Giorgio Prodi

UNIVERSITY OF TARTU Press

The Material Bases of Meaning

Tartu Semiotics Library 22

Σημειωτική

TARTU SEMIOTICS LIBRARY 22

Tartu Semiootika Raamatukogu 22
Тартуская библиотека семиотики 22

Le basi materiali della significazione
Tähenduse materiaalsed alused
Материальные основы значения

The Material Bases of Meaning

Giorgio Prodi

Foreword by Kalevi Kull and Felice Cimatti
Afterword by Anna Gasperi-Campani

UNIVERSITY OF TARTU
Press

Prodi, Giorgio 2021. *The Material Bases of Meaning*.
(Tartu Semiotics Library 22.) Tartu: University of Tartu Press.

Address of the editorial office of the book series:
Department of Semiotics,
University of Tartu,
Jakobi St. 2, Tartu 51014,
Estonia

http://www.flfi.ut.ee/en/department-semiotics/tartu-semiotics-library

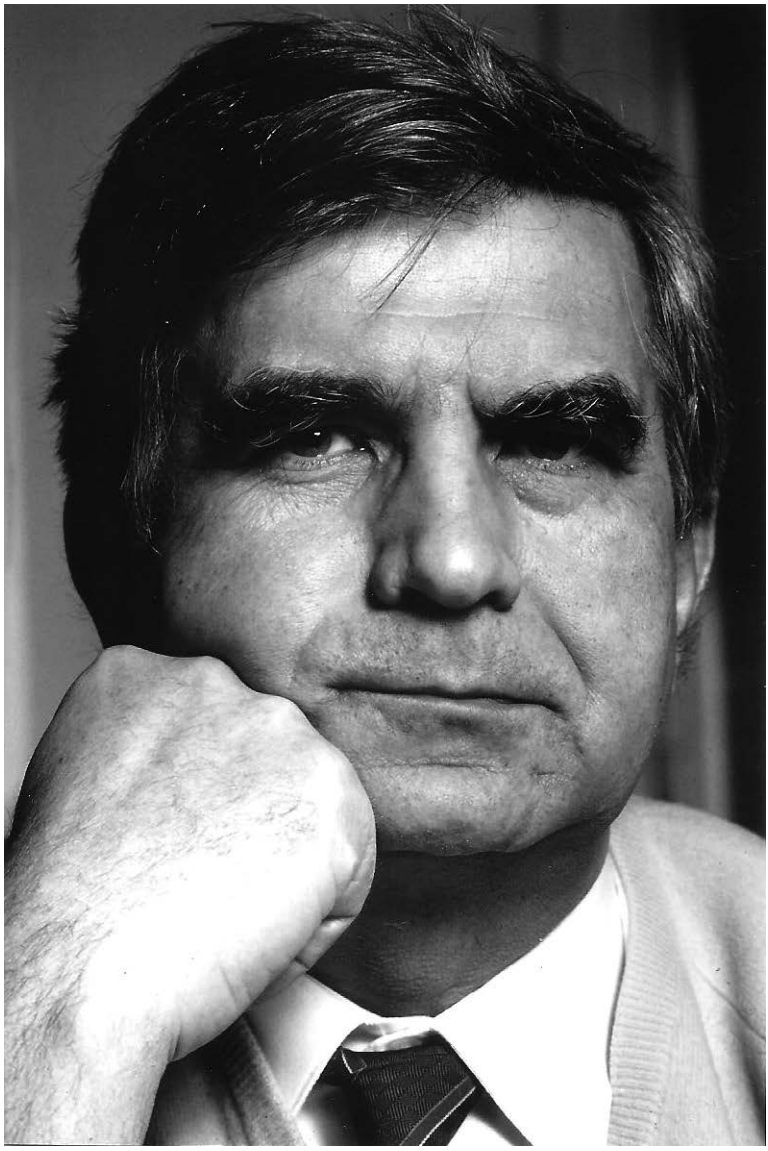
Cover design: Kalle Paalits
Layout: Tiia Ilus

Cover photo: Giorgio Prodi speaking at the oncological conference in Bari in 1980

Original: Prodi, Giorgio 1977. *Le basi materiali della significazione*. (Nuovi saggi italiani 21.) Milano: Bompiani.
Translated by William N. Dodd (text) and Anna Gasperi-Campani (preface, premise, backcover)

ISSN 1406-4278
ISBN 978-9949-03-564-9 (print)
ISBN 978-9949-03-565-6 (pdf)

University of Tartu Press
www.tyk.ee



Giorgio Prodi (1928–1987) in 1986.

Table of Contents

FOREWORD
A biosemiotics of Giorgio Prodi

Kalevi Kull[1]
Felice Cimatti[2]

Biosemiotics – the study of meaning-making in living systems – keeps advancing and is slowly transforming biology. It is building a biology in which the life's process of meaning-making and the impact of semiosis on life in general are described and explained, a biology in which the phenomenon of freedom would find a place. On this scholarly journey, rereading and reintepreting earlier attempts of building such a biology has a very important role.

