

RECENT DEFINITIONS
OF LANGUAGE

I.

Definitions are often viewed with a skeptical eye. The most diverse definitions are successfully applied to a given subject; their discrepancies are noted, and conclusions are drawn concerning the vanity of quibbling over words. In the best of cases the writer, before beginning his own exposition, proposes the definition which he will follow exclusively, convinced that all terminologies are valid so long as they are explicit and respected.¹

This methodological hygiene is not without merit for discussions among specialists within a previously delimited field, sufficiently described. But, if we consider a series of definitions covering several centuries—those of language, for example—we see that we are not precisely concerned with a history whose possible meaning may be sought. In addition, contemporary logic has familiarized us with the idea that the

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1. See the opinions of Saussure, Meillet, Vendryès, and Hjelmslev in J. Marouzeau, *Lexique de la terminologie linguistique* (Paris: Geuthner, 1951), p. ix.

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search for a definition is more than just an urgent academic need. A correct definition, adequate to all that is known on a subject, is both a working tool and a checking device, enabling us to describe better, to classify better, to elaborate better-founded criteria, to delimit our field of study less arbitrarily—in short, to organize our knowledge of things in a way that is more faithful to the nature of things.

II.

Without sketching out a history of the definitions of language, let us take the eighteenth century as an illustrative point of departure.² The *Encyclopédie* criticized the definition of Frain du Tremblay, who criticized that of Furetière's *Dictionnaire* (1704): "Language (*langage*), sequence of words on which each people is agreed; language (*langue*) in use in a Nation to explain to one another what each person thinks." For Du Tremblay it is "a sequence or mass of certain articulated sounds capable of being joined together, which a people uses to signify things and to communicate its thoughts, but which are in themselves indifferent in signifying one thing rather than another." In 1755 the *Encyclopédie* proposes: "A language is the total body of usages proper to a nation to express thoughts by means of the voice."

On the one hand, these definitions mark, unequally, the level the age had reached in its reflection on languages. Furetière is aware of two problems still quite alive: that of modes of speech (*langage*) other than (written) languages (*langues*); "Language," he notes, "is also used figuratively . . . of mute signs; of cries or inarticulate sounds which serve to make known various things") and that of animal communication ("Animals also have their speech [*langage*]," he adds, with some reservation). Du Tremblay attempts to characterize language by its articulated sounds,³ by their property of "being joined together," and he has a clear intuition, unusual for the time, of the arbitrary nature of the signs; the *Encyclopédie* already contrasts language (speech) to all means of expressing thoughts otherwise than *through the voice*. But, on the other hand, we also feel the weight of the ideology of the time on this last definition. When he defines language as the total *body of*

2. The *Dictionnaire de l'Académie Française* (1694) said merely: "LANGAGE: Idiome, Langue que parle une nation. LANGUE: Idiome, termes et façons de parler dont se sert une nation."

3. So does Furetière, who contrasted this characteristic to inarticulate animal cries.

usages, the author is expressing the normative conception of the grammarians of his day. Very explicitly, the whole article establishes the fact that if, “like the Romans long ago and the French today, the nation is one in relation to the government, there can be in the manner of speaking only one legitimate usage”; this differs from the situation in ancient Greece, Germany, and Italy which, divided into governments equal in prestige, have a right to dialects equal in legitimacy. Everything outside this is patois.⁴

III.

A new sounding taken at the beginning of the twentieth century brings up a set of definitions very different from the preceding ones and almost all similar to each other. For Saussure (1916) “a language is . . . a system of distinct signs corresponding to distinct ideas.” For Lalande, in the *Vocabulaire technique et critique de la philosophie* (1926), it is “in the broadest sense, any system of signs capable of serving as a means of communication.” For the *Encyclopaedia Britannica* (article by Jespersen) it is “any means at all of communication between living beings.” For Marouzeau, whose *Lexique de la terminologie linguistique* (1953) registers current usage, it is “any system of signs apt to serve as a means of communication between individuals.”

All these definitions show concretely the progress made in a century of comparative linguistics opening the way to general linguistics, a progress which in every statement except one may be summed up by the presence of the word “system.”⁵

This formulation, in which every writer follows his predecessor almost without modifications from 1916 to 1953, would seem to be evidence of established agreement. The fact is that at any given date it serves to raise as many problems as it solves.

