfettered from the shrill
Heartbeat of the torrid water. . .¹⁶

There is no need to point out the various ways in which these few lines violate all linguistic probability, or to launch into a protracted critical analysis of the poem to show how, despite its lack of any conventional kind of meaning, it still conveys an immense amount of information about the island. At every new reading, this amount of information increases, endlessly expanding the message of the poem and opening up new and different perspectives, in perfect accordance with the intention of the poet who, while writing, was well aware of all the associations that an uncommon juxtaposition of words would provoke in the mind of the reader.

In other words, and to avoid overusing the technical terminology of information theory, what we most value in a message is not "information" but its aesthetic equivalent: its "poetic meaning," its "quotient of imagination," the "full resonance of the poetic word"—all those levels of signification that we distinguish from common meaning. From this point on if I use the term "information" to indicate the wealth of aesthetic meaning contained in a given message, it will be only to highlight those analogies that I deem most interesting.¹⁷

To avoid any possible ambiguity, I shall again emphasize that the equation "information = opposite of meaning" has absolutely no

axiological function, nor could it be used as a parameter of judgment. If it could, the nursery rhyme "Hey diddle diddle / The cat and the fiddle" would have greater aesthetic value than a poem by Petrarch, just as any Surrealist *cadavre exquis* (as well as any nasty pink from Constantinople) would have greater worth than a poem by Ungaretti. The concept of information is useful here only to clarify one of the directions of aesthetic discourse, which is then affected by other organizing factors. That is, all deviation from the most banal linguistic order entails a new kind of organization, *which can be considered as disorder in relation to the previous organization, and as order in relation to the parameters of the new discourse*. But whereas classical art violated the conventional order of language *within well-defined limits*, contemporary art constantly challenges the initial order by means of an extremely "improbable" form of organization. In other words, whereas classical art introduced original elements within a linguistic system whose basic laws it substantially respected, contemporary art often manifests its originality by imposing *a new linguistic system* with its own inner laws. In fact, one might say that rather than imposing a new system, contemporary art constantly oscillates between the rejection of the traditional linguistic system and its preservation—for if contemporary art imposed a totally new linguistic system, then its discourse would cease to be communicable. The dialectic between *form* and the *possibility* of multiple meanings, which constitutes the very essence of the "open work," takes place in this oscillation. The contemporary poet proposes a system which is no longer that of the language in which he expresses himself, yet that system is not a nonexistent language;¹⁸ he introduces forms of organized disorder into a system to increase its capacity to convey information.

It is clear that the signifying power of Petrarch's poem is as great as that of any contemporary poem: at each new reading it discloses something new, something previously unnoticed. But let us look at another lyric poem, a contemporary love poem, probably one of the most beautiful ever written, "Le front aux vitres," by Paul Eluard.

Le front aux vitres comme font les veilleurs de chagrin
Ciel dont j'ai dépassé la nuit

Plaines toutes petites dans mes mains ouvertes
Dans leur double horizon inerte indifférent
Le front aux vitres comme font les veilleurs de chagrin

Je te cherche par delà l'attente
Je te cherche par delà moi-même
Et je ne sais plus tant je t'aime
Lequel de nous deux est absent.

With brow against the windowpane like those who keep
sorrowful vigil
Sky whose night I've left behind
Plains so small in my open hands
In their double horizon inert indifferent
With brow against the windowpane like those who keep
sorrowful vigil

I seek you beyond the waiting
I seek you beyond myself
And I no longer know, so deeply do I love you,
Which of the two of us is absent.

The emotional situation expressed in this poem is fairly similar to that of "Chiare, fresche e dolci acque"; on the other hand, aside from the absolute aesthetic value of the two poems, their communication procedures are completely different. In Petrarch, the partial rupture of the order of the linguistic code introduces a new, unidirectional order which, along with its original organization of phonic, rhythmic, and syntactic elements, conveys a rather ordinary message that can be understood in only one way. In Eluard, on the contrary, it is obvious that the intention is precisely to draw as much poetic meaning as possible out of the very ambiguity of the message: the poet produces emotional tension by suggesting various gestures and emotions from which the reader can choose the ones that, by stimulating his own mental associations, best enable him to participate in the emotional situation evoked by the poem.

What all this means is that the contemporary poet constructs his or her poetic message with devices and according to procedures unlike those used by the medieval poet. Once again, the results are

not at issue here. To analyze a work of art in terms of the amount of information it conveys is not the same as evaluating its aesthetic success, but merely a way of clarifying some of the characteristics and resources of its ability to communicate.¹⁹

Musical Discourse

Let us now transpose all that has just been said onto a musical level: a classical sonata represents a system of probability that makes the succession and superposition of themes easily predictable. The tonal system institutes other rules of probability, whereby the pleasure and the attention of the listener are stimulated by his expectation of the inevitable resolutions of certain tonal progressions. In both cases, the composer can repeatedly break away from the established scheme of probability and introduce a potentially infinite number of variations into even the most elementary scale. The twelve-tone system is just another system of probability. Not so the more contemporary serial compositions, in which the musician chooses a constellation of sounds that can lend themselves to a variety of possible connections. Thus, he breaks away from the banal order of tonal probability and institutes a degree of disorder that, compared to the initial order, is quite high. By so doing, however, he also introduces new forms of organization which, being more open than the traditional one and therefore more charged with information, permit the development of new types of discourse and, as a result, new meanings. Here again, we are confronting a poetics which, aiming at a greater availability of information, makes of this availability its very method of construction. This, of course, has absolutely no effect on the aesthetic result: a thousand awkward constellations of sounds that have broken away from the tonal system may well provide less information and satisfaction than *Eine kleine Nachtmusik*. Nevertheless, it is important to remember that the main objective of this new music is the creation of new discursive structures that will remain open to all sorts of possible conclusions.