This is the reason for publishing this book written over four decades ago. There are several theories explaining the origin of mind from matter, either gradualist or emergentist creation of knowledge via primary formation of signs. This is one among them. We are providing it in order to encourage discussion on the mechanisms of meaning, on the interpretation of primary recognition, meaning-making and knowing, from chemistry to biology to semiotics, and back.

Before moving to the contemporary, more complex biosemiotic models, e.g. those of Howard Pattee, Jesper Hoffmeyer, Terrence Deacon, etc., one should also think over a series of arguments about the distinctions between fitting, recognition, affinity, complementarity, representation, coding, etc. For that purpose, learning from Giorgio Prodi's reasoning is most helpful.

Giorgio Prodi (1928–1987) was an Italian oncologist and philosopher. His work has earned a well-established place in the historical account of biosemiotics (Favareau 2010). Felice Cimatti has published a monographic analysis of his semiotics and philosophy (Cimatti 2018; also Cimatti 2000). Thomas Sebeok and Umberto Eco both praised Prodi's work (Eco 1994; 2018; see Kull 2018a; 2018b). When introducing the concept of

[1] University of Tartu, Estonia.
[2] University of Calabria, Italy.

protosemiosis, Winfried Nöth describes Prodi's model in this context (Nöth 2001). Prodi's work has been discussed in more detail in Italian writings (Caputo 1990; Zorzella, Cappi 2012; etc.), including a recent dissertation by Valerio Marconi (2020). The journal *Il Margine* (7/8, 1989) published a special issue entirely dedicated to his work of (see, e.g., Lambertini 1989; Pontara 1989; etc. from the issue). However, Prodi's semiotics deserves more analyses in the field of biosemiotics itself.

In 1976 when Prodi wrote this book, there was not much biosemiotics yet. He was rather alone with his project and, accordingly, his analysis of biological meaning was rather independent. His encounter in person with other biosemioticians took place at the Vienna congress of semiotics in 1979 (see a page of the congress's program in *Figure*).[3] However, semiotics was popular in Italy, and especially in Bologna at the time. This led Prodi to write:

> What is important is to extend the field of semiotics: we need to dig *deeper* to may uncover what *precedes*. This task is simultaneous and coextensive with that of institutionally-established semiotics, and ought not to be allowed to suffer from possible preclusions against the open and experimental nature of its research. (p. 118)

When *Le basi materiali della significazione* (*The Material Bases of Meaning*) first appeared in Italy in 1977, the global semiotic scenario was dominated by an insufficiently thought through prejudice which placed human voluntary and intentional semiosis in a somewhat different theoretical place in comparison with non-human (animal, plant and cellular) semiosis – if the latter was included in semiotics at all. At that time the concept of *zoosemiotics* had already been introduced by Thomas Sebeok: "the term *zoosemiotics* – constructed in an exchange between Rulon Wells and me – is proposed for the discipline, within which the science of signs intersects with ethology, devoted to the scientific study of signalling behavior in and across animal species. [...] Genetics and linguistics thus emerge as autonomous yet sister disciplines in the larger field of communication sciences, to which, on the molar level, zoosemiotics also contributes" (Sebeok 1963: 465–466). However, this definition does not provide a key to distinguishing (if at all) between different kinds of signs; in particular, it incorporates both intentionally made and non-intentional signs. For example, in a paper entitled "Animal communication" Sebeok wrote that "the communicating organism's selection of a message out of its species-consistent code – as well as the receiving organism's

[3] However, he met Renè Thom and Ilya Prigogine in 1978 (see Afterword, fn 7).

apprehension of it – proceeds either in accordance with a genetic program dictating an almost wholly prefabricated set of responses, or with reference to each animal's unique memory store which then determines the way in which the genetic program is read out" (Sebeok 1965: 1009). In his inclusive semiotic approach Sebeok was interested in bringing together signs that are somewhat voluntarily emitted as well as signs that are involuntary because of being under the control of some genetic program. The basic assumption of the famous handbook on semiotics by Umberto Eco (1976) – one of the main interlocutors of Giorgio Prodi at that time[4] – was, on the contrary, precisely that an unintentional sign does not properly belong to the realm of semiotic phenomena. More specifically, Eco places stimuli below the semiotic threshold because they are unintentional and not based on a semiotic convention:

> If both non-human and human but unintentional events can become signs, then semiotics has extended its domain beyond a frequently fetishized threshold: that which separates signs from things and artificial signs from natural ones. But while gaining this territory, general semiotics inevitably loses its grip on another strategical position to which it had unduly laid claim. For since everything can be understood as a sign if and only if there exists a convention which allows it to stand for something else, and since some behavioral responses are not elicited by convention, stimuli *cannot* be regarded as signs. (Eco 1976: 19)

According to Eco, a stimulus is not a semiotic entity proper because it does not require any cognitive mediation on part of the receiver: "According to the well-known Pavlov experiment, a dog salivates when stimulated by the ring of a bell because of a conditioned stimulus. The ring of the bell provokes salivation without any other mediation" (Eco 1976: 20). A semiotic phenomenon, however, always requires cognitive mediation. That is, a semiotic phenomenon is intrinsically triadic in nature, while a non-semiotic phenomenon is dyadic. According to Eco, such a difference grounds the distinction between the seemingly similar yet very different semiotic phenomena of 'communication' on the one hand, and 'signification' on the other:

> So let us define a communicative process as the passage of a signal (not necessarily a sign) from a source (through a transmitter, along a channel) to a destination. In a machine-to-machine process the signal has no power to signify in so far as it may determine the destination *sub specie stimuli*.