4. What the *Encyclopédie* criticizes Du Tremblay for is this expression, “a mass of words,” which places all usages on the same level. D’Alembert, in the “Discours préliminaire” to the *Encyclopédie*, employs the same idea of a “rather bizarre collection of signs of all sorts,” but he does this to characterize the origin of language, that is, when there were no usages.

5. E. Sapir (1921) speaks at first of a “means of communication,” as does Jespersen, but adds: “through the intermediary of a *system* of symbols” (*Le Langage* [Paris: Payot, 1953], p. 16).

IV.

To see language as a means of communication made up of a system of signs was in effect to raise it to the next order: the body of all systems of signs. The linguist who was probably the first to state this definition, Saussure,⁶ declared at the same time the necessity of founding a vaster science than that of linguistics, the science of all sign systems: semiology.⁷

But that was a new problem, which Saussure's definition did not clearly disclose (here we see the instrumental value of a definition); for it really defined every semiological system, implying that every system of signs is called "language," and, consequently, it provided no criterion allowing a distinction to be made between human languages and all other systems of signs or signals, although a difference between them is generally recognized or felt.

There is a historical reason for this state of affairs: at the time Saussure was developing his thought, between 1896 and 1916, very little study was being devoted to means of communication other than natural languages. The International Maritime Code with its flag signals was a rare exception. The study of animal behavior had barely begun. The new logics were still esoteric. In any case, all the definitions which were to replace Saussure's were to stumble over the same obstacle or were, rather, to dodge the issue: if a system of any kind of signs is called "language," everything is language—but then what is the *specific* difference between linguistics, the science of language, and semiology, the science of systems of signs in general?

If, as Vendryès writes in *Le Langage*, "all organs may serve to create a language"; if, as Giulio Bertoni states in the article *linguaggio* of the *Enciclopedia Italiana*, "human expression is not only articulate and auditive [but] all organs can contribute to the formation of language, which means that we have the language of signs, or mimic language, [if] tears are a language, [if] laughter is a language, etc.," why does linguistics not also study all these systems of signs? Or why was semiology so late in arriving on the scene?

6. Peirce, who died in 1914, had already said: "Signs are employed only in relation to each other, in a system of signs in action ('working system'), never alone." But he was a little-known logician.

7. See *Cours* (Paris: Payot, 1916), pp. 35 ff.

Jespersen, in the article already quoted, groups auditive languages (“ear-languages”) and visual languages (“eye-languages”) in the same way. He also admits that there exist “means of animal communication” different from human languages, but he provides no scientific criterion for the specific analysis of these various “systems of signs.” He confines himself to stating—and this is the old established clause in the matter—that, “in its developed form, language is indeed a human characteristic, and may be considered as the principle distinctive trait of humanity.” Methodologically, we have not escaped from this contradictory situation: every system of signs being a language, and linguistics being the study of language, there is by definition no such thing as semiology, properly speaking; however, since human languages are but one species of sign systems among many (“simply the most important of these systems,” says Saussure), the human languages must then be studied separately from other systems of signs. Or rather: every system of signs utilized by living beings should be called language, and it is therefore possible to speak of animal languages. However, the human languages are systems of signs totally different from all the others (but no one ever states scientifically wherein the difference lies).

In fifty years no one has escaped from these vicious circles,⁸ not because we are concerned with a vain dispute on terminology but because the spontaneous “axiomatics” of this linguistic moment provided no adequate criterion for elucidating the specificity, intuitively presumed, of human languages as compared with all other systems of signs.

V.

The clearest innovation concerning definition of language since Saussure has come not from linguistics but from contemporary logic. Ordinary language had been exposed to close critical analysis in order to obtain an absolutely logical language of mathematics. In part continuing Peirce and in part rediscovering him, the new logics finally reached a careful distinction in language among the relationships of signs with things signified (semantics), of signs with each other (syntax), and of signs with their users (pragmatic). Carnap has given the definition

8. H. S. Sorensen, in 1958, argues again with Hjelmslev to maintain the old definition of language as “a system of signs” and nothing else in his work *Word-Classes in Modern English* (Copenhagen: G. E. C. Gad), p. 12.

most frequently quoted today, stemming from this research: "A language . . . is a system of signs with the rules governing their use."⁹