In a letter to Hildegard Jone, Webern writes: "I have discovered a series [that is to say, twelve sounds] that includes a number of internal connections, not unlike that old formula

S A T O R
 A R E P O
 T E N E T
 O P E R A
 R O T A S

which should be first read horizontally, then vertically, from top to bottom, and from bottom to top."²⁰ It is rather odd that, to give an idea of his constellation, Webern should have used the same formula used by information theorists to establish the statistical possibilities of two or more series of letters combining, each time yielding a different message. The model is, of course, that of the crossword puzzle, except that, for Webern, this technical stratagem is only *one* means by which a musical discourse can be organized, whereas for crossword puzzles such a combination is the only point of arrival.

A constellation is itself a kind of order; for although the poetics of openness seeks to make use of a dis-ordered source of possible messages, it tries to do this without renouncing the transmission of an organized message. The result is a continuous oscillation between the institutionalized system of probability and sheer disorder: in other words, *an original organization of disorder*. Weaver is well aware of this sort of oscillation, by which an increase in meaning involves loss of information, and vice versa: "One has the vague feeling that information and meaning may prove to be something like a pair of canonically conjugate variables in quantum theory, they being subject to some joint restriction that condemns a person to the sacrifice of the one as he insists on having much of the other."²¹

Information, Order, and Disorder

In his collection of essays titled *Information Theory and Esthetic Perception*, Abraham Moles has systematically applied information theory to music.²² He clearly accepts the notion that information is directly proportional to unpredictability and sharply distinct from meaning. What intrigues him most is the ambiguous message—that is, the message which is at once particularly rich in information and yet very difficult to decode. We have already encountered this

problem: the highest level of unpredictability depends on the highest level of disorder, where not only the most common meanings but every possible meaning remains essentially unorganizable. Obviously, this is the problem that confronts all music aiming at the absorption of every possible sound, the broadening of the available scale, and the intervention of chance in the process of composition. The dispute between the supporters of avant-garde music and its critics concerns precisely the greater or lesser comprehensibility of a sound event whose complexity transcends all the habits of the human ear and every system of probability.²³ Insofar as we are concerned, the problem still involves a dialectic between form and openness, between free multipolarity and permanence, which inevitably characterizes the system of possibilities of a work of art.

According to information theory, the most difficult message to communicate is the one that, relying on a wider range of sensibility on the part of the receiver, will avail itself of a larger channel, more likely to allow the passage of numerous elements without *filtering them*—that is, a channel capable of conveying a great deal of information but with the risk of limited intelligibility. When, in his *Philosophy of Composition*, Edgar Allan Poe defines a good poem as one that can be read at one sitting (so as not to ruin its intended effect with interruptions and postponements), he is in fact considering the reader's capacity to receive and assimilate poetic information. The question of the limits of a work of art, often broached by early aesthetics, is much less banal than it might seem, since it already reveals a certain concern with the interactive relationship between the human subject and an objective mass of stimuli organized into comprehensible effects. In Moles's study, this question, enriched by more recent discoveries in the fields of psychology and phenomenology, becomes the question of the "*difference threshold* in the perception of duration." Given a brief succession of melodic data reiterated at ever-increasing velocity, there soon will be a moment when the ear, having reached saturation, ceases to perceive distinct sounds and hears an undifferentiated sonic mixture. This measurable threshold represents an insurmountable limit, and is, in itself, further evidence of the fact that a disorder which is not specifically aimed at subjects accustomed to moving among systems of probability will not convey any information. This tendency toward disorder, characteristic of the poetics of openness, must be understood

as a tendency toward *controlled* disorder, toward a circumscribed *potential*, toward a freedom that is constantly curtailed by *the germ of formativity* present in any form that wants to remain open to the free choice of the addressee.

The distance between a plurality of formal worlds and undifferentiated chaos, totally devoid of all possibility of aesthetic pleasure, is minimal: only a dialectics of oscillation can save the composer of an open work.

A case in point is that of the composer of electronic music who, finding the unlimited realm of sounds and noises entirely at his disposal, can suddenly be quite overwhelmed by it: he wants to offer his listener the full and complex freedom of his compositions, but cannot help referring to the editing and mixing of his material, and using abscissas to channel basic disorder into matrices of oriented potential. In the end, as Moles points out, there is no real difference between *noise* and *signal*, except in intent. Similarly, in electronic music, the difference between *noise* and *sound* is resolved by the voluntary act of the creator, who *offers* his audience a medley of sounds *to interpret*. But if he aims at both maximum disorder and maximum information, he will have to sacrifice some of his freedom and introduce a few modules of order into his work, which will help his listeners find their way through noise that they will automatically interpret as a signal because they know it has been chosen and, to some extent, organized.²⁴

Like Weaver, Moles believes he can recognize a system of indeterminacy whereby information decreases as intelligibility increases. But he goes further: considering indeterminacy as a constant in the natural world, he expresses it with a formula that reminds him of the one used to express uncertainty in quantum physics. For if the methodology and logic of indeterminacy, borrowed from scientific disciplines, are cultural phenomena that may affect the formulation of poetics without being able to explain it, this second kind of indeterminacy, based on the correlation between freedom and intelligibility, can no longer be considered as a more or less distant influence of science on art, but should rather be seen as the specific condition of a productive dialectics—or, to use Apollinaire's expression, the constant struggle "de l'ordre et de l'aventure," the only condition by which a poetics of openness can also be a poetics of art.