[4] About the relationship between Umberto Eco and Giorgio Prodi, see Afterword by Anna Gasperi-Campani, and also Cimatti 2019; Kull 2018a, 2018b.

> In this case we have no signification, but we do have the passage of some information.
>
> When the destination is a human being, or 'addressee' (it is not necessary that the source or the transmitter be human, provided that they emit the signal following a system of rules known by the human addressee), we are on the contrary witnessing a process of signification – provided that the signal is not merely a stimulus but arouses an interpretive response in the addressee. This process is made possible by the existence of a code. (Eco 1976: 8)

A genuine semiotic phenomenon requires that the 'response' of the addressee be the result of some sort of mental reasoning. That is, semiotics seems to imply the presence of a mind, be it self-conscious or not. The theoretical ground of this stance lies in Peircean semiotics. In the following famous definition of the semiotic process, Peirce underlines that semiotics means mediation, and that mediation in turn implies some form of representation:

> A sign, or *representamen*, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen. "Idea" is here to be understood in a sort of Platonic sense, very familiar in everyday talk. (Peirce, CP 2.228)

It should be noticed that such a definition implies that the *interpretant* is a basic unexplained assumption of Peircean semiotics. Since the *interpretant* is a semiotic equivalent of the mind – "a Sign is a representamen of which some interpretant is a cognition of a mind" (Peirce, CP 2.242) – this means that according to Peirce the very existence of the mind is assumed as an axiom of his own semiotic model. It is apparent why such an assumption poses a tremendous problem to any naturalistic approach to semiotics. Peirce describes the semiotic mechanism as it shows itself to human beings, the animals of the *Homo sapiens* species, that is, of the *Homo loquens* species. However, the model does not explain how mind could be developed from the bare material world of the Earth origin. That is, the assumption that at the very beginning of life there was already a mind or something like a mind seems quite implausible. This is a hard problem that the Peircean semiotics leaves as a legacy to any subsequent semiotic and/or biosemiotic theory based on his triadic model.

This is exactly the critical point raised by Prodi (from a materialistic point of view) when he confronts Eco and the interpretative semiotic model

(Cimatti 2018), a model which does not explain the origin of semiosis, that is, its non-conscious origin: "since there is no doubt that the world of culture is, wholly and integrally, a world of discourse, what is specifically human is theorised by its authorised science – semiotics – as a quality that erupts miraculously from nature, without antecedents, characterising a species created *ex novo* in Linnaeus' final chapter. Discourse and the word are breathed into man, and man moves from his clay, transfigured in the image of the word" (p. 28). Prodi introduced a problem no semiotic theory can avoid, because one cannot assume such complex notions as 'mind', 'intentionality' and 'consciousness' as unquestioned: "behind human communication there is a void, or the weak backing of bird cries and scent calls [...] by dismissing from the field of analysis the various impurities, the improper codes, the natural situations which only our ingenuity regards as sign" (p. 29).

In this vein, Prodi proposes a simpler molecular model as a natural ground for semiosis. In such a model, semiosis there is no need for a cognitive mediation between the 'sender' and the 'recipient' in the very first stages of the development of. Prodi renders the basic distinction made by Eco between 'communication' and 'signification' inoperative. According to Prodi, we need to start the biosemiotic explanation from the completely unintentional and unconscious notion of 'complementarity':

> We can define this condition as follows: the reciprocal change in two things is subject to their being complementary. The change is represented, for instance, by the formation of a metastable complex between the two terms. We do not need to initially assume a primary role for one of the two terms, but simply postulate the kinetic characteristics necessary for A and B to meet in the sea of possible objects and events. "Reciprocal specificity" does not mean "tending towards". We shall no longer take the existence of reciprocity as entailing an "external design" or "plan". Thus, we rule out any recourse to models of tropism. All that needs to be posited is the possibility of movement (the simplest condition of which is random) of A and B in their context, with a certain probability of meeting. Whereas contacts with other material elements present are collisions (and these elements are indifferent), the accidental contact between A and B turns into a reason for change. A and B, that is, reveal themselves as contextually correspondent precisely through the reciprocal modification regulated by selectivity. This is how A and B select each other in the context of indifferent presences. (p. 37)