Just as the Saussurian definition could be traced for fifty years, the last quarter-century is marked by the various statements of the logicians' definition. Strangely enough, while the nineteenth-century *Larousse* continued the old seventeenth-century definition ("a language is the idiom of a nation"), that of the twentieth century is one of the first (1931) to transpose into linguistics the Carnapian formula: "Language (*langage*): the body of terms of an idiom and of the rules of its grammar." The *Oxford English Dictionary* likewise notes: "Language: a vocabulary . . . and way of using it." We find this transposition in Charles Morris (1946), who believes he can place on this base one of the first treatises of semiology: languages, to deserve the name, must constitute "a system of interconnected signs, combinable in certain ways and not in others. . . ."¹⁰ We find it again in G. A. Miller, who speaks of "a body of symbols and of rules for their use."¹¹ It is partially stated in G. G. Granger (1957): "A linguistic expression appears to us . . . as a discrete linear (or quasi-linear) sequence of elements drawn from a lexicon first known by its users, the choices being limited by syntactical rules."¹²

It is easy to understand why this definition of the logicians, enjoying the prestige of results obtained in their field (it explained the effectiveness of their earliest axioms and facilitated the construction of new and even more rigorous ones), was a legitimate temptation to semiologists and linguists—at least as a hypothesis to be verified in their own fields. But the results do not measure up to what might have been hoped for.

First of all, it occurs to us that this failure is partially due to the fact that in reality the logicians' definition did not really add anything to

9. This definition is given here as the most typical, though recent (1954), in *Einführung in die symbolische Logik* (Vienna), p. 1.

10. *Signs, Language and Behavior* (New York, 1946), p. 34. On pages 34 and 36 Morris gives three other versions of the same definition, including: "A plurality of signs subject to restrictions in their combinations."

11. G. A. Miller, *Langage et communication*, trans. C. Thomas (Paris: Presses Universitaires de France, 1956). Despite the title, references to communication systems other than language are rare, and language and communication are almost invariably used synonymously.

12. See "Logique, langage et communication," in *Hommage à Bachelard* (Paris: Presses Universitaires de France, 1957), p. 33.

Saussure's: the obvious addition ("and rules for their use") merely rendered the meaning of the word *system* more explicit. At most the logicians, for their own needs, distinguished clearly the two periods of their creative procedure: to define signs, then to define the combining rules legitimate to these signs. But besides this, and especially, the logicians' definition allowed no escape from the old vicious circle: speaking of *language* as of "systems of signs" in general, they gave up, to all intents and purposes, any possibility of distinguishing in what the systems of signs might be irreducibly specific. (Only Lalande, in 1932, in the *Nouveau supplément* of his *Vocabulaire* suggests that such a specificity was recognized in the human languages: "The word language," he wrote, "is accidentally and in rare cases applied metaphorically to systems of signs or expressions other than words." But the *Larousse du XX^e siècle*, in its new logician's definition of language, significantly added: "any means of expressing ideas.")

The case of Charles Morris is here especially typical, because he proposed explicitly to erect "the science of signs, be they animal or human, linguistic or non-linguistic, true or false, adequate or inadequate, normal or pathological."¹³ Now in spite of this program he is unable to say what makes the specificity of each of the systems of communication he envisages, from natural languages to languages of gesture, to that of deaf-mutes, to written languages, to the plastic arts, music, etc.

Morris is indeed a pioneer; his failure is a first step. But he is justly criticized for skilfully avoiding the problems which offered resistance to his "system of signs." A "semiotician," interested in analyzing the specific traits of the various systems of signs, should have been alerted by these recalcitrant facts. Morris tosses off in six lines the *vocal* or *phonic* character of natural languages (the central problem of human language) by a comparison which is not a reason: "Finally," he says, "we should mention that many people, especially those who are linguists by trade, will protest the fact that we fail to include in our definition of language, the condition that linguistic signs must be vocal. As for us, we see no theoretical need to include this condition: to take it into consideration would be like insisting that houses made of different materials should not all be called houses."¹⁴ On another recalcitrant

13. Morris, *op. cit.*, p. 223; see also p. 2.

14. *Ibid.*, p. 38. For the theoretical reasons to include the phonic character in a definition of language, see below, André Martinet's thesis of double articulation.