Postscript

All these points need further clarification. It would indeed be possible to show that the mathematical concept of information cannot be applied to the poetic message, or to any other message, because information (qua entropy and coexistence of *all* possibilities) is a characteristic of the *source* of messages: the moment this initial equiprobability is filtered, there is selection and therefore order, and therefore meaning.

This objection is perfectly correct if we consider information theory only as a complex of mathematical rules used to measure the transmission of bits from a source to a receiver. But the moment the transmission concerns information among human beings, information theory becomes a *theory of communication*, and we need to establish whether concepts borrowed from a technique used to quantify information (that is, a technique concerned with the physical exchange of signals considered independently from the meanings they convey) can be applied to human communication.

A source of information is always a locus of high entropy and absolute availability. The transmission of a message implies the selection of some information and its organization into a signifying complex. At this point, if the receiver of the information is a machine (programmed to translate the signals it receives into messages that can be rigorously referred back to a particular code, according to which every signal signifies one and only one thing), either the message has a univocal meaning or it is automatically identified with noise.

Things are, of course, quite different in a transmission of messages between people, where every given signal, far from referring univocally to a precise code, is charged with connotations that make it resound like an echo chamber. In this case, a simple referential code according to which every given signifier corresponds to a particular signified is no longer sufficient. Far from it, for, as we have already seen, the author of a message with aesthetic aspirations will intentionally structure it in as ambiguous a fashion as possible precisely in order to violate that system of laws and determinations which makes up the code. We then confront a message that deliberately violates or, at least, questions the very system, the very order—*order as system of probability*—to which it refers. In other

words, the ambiguity of the aesthetic message is the result of the deliberate "dis-ordering" of the code, that is, of the order that, via selection and association, had been imposed on the entropic disorder characteristic of all sources of information. Consequently, the receiver of such a message, unlike its mechanical counterpart that has been programmed to transform a sequence of signals into messages, can no longer be considered as the final stage of a process of communication. Rather, he should be seen as the first step of a new chain of communication, since the message he has received is in itself another *source of possible information*, albeit a source of information that is yet to be filtered, interpreted, out of an initial disorder—not absolute disorder but nonetheless *disorder in relation to the order that has preceded it*. As a new source of information, the aesthetic message possesses all the characteristics proper to the *source* of a normal informative chain.

Of course, all this quite expands the general notion of information; but the important thing here is less the analogy between two different situations than the fact that they share the same procedural structure. A message, at the outset, is a disorder whose latent meanings must be filtered before they can be organized into a new message—that is, before they can become not a work to be interpreted but an interpreted work (for example, *Hamlet* is a source of possible interpretations whereas Ernest Jones's reading of *Hamlet*, or T. S. Eliot's for that matter, is an interpreted message that has condensed a disordered quantity of information into an arrangement of selected meanings).

Obviously, neither this filtered information nor the informative capacity of the source-message can be precisely quantified. And this is where and why information theory becomes a theory of communication: it preserves a basic categorial scheme but it loses its algorithmic system. In other words, information theory provides us with only one scheme of possible relations (order-disorder, information-signification, binary disjunction, and so on) that can be inserted into a larger context, and is valid, in its specific ambit, only as the quantitative measurement of the number of signals that can be clearly transmitted along one channel. Once the signals are received by a human being, information theory has nothing else to add and gives way to either semiology or semantics, since the question henceforth becomes one of signification—the kind of signifi-

cation that is the subject of semantics and that is quite different from the banal signification that is the subject of information. On the other hand, it is precisely the existence of open works (that is to say, of the openness proper to works of art, the existence of messages which manifest themselves as sources of possible interpretations) that requires an extension of the notion of information.

It would be fairly simple to show that information theory was not conceived to explain the nature of the poetic message and that, therefore, it is not applicable to processes involving both the denotative and connotative aspects of language—so simple that everybody would immediately agree with the proposition. On the other hand, it is precisely because information theory *cannot* and *should not* be applied to aesthetic phenomena that numerous scholars have tried to apply it to the field of aesthetics; likewise, it is precisely because information theory is not applicable to processes of signification that some have tried to use it to explain linguistic phenomena. Indeed, it is precisely because in their original usage the concepts pertaining to information theory have nothing to do with a work of art that, in this essay, I have tried to determine to what extent they can be applied to it. Of course, if they had been applicable to begin with, there would be no point in trying to find out whether they could be applied or not. On the other hand, the only reason I want to find out is that I think that, in the end, a work of art can be analyzed like any other form of communication. In other words, I believe that, ultimately, the mechanism that underlies a work of art (and this is what needs to be verified) *must* reveal the same behavior that characterizes the mechanisms of communication, including those types of behavior that involve the mere transmission, along one channel, of signals devoid of all connotative meaning, which can be received by a machine as instructions for a sequence of operations based on a preordained code capable of establishing a univocal correspondence between a given signal and a given mechanical or electronic behavior.