Thus, Prodi tries to transform the mentalistic (therefore idealistic) notion of 'meaning' into the simpler and naturalistic notion of 'reciprocal specificity' plus context. Take the case of the two generic entities A and B. The former interacts with the latter, while discarding the "uninteresting" entities C, D

and all other entities it could interact with. This means that A is somewhat *a posteriori* "interested" in B. Therefore, one can "say that A reads (deciphers, explores) B and vice-versa. In nature, complementariness is above all a reading or interpretation, that is, an exchange subject to reciprocal meaningfulness" (p. 38). Through the unintentional notion of 'complementarity' plus 'context', Prodi describes proto-semiosis[5] which places itself before the very distinction between living and non-living entities as between mental and non-mental entities: "the terms 'interpretation', 'reading' and 'meaningfulness' are used here at the most basic level, as a sort of amorphous linguistic allusion to the 'correspondence of specificity'. However, they have an analogical function, as well as foreshadowing the direction this study will take later on" (p. 39). It turns out that Prodi renders inoperative such distinctions as those between 'communication' and 'signification', 'stimulus' and 'sign', or the notion of 'semiotic threshold' itself (Cimatti 2019; see also Diodato 2020) which risks tracing a net boundary between human and non-human semiosis. Therefore, Prodi proposes a different definition of 'meaning': "meaning in nature is thus the relation of correspondence between material states which appear as triggers for change [...]. Meaning and the attribution of meaning are sequential material processes that presuppose both a world to be explored and a structure capable of exploring, and, in all cases, the limited and specialized possibilities of this exploration" (p. 39). According to Prodi, the origins of semiosis are unintentional and uncognitive: this is the only way to make semiosis a natural phenomenon: "initially the poles of the semiotic relation are two. There is the thing, which is sign in the first place, since it is both interpreted and consumed by a reader. Mediation – the sign as an independent entity – comes later, but it is important to go back to this biunivocal origin because, in such a perspective, the sign no longer refers to an indefinitely long chain (in which one sign is explained by another and so on) but to a chain of interactions which are finite in number, however many – in other words to the meaning of the sign in the sphere where it is used by a reader" (p. 118).

It may strike the reader's eye that Prodi does not make almost any references in his text. Umberto Eco's name is not mentioned, yet his presence can be felt implicitly.[6] Prodi's original book contains no list of references at all.

---

5 The term 'protosemiosis' appears in Prodi (1988b: 55), he is not using it in the current book. Sebeok (1997: 436) mentions that this term "must surely be read as a metaphorical expression".

6 For instance, the last sentence of the book (p. 189): "Structures are thus open onto the world" ("Le strutture sono dunque aperte al mondo") can be considered as an allusion to Roland Barthes, or Umberto Eco, or both.

The names mentioned (mostly once and very briefly) throughout the whole text amounts to only around twenty (see the index). However, these include classic authors of semiotics such as Gottlob Frege, Charles S. Peirce, Roland Barthes, Ferdinand de Saussure, Charles Morris, Charles K. Ogden and Ivor A. Richards. Even fewer biologists' names deserve mention – only Carl Linnaeus and Charles Darwin appear briefly.[7] Prodi wrote very much, penning also novels. However, he was certainly well aware of semiotics as well as the contemporary theory and philosophy of biology. For instance, we can find Giorgio Prodi's name as the editor of the Italian translation of Michael Ruse's *Philosophy of Biology* (Ruse 1976).

In a rare paragraph, Prodi is explicit on his views on Saussure and Peirce:

> The delimitation of the field of semiotics constitutes a crucial issue. As founded by De Saussure, semiotics is a science of artificial and conventional systems, such as language, of course, and all the other inter-human exchange systems governed by rules (e.g. rules of politeness, the highway code, military signs, etc.) In this respect, the general system outlined by Peirce may also be non-human, since the process of semiosis occurs wherever there is a mediation between an interpreter and a thing by means of an interpretant. But in Peirce's framework, and broadly speaking in Morris's too, the only possible domain for this kind of semiosis is the human one; at least, they both conceive interpretation in an anthropomorphic and anthropocentric manner. Unlike the De Saussure's demarcation, Peirce's does not need to postulate either intentionality or conventionality (i.e. the artificial nature of semiosis). Nevertheless, in his approach to the problems of semiosis, the sign is something already given as a mediator. It is already inserted in a semiotic function whose origins thus remain totally obscure. What we must do is to go a step further and eliminate not only intentionality but also mediation in the most elementary stage of meaning. A sign is not something that officially represents something else. It is a natural object that corresponds to (and is a function of) something else. When we use the expression "stands for", we really mean to allude to a material function, even if the term seems to carry a highly metaphorical aura. (p. 117–118)

As Prodi says, "General semiotics [...] is a comparative physiology of communication systems" (p. 121). Important works which demonstrate how to reconcile Peircean semiotics with material basis of signification appeared only in 1990s – Jesper Hoffmeyer's *Signs of Meaning in the Universe* (1996), and Terrence Deacon's *Symbolic Species* (1997).[8] In parallel, there were scholars who worked out their own, independent terminology for

[7] More references can be found e.g. in Prodi 1983 and 1988c.