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fact, the clarification (if such be possible) of specific traits which oppose or might oppose animal communication to natural human languages, Morris responds with age-old generalities which can no longer be considered satisfactory: that it is “evident that meaningful processes in man presuppose meaningful processes such as occur in animals, and that the first develop out of the second”; that it is “evident that human behavior in language shows astonishing complexity, a refinement immeasurable with that observed in animals.”¹⁵ Despite his more learned terminology, Morris teaches us no more on this point than does Buffon, who two centuries earlier had written: “It is due to the fact that a language supposes a sequence of thoughts that animals have no language.”

Morris thus maintains that language, specifically, human language, should be defined as “a plurality of signs subject to restrictions in their combinations,” although, as he notes with some embarrassment, “animal signs may be interconnected, and in such a way that animals may be said to infer; [but] there is no proof that these signs are combined, by the animals producing them, according to the limitations of combinations necessary for the signs to form a linguistic system.”¹⁶ Morris had but to examine this thesis in the light of Karl von Frisch’s descriptions of communication among bees to raise doubts in his own mind concerning the discriminating value of his definition. Colin Cherry, however, the author of one of the most recent and richest works on these questions, hardly goes beyond Morris even after examining von Frisch’s work: no language among the bees because—pure Buffon once again—“no system of organized thought.”¹⁷

Colin Cherry’s work is by no means barren: we wish simply to note here that he too, for want of a good definition of language, fails to provide exhaustive criteria which, allowing a definition of what is specific

15. *Ibid.*, pp. 52–53, 54.

16. *Ibid.*

17. Colin Cherry, *On Human Communication* (New York: John Wiley & Sons, 1957), p. 18. On communication among bees, he adds—to exclude it from languages—that it is neither developable, flexible, nor universal and that it is relative to the past, never to the future; the first, second, and fourth of these traits might be open to discussion. He states (p. 75) that “only man has the gift of language” without indicating a criterion. Generally, he adheres to Carnap’s definition. Intuitively, however, he distinguishes *linguistic systems* (the natural languages) from *pure systems* (“systems freely invented or constructed with signs and numbers” [p. 221]).

to each of the most diverse "systems of signs," would provide a foundation for semiology.

The key to these various problems, which have remained unresolved for so long, has recently been provided. This achievement came not from an entirely new definition of language, bursting out in opposition to those which had preceded, but from a series of analyses out of which there developed an original view of language, at first implicit, then made explicit little by little, by very reason of its effectiveness.

The point of departure is doubtless to be found in Hjelmslev. He stressed the point that the linguistic sign is formed by means of a limited number of non-signs (phonemes) and repeated that it was one of the characteristic structural traits of human languages.¹⁸ But it seems to have been André Martinet who first (1949) drew all its consequences from his observation, concerning the definition of the language of men as opposed to other sign systems: this is his theory of the *double articulation* of human language.

The expression "articulate language," whose origin and history merit study, conceals the fact that human language, as a system of signs, is articulated twice. Before there was any science of language, this expression used to designate the groups of sounds produced by the voice in such a way that distinct signs, or words, are recognized. In this first meaning it is the phrase, the statement, that are "articulated," that is, cut into articles or segments, as a crab's claw is said to be "articulated." The statement "The earth is round" is formed of four of these segments (the + earth + is + round), as opposed to the "unarticulated" cries emitted by animals, children before they learn to speak, the sick, madmen, and monsters. But when it is said: "the articulate voice," "articulate," "your articulation is not clear," the term "articulate" is being used in another sense, with reference to the movements of the vocal organs which, this time, cut the statement into sequences of vowels and consonants, not of words. The statement, "the earth is round," is then phonically constituted of eleven distinct articulations (ø + i + ə: + θ + i + z + r + a + u + n + d). (Note that animal cries, those of moaning patients, madmen, etc., which are called "inarticulate," do present this same sort of articulation.)

This antiquated expression, which confused facts of two orders, has

18. A. Martinet, "A propos des fondements de la théorie linguistique de Louis Hjelmslev," *B.S.L.*, 1946, No. 4, especially p. 27.

been given its fullest meaning in recent linguistics by an analysis which clearly distinguishes the functional place and meaning of these two types of articulation in the system of signs that is human language. The first articulation cuts the linguistic statement into signs, into units called meaningful, since each one has its own meaning: *grosso modo*, these are the words of the language, following traditional terminology. A second articulation cuts the signs themselves into smaller units than the sign (la = l + a, or two units of this type), these being non-significant units, or phonemes.¹⁹ Since the development of scientific phonetics, and even earlier as we have seen, everyone knew this, but nothing had been drawn from it on the theoretical level. Martinet's contribution lay in seeing that this descriptive trait was specific to human languages and set them apart from all other systems of signs.²⁰ He thus provided the instrumental criterion of a scientific separation—based on the nature of the things studied—between languages and the other means of communication by signs, between linguistics and semiology.