On the other hand, the objection would be insuperable if the following points were not now clear:

1. The application to aesthetics of concepts borrowed from information theory has not generated the idea of the open, polyvalent, ambiguous work of art. Rather, it is the ambiguity and polyvalence of every work of art that has induced some scholars to

consider informational categories as particularly apt to explain the phenomenon.

2. The application of informational categories to phenomena of communication has by now been endorsed by a number of scholars, from Jakobson, who applied the idea of *integrated parallelism* to linguistic phenomena, to Piaget and his followers, who have applied the concepts of information theory to perception, all the way to Lévi-Strauss, Lacan, the Russian semiologists, Max Bense, advocates of the Brazilian new criticism, and so on. Such a fertile interdisciplinary and international consensus cannot be seen as a mere fad or a daring extrapolation. What we are confronting here is a categorial apparatus that may provide the key to several doors.

3. On the other hand, even if we were confronting mere analogical procedures or uncontrolled extrapolations, we would have to admit that knowledge often progresses thanks to an imagination that explores hypotheses and dares to take uncertain shortcuts. Too much rigor and an excess of honest caution can often deter one from venturing along paths that could well be dangerous but that could also lead to a plateau whence an entire new landscape would open up, with roads and highways that might have escaped a first, cursory topographic inspection.

4. The categorial apparatus of information theory appears methodologically fruitful only when inserted in the context of a *general semiotics* (although researchers are only now beginning to realize this). Before rejecting informational notions, one must verify them in the light of a semiotic rereading.

Such a semiotic endeavor could not, of course, be encompassed in this essay. The objections I have tried to answer in this postscript were for the most part raised by Emilio Garroni, author of one of the few exhaustive and scientifically sound critiques of *Opera aperta*.²⁵ And I do not pretend to have satisfactorily answered all his objections here. These comments are intended, in fact, to supply this essay, which still maintains its original structure despite numerous revisions, with a few answers to possible future objections. They are also designed to show how some of these answers were already implicit in the original argument, even though I did not make them explicit until stimulated by Garroni's observations. It is thanks to these observations that I have been motivated to explore this issue further.

III

Information and Psychological Transaction

I hope that this discussion has demonstrated how a mathematical study of information can provide the tools necessary for elucidating and analyzing aesthetic structures, and how it reflects a penchant for the "probable" and the "possible" that mathematics shares with the arts.

On the other hand, information theory evaluates quantity and not quality. The quantity of information concerns only the statistical probability of events, whereas its value can be measured only in terms of the interest we bring to it.²⁶ The quality of information is related to its value. To determine the value an unforeseeable situation may have for us (unforeseeable but verifiable, whether it be a weather forecast or a poem by Petrarch or Eluard), and the nature of its singularity, *we must consider both the structural fact in itself and the attention we have brought it*. At this point, questions of information become *questions of communication*, and our attention must shift from the message itself, qua objective system of possible information, to the relationship between message and receiver—a relationship in which the receiver's interpretation constitutes the effective value of the information.

The statistical analysis of the informative possibilities of a signal is, in fact, a *syntactic* analysis, in which the *semantic* and *pragmatic* dimensions play only a secondary role, the former to define in what cases and under which circumstances a given message may provide more information than another, and the latter to suggest what kind of behavior this information might entail.

But although the transmission of signs conceived according to a rigorous code, based on conventional values, can be explained without having to depend on the interpretive intervention of the receiver, the transmission of a sequence of signals with little redundancy and a high ratio of improbability demands that we take into consideration both the attitudes and the mental structures by which the receiver, of his own free will, selects a message and endows it with a probability that is certainly already there but only as one probability among many.

This, in turn, means that it may be necessary to add a psychological point of view to the structural analysis of certain communica-

tion phenomena—an operation that may seem to contradict the antipsychological tendency of the various formalist methodologies that have been applied to the study of language (from those of Husserl to those of the Russian Formalists). On the other hand, how could one examine the signifying possibilities of a given message without taking the receiver of the message into account? To consider the psychological aspect of the phenomenon merely means that we recognize that the message cannot have any meaning, at least formally speaking, unless it is interpreted in relation to a *particular situation* (a psychological situation that is also, by extension, historical, social, anthropological, etc.).²⁷

It is therefore necessary to consider the transactional rapport that is established, at both an intellectual and a perceptual level, between certain stimuli and the world of the receiver—a *transactional rapport* that constitutes the very processes of perception and reasoning. In the case at hand, this kind of analysis is more than a methodologically necessary stage: it confirms everything I have said up to now concerning the possibility of an “open” *appreciation* of a work of art. In fact, a basic theme of the most recent currents in psychology is that of the fundamental openness of every perceptual and intellectual process.