[8] See also Stjernfelt 2014.

biosemiotics – like Marcel Florkin (1974) who did it about simultaneously with Prodi, or Yoshimi Kawade (1996; see Favareau, Kull 2020) and Marcello Barbieri (2000) somewhat later, while facing similar difficulties of extending semiotics to biology as Prodi had before them. A more integrative general semiotics with biosemiotics as its natural part is a 21st-century development.

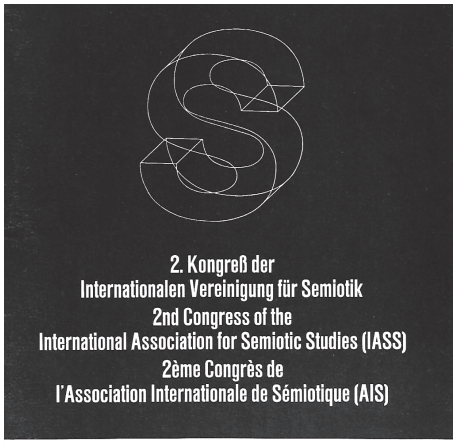
Therefore, one can appreciate the global value of the biosemiotic proposal of Prodi, who many decades before the actual re-emergence of the problem of "realism" (Kroupa, Simoniti 2020) and the contemporary debate on the "anthropocene" (Crutzen 2002) assumes a radical anti-anthropocentric stance in semiotics and philosophy. Both in respect to the independent existence of external reality and the place of *Homo sapiens* with respect to nature, Prodi removes the human position from the central position that humanistic anthropocentrism has always attributed to it.

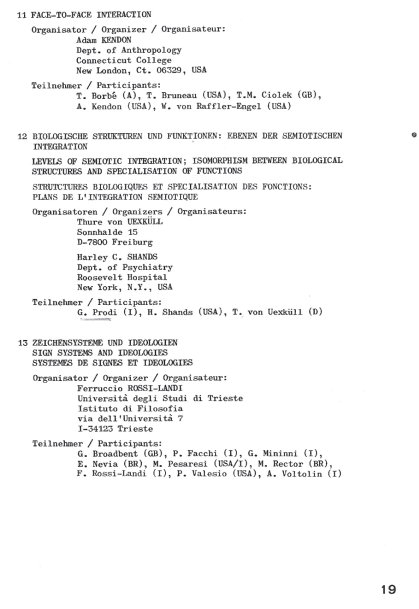
The main legacy of *The Material Bases of Meaning*, which is maybe more relevant today than when the book first appeared, is a deeply naturalistic stance, which is still not well understood by the humanistic sciences. The position for the human species in the world is not that special. Our semiotic and cognitive capacities are products of the development of much simpler forms of natural and widespread forms of semiosis. There is nothing so special in being human: "the possibilities of human communication – from its first anthropological organisations to formal logic and poetry – are given as the fruit of ever more ancient natural antecedents and [...] the possibility of receiving and transmitting signs is an ancestral fact [...]. [I]t is impossible to fix *a priori* a semiotic threshold. The field must be totally open towards the origins and remain indeterminate in any case" (p. 29–30). Since there are bacteria, there are also interpretation, knowledge, and signs, says Giorgio Prodi.

Giorgio Prodi's academic production was extensive (see also the Afterword by Anna Gasperi-Campani in this volume). Almost all of his philosophical and semiotic works were in Italian and until this book, there was rather little available in translation. Prodi's earlier semiotic publications in English include only the following.

(1) An article in the encyclopedic dictionary of semiotics edited by Thomas A. Sebeok (Prodi 1986). Compiled from two unpublished pieces "Ontogeny of codes" and "Phylogeny of codes", it was republished in the second and third editions of the encyclopedia (Prodi 1994; 2010b),
(2) A long article translated as an excerpt from Prodi's 1977 book (Prodi 1988a).

(3) A chapter in the Proceedings of a semiotics and immunology conference (Prodi 1988b). It was republished in Donald Favareau's anthology of biosemiotics (Prodi 2010a).
(4) A talk given at a symposium on the nature of culture in Bochum, on October 7–11, 1986 published in the Proceedings of the symposium (Prodi 1989a).
(5) A chapter on biology as natural semiotics, published in a volume edited by Walter Koch (Prodi 1989b).
(6) A talk on biologically grounded ethics, given at the 1987 conference "Ethics of scientific knowledge" in Venice and reproduced in a bilingual printing (Prodi 1989c).