The criterion of double articulation as a fundamental trait of what language is has proved to be an excellent operational criterion. Pictographic-ideographic writings (from pure hieroglyphics to flag-signals); numerical and symbolic signs employed in mathematics and formalized logics; abbreviations either of recognizable design (the schematic silhouette of a locomotive to indicate a grade crossing) or arbitrary in design (a red disk crossed by a white bar to indicate "Do not enter" at a one-way street); the conventional signs of cartography, of standardized industrial drawing, schemas of all kinds, etc.—all these systems of signs have been shown to differ specifically from human language because all of them utilize only the first type of articulation: all cut their messages into meaningful units, never into distinctive non-significant units. And

19. A. Martinet, "La double articulation linguistique," in *Travaux du Cercle Linguistique de Copenhague*, V (1949), 30–37. These are eight basic pages, constituting a turning point in contemporary linguistics. See also Martinet's "Arbitraire linguistique et double articulation," in *Cahiers F. de Saussure*, No. 15 (1957), pp. 105–16, eleven pages which complete the preceding.

20. Linguistics distinguishes between original phonic language and its various *written forms*, some of which (ideographs, hieroglyphics) do not reflect the second articulation of language, while certain others (alphabetic writing, Morse code, Braille, the deaf-mute's alphabet) transcribe this second articulation. These writings are not systems of signs *sui generis*; they are systems called substitutive of the original phonic language. (See E. Buyssens, *Les Langages et le discours* [Brussels, 1943]).

the double articulation of human (phonic, or vocal) language provides the key to the richness and complexity of human languages, with which no other system of signs can be measured on a par. Martinet's analysis clearly shows that a system of signs utilizing only the first sort of articulation would have to multiply infinitely the distinct meaningful units to distinguish the multitude of things signified: the number of totally different signs would be immense. On the other hand, in the case of a system of phonic signs, if each distinct meaningful unit had a distinct meaningful sign, "the arbitrary character of the sign . . . would soon be sacrificed on the altar of expressivity." Martinet concludes: "The phonemes produced by the second linguistic articulation are thus revealed as the guarantees of the arbitrary nature of the sign,"²¹ which is the instrument of the prodigious combinatory fertility characteristic of human languages.

The double articulation of the human languages also provides the rational explanation of the differences, so often stated a priori between animal communication and human language. Whether we are concerned with communication among bees,²² or among crows, Martinet's criterion leads to analyses which are finally effective. Among the bees it will doubtless be shown to contain units of the first articulation, meaningful, expressing in several ways distances and directions—but these units (which we shall treat further) are not divisible exclusively in time: they are also "readable" in space (as "round," for example, or "lively dance"). As for crows, their productions are phonic messages like the human voice. Philippe Gramet's experiments tend to prove that these messages are in fact divisible into units of the second articulation (phonemes) but without any evidence within a statement of meaningful units of the first articulation (or kinds of "words").²³ In any case, these analyses would suggest that it will be possible, in semiology, to begin a rational classification of widely differing systems of signs: from those of signs readable in space to those of signs read in time; from

21. See Martinet's "Arbitraire linguistique et double articulation," p. 110.

22. Benveniste's analysis ("Animal communication and human language," *Diogenes* No. 1 [1952], pp. 1-7), the only one which studied von Frisch's results from a truly semiological point of view, also moved in this direction, by stressing the search for a presence or an absence of units (morphemes, or "empty" phonemes) in the messages of bees.

23. Philippe Gramet, "Recherches acoustiques sur les corbeaux," *La Nature*, February, 1959, pp. 49-55.

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symbolic means of communication (in which the message reproduces mimes or sketches the thing to be communicated) to means of communication with arbitrary signs in which the smallest unit is the total message, or the meaningful unit, or the non-meaningful unit—all this without counting the means of communication which may, as among the bees, combine several of these systems of semiologically different signs.