These perspectives are founded on a critique of Gestalt psychology, which maintains that perception is the apprehension of a configuration of stimuli, that is, of stimuli that already possess an objective organization—recognition more than apprehension, thanks to the fundamental isomorphism between the structures of the object and the psychophysical structures of the perceiving subject.²⁸

Later, post-Gestalt schools have reacted against the metaphysical burdens of this psychological theory, and have described the cognitive experience as an experience that occurs in stages, as a process that, far from exhausting the possibilities of the object, highlights those aspects of it that lend themselves to an interaction with the dispositions of the subject.²⁹

American transactional psychology, an outgrowth of Dewey's naturalism (and other French currents, of which more later), maintains that although perception is not the reception of physical stimuli, as described by classical associationism, it nevertheless represents a relationship in which my memories, my unconscious persuasions, and the culture I have assimilated (in other words, my

acquired experience) fuse with exterior stimuli to endow them with the *form* and the *value* they assume in my eyes according to the aims I am pursuing. To say that "there is value in every experience" means, to a certain extent, that in the realization of a perceptual experience there is always an artistic component, an "action with creative intentions." As R. S. Lillie once said, "The psychical is foreseeing and integrative in its essential nature; it tends to finish or round off an uncompleted experience. To recognize this property as having its special importance in the living organism is not to ignore or undervalue the stable physical conditions which also form an indispensable part of the vital organization. In the psychophysical system which is the organism, factors of both kinds are to be regarded as equally important and as always supplementing one another in the total activity of the system."³⁰ Or, as we might say in words less fraught with biological and naturalistic connotations: "As human beings we can sense only those 'togethernesses' that have significance to us as human beings. There are infinities of other togethernesses that we can know nothing about. It will be generally agreed that it is impossible for us to experience all possible elements in any situation, let alone all the possible interrelationships of all the elements." This is why, time after time, we end up relying on our experience as the formative agent of perception: "Apparently the organism, always forced to 'choose' among the unlimited number of possibilities which can be related to a given retinal pattern, calls upon its previous experiences and 'assumes' that what has been most probable in the past is most probable in the immediate occasion . . . In other words, what we see is apparently a function of some sort of weighted average of our past experiences. It seems that we relate to a stimulus pattern a complex, probability-like integration of our past experience with such patterns. Were it not for such integrations, which have been labeled assumptions, the particular perceptual phenomenon would not occur. It follows from this that the resulting perceptions are not absolute revelations of 'what is out there' but are in the nature of probabilities or predictions based on past experience."³¹

In a different context, Piaget also devoted a great deal of attention to the probabilistic nature of perception. In contrast to Gestalt theoreticians, he viewed the structure of a sensorial datum as the

product of an equilibration depending on both innate factors and external factors that constantly interfere with one another.³²

Piaget's notion of the "open," dynamic nature of the cognitive process is even more exhaustively treated in his analysis of intelligence.³³

Intelligence tends to compose "reversible" structures whose balance, arrest, and homeostasis are only the terminal stage of the operation, indispensable to its practical effectiveness. In itself, intelligence reveals all the characteristics of what I have defined as an "open" process. The subject, guided by experience, proceeds by hypotheses and trial-and-error to find not the preconceived, static forms of Gestalt theoreticians but reversible, mutable structures that allow him, after he has linked two elements in a relationship, to pull them apart again and go back to where he started. As an example, Piaget cites the relationship $A + A' = B$, which can also be expressed as $A = B - A'$, or $A' = B - A$, or even $B - A = A'$, and so on. This set of relationships does not constitute a univocal process, such as the one found in perception, but rather an operational possibility that allows for various reversals (not unlike those occurring in a twelve-tone musical series that lends itself to a variety of manipulations).

As Piaget reminds us, in its last stage, the perception of forms involves a number of recenterings and modifications that enable us to see the ambiguous outlines of psychology textbooks in different ways. But a system of reasoning involves more than a "recentering" (*Umzentrierung*); it involves a general decentering that permits something like the dissolution, the liquefaction, of static perceptual forms, thus facilitating operational mobility—and thus creating infinite possibilities for new structures. Though it lacks the reversibility characteristic of intellectual operations, the perceptual process does involve certain regulations, partly influenced by the contributions of experience, which already "sketch and prefigure the mechanisms of composition that will become operational once total reversibility is possible."³⁴ In other words, if at the level of intelligence there is an elaboration of variable and mobile structures, at the level of perception there are a number of uncertain, probabilistic processes that help turn perception itself into a process open to a number of possible solutions (and this despite the percep-

tual constants that our experience does not allow us to question). Both cases involve constructive activity on the part of the subject.³⁵

Having thus established that knowledge is at once a process and an "openness," we can now pursue our discussion along two lines of thought that correspond to a distinction I have already proposed.

1. Psychologically speaking, the aesthetic pleasure evoked by *any* work of art depends on the same mechanisms of integration characteristic of all cognitive processes. This kind of activity, fundamental to the aesthetic appreciation of any form, is what, elsewhere, I have already defined as *openness of the first degree*.

2. Contemporary poetics places greater emphasis on these particular mechanisms, while situating aesthetic pleasure less in the final recognition of a form than in the apprehension of the continuously open process that allows one to discover ever-changing *profiles* and possibilities in a single form. This may be termed *openness of the second degree*.

Following these two directions, one realizes that only transactional psychology (more interested in the genesis of forms than in their objective structure) can allow us to fully understand this second, and more complete, sense of "openness."

Transaction and Openness

Let us first examine how art in general depends on deliberately provoking incomplete experiences—that is, how art deliberately frustrates our expectations in order to arouse our natural craving for completion.

Leonard Meyer has provided us with a satisfactory analysis of this psychological mechanism in his book *Emotion and Meaning in Music*,³⁶ where he uses Gestalt premises to build an argument concerning the reciprocal relationship between objective musical structures and our patterns of reaction—that is, how a message conveys a certain amount of information which, however, acquires its value only in relation to the receiver's response and only then organizes itself into a *meaning*.