11 FACE-TO-FACE INTERACTION
Organisator / Organizer / Organisateur:
Adam KENDON
Dept. of Anthropology
Connecticut College
New London, Ct. 06329, USA
Teilnehmer / Participants:
T. Borbé (A), T. Bruneau (USA), T.M. Ciolek (GB), A. Kendon (USA), W. von Raffler-Engel (USA)

12 BIOLOGISCHE STRUKTUREN UND FUNKTIONEN: EBENEN DER SEMIOTISCHEN INTEGRATION
LEVELS OF SEMIOTIC INTEGRATION; ISOMORPHISM BETWEEN BIOLOGICAL STRUCTURES AND SPECIALISATION OF FUNCTIONS
STRUCTURES BIOLOGIQUES ET SPECIALISATION DES FONCTIONS: PLANS DE L'INTEGRATION SEMIOTIQUE
Organisatoren / Organizers / Organisateurs:
Thure von UEXKÜLL
Sonnhalde 15
D-7800 Freiburg
Harley C. SHANDS
Dept. of Psychiatry
Roosevelt Hospital
New York, N.Y., USA
Teilnehmer / Participants:
G. Prodi (I), H. Shands (USA), T. von Uexküll (D)

13 ZEICHENSYSTEME UND IDEOLOGIEN
SIGN SYSTEMS AND IDEOLOGIES
SYSTEMES DE SIGNES ET IDEOLOGIES
Organisator / Organizer / Organisateur:
Ferruccio ROSSI-LANDI
Università degli Studi di Trieste
Istituto di Filosofia
via dell'Università 7
I-34123 Trieste
Teilnehmer / Participants:
G. Broadbent (GB), P. Facchi (I), G. Mininni (I), E. Nevia (BR), M. Pesaresi (USA/I), M. Rector (BR), F. Rossi-Landi (I), P. Valesio (USA), A. Voltolin (I)

19

Figure. The section on biology and semiotics in the second world congress of semiotics in 1979. The first and last pages of the congress programme. [From Giorgio Prodi's archive, kindly provided by Anna Gasperi-Campani.]

The present volume contains the English translation of Giorgio Prodi's book *Le basi materiali della significazione* that appeared in Italian in 1977 (Prodi 1977). The existence of this translation became apparent in a correspondence between Felice Cimatti and Anna Gasperi-Campani, Giorgio Prodi's wife. The translation was made by William Dodd already in the 1980s, but had remained unpublished until now. However, this is also a new version of this book, as it is not the Italian original. For the purposes of the translation

and after it had been finished, Giorgio Prodi himself made several improvements in the text (see more about this in the Afterword by Anna Gasperi-Campani). The completed translation was not published; instead, a brief version was made which appeared as an article in *Semiotica* (Prodi 1988a). That "brief version" was a long article, but to really understand Prodi's thought, the book-length version serves the purpose best. Based on the preserved typewritten translation with many additional remarks by Prodi, the manuscript was prepared for publication by Anna Gasperi-Campani.

Between the same covers we also publish the text of Prodi's talk ("The formation of meaning in phylogenesis") at the Second Congress of the International Association for Semiotic Studies in 1979 in Vienna. In that congress, the section of semiotics in biology ("Levels of semiotic integration: Isomorphism between biological structures and specialisation of functions") was organised by Thure von Uexküll and Harley C. Shands, with a presentation by Giorgio Prodi (see the programme in *Figure*). The congress was an important mark in the history of biosemiotics as it included one of the first specialised sessions on semiotic biology ever. The same year Sebeok and Prodi spent several days together at Thure von Uexküll's home in Freiburg to discuss biosemiotics (see Sebeok 1998: 34–35). The text of Prodi's talk was not published in the volume of Proceedings of this Congress (Borbé 1984), and has been prepared for its first publication in this volume by Anna Gasperi-Campani.

Acknowledgement. We are deeply grateful to Anna Gasperi-Campani Prodi for her help, work and care that made the publication of this volume possible. We thank Ene-Reet Soovik for her help in editing. Support by the University of Tartu and by the grant PRG314 from Estonian Science Foundation is appreciated.

References

Barbieri, Marcello 2000. *I codici organici: La nascita della biologia semantica*. Ancona: Pequod.

Borbé, Tasso (ed.) 1984. *Semiotics Unfolding: Proceedings of the Second Congress of the International Association for Semiotic Studies, Vienna, July 1979*. 3 volumes. (Approaches to Semiotics 68.) Berlin: Mouton de Gruyter.

Caputo, Cosimo 1990. Bio-logia vs semio-logia: La proposta di Giorgio Prodi. *Idee: Genesi del senso* 5(13/15): 183–188.

Cimatti, Felice 2000. The circular semiosis of Giorgio Prodi. *Sign Systems Studies* 28: 351–379.

Cimatti, Felice 2018. *A Biosemiotic Ontology: The Philosophy of Giorgio Prodi*. (Biosemiotics 18.) Berlin: Springer.

Cimatti, Felice 2019. Linguaggio e natura nell'Italian Thought: Il dibattito sulla 'soglia semiotica' fra Umberto Eco e Giorgio Prodi. *Agalma* 38: 60–69.

Crutzen, Paul J. 2002. The "anthropocene". *Journal de Physique IV* 12(10): 1–5.

Deacon, Terrence 1997. *The Symbolic Species: The Coevolution of Language and the Brain*. New York: Norton.

Diodato, Filomena 2020. The embodiment of language: sign function and semiotic threshold. *Rivista Italiana di Filosofia del Linguaggi* 14: 203–215.