VII.

Though rich in meaning, the criterion of double articulation—whose career has scarcely begun—has not exhausted the search for a definition of language. Just as, two or three decades ago, everyone leaped upon the logicians' definition, which was expected to work wonders, so today they rush from all sides to embrace the *mathematical theory of communication* of Shannon and Weaver. Not that this haste should be criticized: all who are interested in the science of signs foresee that this mathematical theory of the transmission of signals ought to help in the exploration, one step further, of the analysis of language. But up to the present all efforts to apply this theory to linguistics have proved to be partial failures because of the very avidity with which the theory has been embraced. Too often this leads to metaphorical transpositions of the terminology proper to this theory, which are then applied in the field of linguistics. As the theory itself has been called in French, apparently through a faulty translation, a *théorie de l'information*, uses of the term *information* have multiplied (loss of *information*, gain of *information*) where the term *champ sémantique* ("semantic field" or, in English, "area of meaning") had previously been used, without anything being added by the new terminology to our knowledge of the facts. In the same way, people are beginning to speak of "semantic noise" instead of saying "equivocation," "ambiguity," "homonymy"; they even speak of "quantity of information"—exactly as, twenty-five years ago, all terminologies were suddenly invaded by "restricted" and "generalized" relativities. This epidemic of terminological measles will pass, giving way to more serious application.

On one point, at any rate, the new theory has already introduced a new element²⁴ which has proved very useful in our defining criteria of

24. We shall here set aside as secondary to the theme of this article the notion of "redundance," whose use in linguistics has proved to be easy as well as enlightening.

language. This has been in bringing out insistently the fact that a linguistic message is composed of a *linear* succession of *discrete* signs or, in other words, differential, discontinuous, or digital signs.²⁵

Here we may surely recall the categorical page (*Cours*, p. 105) in which Saussure had marked the fundamental importance of the linear (i.e., articulated in a succession of units irreversible in time) character of language and its difference from other systems of signs articulated in space. But the semiological value of Saussure's indication had remained unexploited. It took on new value in the stress laid by the theory of information on this characteristic of language, as shown by its presence in Granger's definition. Granger, however, does not draw out of the statement all that he might: this very trait embarrasses him slightly, as shown in the somewhat regretful feeling of his parenthetical "or quasi-linear." He observed in fact that, if one follows his definition "mathematics is not only a language," then "mathematical language" would have several dimensions, since a part of its signs (figures, graphs, material arrangement of signs on the page, matrixes, etc.) are read according to structures articulated in space, like the plastic arts. But for different reasons Granger does not accept the plastic arts as languages, even though they are means of communication, because they do not offer discrete units of meaning. In the same way mathematics, according to him, is not merely a language because its "essential function is not to inform,"²⁶ a most dubious and non-discriminating reason. He fails to see how close he is to one of the great semiological classifications, that suggested by Saussure and formulated—though he, too, failed to draw anything from it—by Colin Cherry: that there are systems of signs which are read in time and others read in space.²⁷

The *discrete* character of signs is itself confirmed as a highly discriminating trait. It permits a separation, for reasons based on their very nature, of systems which are articulated in units of this sort, in discontinuity, from all systems of communication in which a *thing signified* of continuous size (e.g., the increasing breadth of a real river) is repre-

25. On this point, the most effective texts are still those of B. Mandelbrot, *Word*, X, No. 1 (1954), 1–27, or collected in *Logique, langage et théorie de l'information* (Paris: Presses Universitaires de France, 1957).

26. Granger, *op. cit.*, pp. 33, 37, 52–54.

27. Cherry, *op. cit.*, p. 122.

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sented by a *meaningful thing* which symbolizes this continuous size as continuing: the blue line on the map, gradually widening between the source of the river and its mouth.²⁸

Such is the already established contribution of the theory of information to the definition of language. Neither facile irony nor polemical enjoyment led us to begin by criticizing the imprudent use of its terminology without precautions: we did this rather because so much can be expected from the theory. Up to the present, linguistics has not yet truly assimilated the theory of information. When this has been done, a definition of language will doubtless have to be rewritten. This will probably be possible within a few years, but the time is not yet.

28. This example should not be considered as a very special case: let the reader recall all the graphic representations of the *scale*, where the signifying thing is found to be linked in a rigorously formal manner to continuous values proportional to the thing signified.