According to Wertheimer, a thought process can be described as follows: given a situation S_1 , and a situation S_2 which represents the solution of S_1 (its terminus *ad quem*), what we call "process" is the

transition from the first situation to the second—a transition during which S_1 , structurally incomplete and ambiguous, gradually finds a definition and a solution as S_2 . Meyer applies this same definition to his analysis of musical discourse: a stimulus catches the attention of the listener as incomplete and ambiguous, leading him to expect a resolution, a clarification, which arouses his emotions because it is delayed. In other words, the listener's need for an answer is momentarily frustrated or inhibited, and he finds himself in a state of crisis. If his expectations, his need, were satisfied immediately, there would be no crisis and no emotion. This game of postponement and emotional reaction is what provides musical discourse with a meaning. Whereas in daily life numerous critical situations are never resolved and end up disappearing as accidentally as they appeared, in music, the frustration of an expectation becomes meaningful for the very reason that it makes the relationship between expectation and resolution explicit before bringing it to a conclusion. But it is precisely because it eventually arrives at a conclusion that the cycle *stimulus-crisis-expectation-satisfaction-reestablishment of an order* acquires a meaning. "In music, the very stimulus, music itself, provokes expectations, inhibits them, and then provides them with meaningful solutions."³⁷

How is an expectation created? What does a crisis consist of? What kinds of solutions can satisfy the listener? For Meyer, all these questions can be answered by Gestalt theory. The psychological dialectics of expectation and satisfaction is, in fact, determined by formal laws: laws of pregnancy, of the *good curve*, of proximity, of equality, and so on. The listener expects that the process will reach its conclusion according to a certain symmetry, and that it will organize itself in the best possible way, in harmony with the psychological models that Gestalt theory has discerned in both our psychological structures and external objects. Since the emotional response is provoked by a blockage of the regular process, the listener's dependence on the right form and his memory of previous formal experiences intervene to create *expectations*—predictions of a solution, formal prefigurations through which the inhibited tendency will find satisfaction. While there is inhibition, there is also the pleasure of expectation, a feeling of impotence in front of the unknown; and the more unexpected the solution, the greater the pleasure when it occurs. So if it takes a crisis to provoke pleasure,

then it is obvious, as Meyer points out, that the laws of form pre-empt musical discourse only on condition that they be constantly violated during its development. The solutions the listener expects are not the most obvious but rather the least common, a transgression of the rules that will enhance his appreciation of and the pleasure in the final return to legality. According to Gestalt theory, the "right" form is the one that natural data assume by necessity the moment they organize in unitary complexes. Does musical form also manifest the same tendency toward an original stability?

At this point, Meyer tempers his Gestaltism and admits that the notion of *optimal organization*, in music, can refer only to a *cultural datum*. This means that music is not a universal language, and that our tendency to prefer certain solutions to others is the result of our apprenticeship within the context of a musical culture that has been historically defined. Sounds that a particular musical culture considers unexpected may well be, in a different culture, so legitimate as to be banal. The perception of a totality is neither immediate nor passive: it is an act of organization that has to be learned within a sociocultural context. The laws of perception are not natural and innate; rather, they are the reflection of *cultural patterns*, or, as a transactional psychologist would say, they are *acquired forms*, a system of preferences and habits, convictions and emotions, fostered in us by the natural, social, and historical context we inhabit.³⁸

As an example, Meyer proposes the complex of stimuli constituted by the letters TRLTSEE. There are various, formally satisfactory ways of grouping these letters. TT/RLS/EE, for instance, for the sake of symmetry and to respect the most elementary laws of contiguity. Of course, an English reader might prefer the combination LETTERS as more meaningful and, therefore, "right" from every standpoint. In this particular case, the letters have been organized according to an acquired experience, a particular linguistic system. The same thing happens with a complex of musical stimuli: the dialectics of crises, expectations, predictions, and satisfactory solutions obeys the laws of a particular cultural and historical context. The auditory culture of the Western world was, at least until the beginning of the twentieth century, tonal. Therefore, it is within the framework of a tonal culture that certain crises can be

crises and certain solutions can be solutions; of course, things would be quite different with primitive or oriental music.

On the other hand, Meyer implicitly relies on a Gestalt tradition even when he analyzes different musical cultures to locate different modes of organization: every musical culture establishes its own syntax which, in turn, directs the listener according to specific modes of reaction. Every kind of discourse has its own laws, which are also the laws of its form, the very same laws on which the dynamics of crises and solutions depends. The average listener tends to find a solution to crisis in rest, to disturbance in peace, to deviation in the return to a polarity defined by the musical habits of a civilization. The crisis is valid only in relation to its solution. The listener aspires to a solution and not to a crisis for the sake of crisis alone. If Meyer has borrowed all his examples from classical music, it is because his argument is, in essence, quite conservative: what he offers us is a psychological and structural interpretation of *tonal* music.