Eco, Umberto 1976. *A Theory of Semiotics*. Bloomington: Indiana University Press.

Eco, Umberto 1994 [1988]. In memory of Giorgio Prodi: A challenge to the myth of two cultures. (Johnston, Marina, trans.) In: Jaworski, Leda Giannuzzi (ed.), *Lo studio bolognese: campi di studio, di insegnamento, di ricerca, di divulgazione*. Stony Brook: Forum Italicum (Center for Italian Studies, State University of New York at Stony Brook), 75–78.

Eco, Umberto 2018. Giorgio Prodi and the lower threshold of semiotics. *Sign Systems Studies* 46(2/3): 343–351.

Favareau, Donald 2010. Introduction and commentary: Giorgio Prodi (1928–1987). In: Favareau, Donald (ed.), *Essential Readings in Biosemiotics: Anthology and Commentary*. (Biosemiotics 3.) Berlin: Springer, 323–327.

Favareau, Donald; Kull, Kalevi 2020. [Chapter 14. Yoshimi Kawade:] A biosemiotician of the first generation. In: Iwakura, Yoichiro; Yonehara, Shin; Fujisawa, Junichi; Asano, Masahide; Kawade, Tokinori (eds.), *Keep Asking What Life Is: Beyond Molecular Biology*. Kyoto: Kyoto University Press, 197–225.

Florkin, Marcel 1974. Concepts of molecular biosemiotics and of molecular evolution. *Comprehensive Biochemistry* 29A: 1–124.

Hoffmeyer, Jesper 1996 [1993]. *Signs of Meaning in the Universe.* (Haveland, Barbara J., trans.) Bloomington: Indiana University Press.

Kawade, Yoshimi 1996. Molecular biosemiotics: Molecules carry out semiosis in living systems. *Semiotica* 111(3/4): 195–215.

Kroupa, Gregor; Simoniti, Jure (eds.) 2020. *New Realism and Contemporary Philosophy*. London: Bloomsbury Academic.

Kull, Kalevi 2018a. Biosemiotics by Giorgio Prodi: A postscript. In: Cimatti, Felice, *A Biosemiotic Ontology: The Philosophy of Giorgio Prodi*. (Biosemiotics 18.) Berlin: Springer, 135–147.

Kull, Kalevi 2018b. Umberto Eco on the biosemiotics of Giorgio Prodi. *Sign Systems Studies* 46(2/3): 352–364.

Lambertini, Roberto 1989. Mangiare, parlare, indagare: alcuni aspetti della teoria della conoscenza di Giorgio Prodi. *Il Margine* 9(7/8): 8–21.

Marconi, Valerio 2020. *La linea, il triangolo e il quadrato: La natura relazionale di segno e significato in Aristotele, Peirce e Hjelmslev*. Doctoral dissertation. University of Urbino: Dipartimento di Scienze della Comunicazione, Studi Umanistici e Internazionali.

Nöth, Winfried 2001. Protosemiotics and physicosemiosis. *Sign Systems Studies* 29(1): 13–27.

Peirce, Charles S. 1931–1958. *The Collected Papers of Charles Sanders Peirce*. Cambridge: Harvard University Press. [CP]

Pontara, Maria Teresa 1989. Biologia scienza umana: l'uomo schiavo della biologia? *Il Margine* 9(7/8): 106–113.

Prodi, Giorgio 1977. *Le basi materiali della significazione*. (Nuovi saggi italiani 21.) Milano: Bompiani.

Prodi, Giorgio 1983. Linguistica e biologia. In: Segre, Cesare (ed.), *Intorno alla linguistica*. Milano: Feltrinelli, 172–202. [Discussion on "Linguistica e biologia", 308–319.]

Prodi, Giorgio 1986. Semiosic competence, development of. In: Sebeok, Thomas A. (ed.), Encyclopedic Dictionary of Semiotics. Vol 2, N–Z. (Approaches to Semiotics 73.) Berlin: Mouton de Gruyter, 884–887.

Prodi, Giorgio 1988a [1977]. Material bases of signification. *Semiotica* 69(3/4): 191–241.

Prodi, Giorgio 1988b. Signs and codes in immunology. In: Sercarz, Eli E.; Celada, Franco; Michison, N. Avrion; Tada, Tomio (eds.) 1988. *The Semiotics of Cellular Communication in the Immune System: Proceedings of the NATO Advanced Research Workshop on the Semiotics of Cellular Communication in the Immune System held at Il Ciocco, Lucca, Italy, September 9–12, 1986.* (Nato ASI Series 23.) Berlin: Springer, 53–64.

Prodi, Giorgio 1988c. *Teoria e metodo in biologia e medicina*. Bologna: Editrice CLUEB.

Prodi, Giorgio 1989a. Culture as natural hermeneutics. In: Koch, Walter A. (ed.), *The Nature of Culture. Proceedings of the International and Interdisciplinary Symposium, October 7–11, 1986 in Bochum*. (Bochum Publications in Evolutionary Cultural Semiotics; BPX 12.) Bochum: Studienverlag Dr. Norbert Brockmeyer, 215–239.