This point of view remains fundamentally unchanged even when Meyer, in his later work, shifts from a psychological approach to information theory. According to him, the introduction of uncertainty or ambiguity into a probabilistic sequence, such as a musical discourse, will automatically provoke an emotion. A style is a *system of probability*, and the awareness of probability is latent in the listener, who can therefore afford to make predictions concerning the consequences of a given antecedent. To attribute an aesthetic meaning to a musical discourse amounts to rendering the uncertainty explicit and experiencing it as highly desirable. Meyer maintains that "musical meaning arises when an antecedent situation, requiring an estimate as to the probable modes of pattern continuation, produces uncertainty as to the temporal-tonal nature of the expected consequent . . . [The] greater the uncertainty, [the] greater the information . . . A system which produces a sequence of symbols . . . according to certain probabilities is called a *stochastic process*, and the special case of a stochastic process in which the probabilities depend on the previous events, is called a *Markoff process* or a *Markoff chain*."³⁹ If music is a system of tonal attractions, in which the existence of a musical event imposes a certain probability on the occurrence of a subsequent event, then the event that responds to the natural expectations of an ear will pass unnoticed

and, as a result, the uncertainty and the emotion—and, of course, the information—it entails will be minor. Since, in a Markoff chain, the uncertainty decreases as the distance from the starting point increases, in order to heighten the meaning (read: information) of the musical discourse the composer will have to introduce some uncertainty at every step. This is the sort of suspense used to break the tedium of probability in most tonal processes. Music, like most languages, contains a certain amount of redundancy that the composer tries to remove so as to increase the interest of his listeners.

Having reached this point, however, Meyer goes back to reconsider the persistence of acquired experience and reminds his readers that there are two sorts of noise in musical discourse: *acoustical noise* and *cultural noise*. The latter type is determined by the difference between our habitual reactions (that is, our assumptions) and those required by a particular musical style. According to Meyer, contemporary music, overly intent on eliminating all redundancy, is nothing more than a kind of noise that prevents the listener from understanding the meaning of a musical discourse.⁴⁰

In other words, he sees the oscillation between informative disorder and total unintelligibility, which had already concerned Moles, not as a problem to be solved but as a danger to be avoided. With this distinction between desirable and undesirable uncertainty, Meyer—though he is well aware of the historicity and the capacity for evolution of every system of acquired forms—eliminates the possibility of a real evolution of musical sensibility. For him, musical language is a system of probabilities in which improbability can be introduced only with caution. At which point we may well fear that the repertory of possible uncertainties will eventually become so normal as to enter the realm of recognized probabilities, until what once was pure information becomes sheer redundancy. This is very clearly what has happened in certain fields of popular music, where it would be vain to look for the slightest surprise or emotion: a piece by Liberace is as predictable as a Hallmark birthday card, concocted according to the most banal of laws and totally devoid of any additional information.

Every human being lives within a determinate *cultural pattern* and interprets his or her experience according to a set of acquired forms. The stability of this world is what allows us to move ratio-

nally amid the constant provocations of the environment and to organize external events into a coherent ensemble of organic experiences. The safeguarding of our assumptions against all incoherent mutations is one of the basic conditions of our existence as rational beings. But there is a difference between the preservation of a system of assumptions as an organic whole and the refusal of all possible change, since another condition of our survival as thinking beings is precisely our capacity to let our intelligence and our sensibility evolve by integrating new experiences into our system of assumptions. Our world of acquired forms must maintain its organic structure in the sense that it must evolve harmoniously, without shocks and undue deformations; but *evolve it must*, and in order to evolve it must undergo certain modifications. After all, what most distinguishes Western man from those who live in "primitive" societies is precisely the dynamic, progressive nature of his cultural patterns. What makes a society "primitive" is its inability to let its cultural patterns evolve, its unwillingness to interpret and exploit the original assumptions of its culture, which thus persist as empty formulas, rites, taboos. We have very few reasons to consider the cultural pattern of the West as universally superior, but one of these reasons is its plasticity, its flexibility, its capacity to respond to circumstantial challenges by constantly interpreting new experiences and elaborating new ways to adjust to them (more or less rapidly, depending on the sensibility of the individual or of the collectivity).

Art, in all its forms, has also evolved in a similar fashion, within a "tradition" that may seem immutable but which, in fact, has never ceased to introduce new forms and new dogmas through innumerable revolutions. Every real artist constantly violates the laws of the system within which he works, in order to create new formal possibilities and stimulate aesthetic desire: when Brahms's works were first performed, the expectations aroused by one of his symphonies in a listener accustomed to Beethoven were certainly very different, both in quality and range, from the expectations aroused by a Beethoven piece in a listener accustomed to Haydn. And yet, theorists of contemporary music (and with them, those of contemporary art in general) reproach classical tradition for the fact that all its formal innovations, and the kind of expectations they entailed, would no sooner be introduced than they would become new systems of assumptions aiming at the completion and final

satisfaction of expectation, thereby encouraging what Henri Pousseur calls *psychic inertia*. Most classical compositions were determined by the polarity characteristic of the tonal system, except for a few brief moments of crisis whose function was to comply with the listener's inertia by leading it back to the original pole of attraction. According to Pousseur, even the introduction of a new tonality into the development of a particular piece required a device able to overcome this inertia: what is known as *modulation*. But even modulation violates the hierarchy of the system only so as to introduce a new pole of attraction, a new tonality, a new system of inertia.

There were reasons for all this: both the formal and the psychological requirements of art were a reflection of the religious, political, and cultural demands of a society based on a hierarchical order, on the notion of absolute authority, on the presumption of an immutable, univocal truth, crucial to social organization and celebrated by different forms of art.⁴¹

The experiences of contemporary poetics (whether concerning music or other art forms) show how much the situation has changed.

In its search for an "openness of the second degree," in its reliance on ambiguity and information as essential values of a work of art, contemporary poetics rebels against the *psychic inertia* that has been hiding behind the promise of a *recovered order*.

Today, the emphasis is on the process, on the possibility of identifying individual orders. The kind of expectation aroused by a message with an open structure is less a *prediction of the expected* than an *expectation of the unpredictable*. The value of an aesthetic experience is determined today not by the way a crisis is resolved but rather by the way in which, after propelling us into a sequence of known crises determined by improbability, it forces us to make a choice. Confronted by disorder, we are then free to establish temporary, hypothetical systems of probability that are complementary to other systems that we could also, eventually or simultaneously, assume. By so doing, we can enjoy both the equiprobability of all the systems and the openness of the process as a whole.

As I have already mentioned, only a psychology concerned with

the genesis of structures can justify this tendency of contemporary art. And indeed, today's psychology seems to pursue its explorations in precisely the same directions taken by the poetics of the open work.

Information and Perception

Information theory has contributed greatly to opening new perspectives for psychological research. In his study of perception as a *deformation* of the object (meaning that the object varies according to the position of the perceiver), the psychologist Ombredane, along with others I have already mentioned,⁴² has come to the conclusion that this process of exploration eventually ends when the perceiver chooses one particular form (which, from that moment on, imposes itself on all the others). But Ombredane refuses to give a Gestaltist answer to the question "Where do such forms come from?" Instead, he prefers to examine the genesis of this structural phenomenon in the light of experience.

"If we compare different points of view . . . then we realize that one of the fundamental characteristics of perception is that perception is the result of a process of *fluctuation* that involves a continuous exchange between the disposition of the subject and all the possible configurations of the object—configurations that are more or less stable within a more or less *isolated* spatiotemporal system characteristic of that particular *behavioral episode* . . . Perception can be expressed in terms of probability, like those used in thermodynamics or in information theory." Consequently, the percept is none other than the temporary stabilization of a sensible configuration resulting from the more or less redundant organization of useful information that the receiver has selected from a field of stimuli during the perceptual process. The same field of stimuli can yield an indeterminate number of more or less redundant patterns; what Gestaltists call the "right form" is such a pattern, the one that "requires the least information and the most redundancy." Consequently, the "right form" corresponds to the "maximal state of probability of a fluctuating perceptual whole." At this point we realize that, in terms of statistical probability, the "right form" loses all its ontological connotations, thus ceasing to be the prefixed

structure of all perceptual processes, the definitive code of perception.

The undetermined field of stimuli that can yield various forms of redundant organization is not the opposite of the "right form," just as a nonperceivable, amorphous whole is not the opposite of the percept. The subject chooses the most redundant form out of a particular field of stimuli when he has reasons to do so, but he can disregard the "right form" in favor of other patterns of coordination that have remained in the background.

According to Ombredane, it should be possible to characterize different ways of exploring the field of stimuli from both an operational and a typological standpoint: "There are those who cut their exploration short and opt for a particular structure before having a chance to use all the information they could have gathered; there are those who prolong their exploration and refuse to adopt any structure; and then there are those who reconcile the two attitudes and try to be aware of several possible structures before they integrate them into a progressively constructed unitary percept. There are also those who slide from one structure to the next without being aware of the incompatibilities between them. This is what happens in people suffering from hallucinations. If perception is a form of 'commitment,' there are different ways in which one can commit oneself, or refuse to commit oneself, to seeking useful information."

This brief typological survey ranges all the way from the pathological to the everyday, and allows for a large number of perceptive possibilities which it entirely justifies. There is no need to stress the value that these psychological hypotheses can have for a discussion of art. All one needs to add is that, given such premises, psychologists will have to explain how and to what extent an apprenticeship based on unusual perceptual exercises and intellectual operations might modify the usual schemes of reaction. (Which is to say: Will the use of information theory prevent the violations of codes and systems of expectation from turning into the key elements of a new code, of a new system of expectations?) Aesthetics, art history, and the phenomenology of taste have confronted, if not quite solved, this problem for centuries, at a macroscopic level. How often have new creative modes changed the meaning of form, people's aes-

thetic expectations, and the very way in which humans perceive reality?⁴³

The poetics of the open work is an expression of such a historical possibility: here is a culture that, confronting the universe of perceivable forms and interpretive operations, allows for the complementarity of different studies and different solutions; here is a culture that upholds the value of discontinuity against that of a more conventional continuity; here is a culture that allows for different methods of research not because they may come up with identical results but because they contradict and complement each other in a dialectic opposition that will generate new perspectives and a greater quantity of information.

After all, the crisis of contemporary bourgeois civilization is partly due to the fact that the average man has been unable to elude the systems of assumptions that are imposed on him from the outside, and to the fact that he has not formed himself through a direct exploration of reality. Well-known social illnesses such as conformism, unidirectionism, gregariousness, and mass thinking result from a passive acquisition of those standards of understanding and judgment that are often identified with the "right form" in ethics as well as in politics, in nutrition as well as in fashion, in matters of taste as well as in pedagogical questions.

At which point, we may well wonder whether contemporary art, by accustoming us to continual violations of patterns and schemes—indeed, alleging as a pattern and a scheme the very perishability of all patterns and all schemes, and the need to change them not only from one work to the next but within the same work—isn't in fact fulfilling a precise pedagogical function, a liberating role. If this were the case, then its discourse would go well beyond questions of taste and aesthetic structures to inscribe itself into a much larger context: it would come to represent modern man's path to salvation, toward the reconquest of his lost autonomy at the level of both perception and intelligence.