Prodi, Giorgio 1989b. Biology as natural semiotics. In: Koch, Walter A. (ed.), *For a Semiotics of Emotion*. (Bochumer Beiträge zur Semiotik; BBS 4.) Bochum: Brockmeyer, 93–110.

Prodi, Giorgio 1989c. Toward a biologically grounded ethics. *Alma Mater Studiorum* 2(1): 65–73.

Prodi, Giorgio 1994. Semiosic competence, development of. In: Sebeok, Thomas A. (ed.), *Encyclopedic Dictionary of Semiotics*. Vol 2, N–Z. 2nd ed. (Approaches to Semiotics 73.) Berlin: Mouton de Gruyter, 884–887. [Reprint of Prodi 1986.]

Prodi, Giorgio 2010a. Signs and codes in immunology (1988). In: Favareau, Donald (ed.), *Essential Readings in Biosemiotics: Anthology and Commentary*. (Biosemiotics 3.) Berlin: Springer, 328–335. [Reprint of Prodi 1988b.]

Prodi, Giorgio 2010b. Semiosic competence, development of. In: Sebeok, Thomas A.; Danesi, Marcel (eds.), Encyclopedic Dictionary of Semiotics. Vol 2, N–Z. 3rd ed. Berlin: De Gruyter Mouton, 907–910. [Reprint of Prodi 1986.]

Ruse, Michael 1976. *Filosofia della biologia*. (Vignoli, Gerardo, trans.; Prodi, Giorgio, ed.) Bologna: Società editrice il Mulino. [Translation of: Ruse, Michael 1973. *The Philosophy of Biology*. London: Hutchinson.]

Sebeok, Thomas Albert 1963. Communication among social bees, by Martin Lindauer; Porpoises and sonar, by Winthrop N. Kellogg; Man and dolphin, by John C. Lilly. *Language* 39(3): 448–466.

Sebeok, Thomas Albert 1965. Animal communication: A communication network model for languages is applied to signaling behavior in animals. *Science* 147(3661): 1006–1014.

Sebeok, Thomas A. 1997. The evolution of semiosis. In: Posner, Roland; Robering, Klaus; Sebeok, Thomas A. (eds.), *Semiotics: A Handbook on the Sign-theoretic Foundations of Nature and Culture*, vol. 1. Berlin: Walter de Gruyter, 436–446.

Sebeok, Thomas 1998. The Estonian connection. *Sign Systems Studies* 26: 20–41.

Stjernfelt, Frederik 2014. *Natural Propositions: The Actuality of Peirce's Doctrine of Dicisigns*. Boston: Docent Press.

Zorzella, Cristina; Cappi, Maurizio 2012. L'uomo come *specie di comunicazione*: Bio-logica e strutture della significazione nella semiotica di Giorgio Prodi. In: Galassi, Romeo; Zorzella, Cristina; Cigana, Lorenzo (eds.), *Glossematica e semiotica: loro espansioni*. (Janus: Quaderni del circolo glossematico 10.) Treviso: ZeL Edizioni, 181–199.

Giorgio Prodi

The material bases of meaning

Translated by William N. Dodd and Anna Gasperi-Campani
(Preface, Premise)
Edited by Anna Gasperi-Campani

Preface

The prevalent tendency of semiotics is that to analyse definite conditions of semiosis: language, for instance. The outcome, in a second degree analysis, is a theory of semiosis.

The alternative proposed here is to consider the natural evolution of (any) condition of exchange, which functionally define the coalescence of systems of communication and signification. The outcome is a theory of semiotic function.

This second path is not an alternative to the first: one might say that the first is semiosis proper, the second its prehistory.

However, the latter way of proceeding bears relevant consequences also on the level of a "general theory of semiosis": not only prehistory, then, but historic interpretation, also in the sense of the present-ness of communication.

The most important consequence of such point of view is that the semiotic function becomes deeply identified with knowledge. The second is that considerations on systems of signification and of communication can never be only analytical – that is, purely concerned with an anatomy of semiosis – but functional and dynamic.

The present book sets out to treat the prehistory of semiosis through its momentous consequences on the history and on the theory of semiosis.

It is a continuation – narrower in scope but identical in perspective – of the discourse I began in the book "*La scienza, il potere, la critica*", published in 1974 by Il Mulino.

Premise

Semiology today presents several uncertainties, which amount to a crisis in its self-identity. These doubts concern fundamental points, and perhaps they raise questions on the very existence of a discipline called semiology.

Someone involved in the subject in some irreversible, institutional way will naturally explain the crisis with impromptu interpretations of a historical bent: a discipline that grew too quickly, loaded with excessive expectations. And it is easy to indicate equally impromptu remedies: the necessity of a pause for reflection and of critical work on the materials already collected. In the main, such interpretations aim to protect the existence and autonomy of the discipline.

It seems necessary, however, to go beyond the reasons and modes that have historically defined semiology, and to examine the case for it vis-à-vis other disciplines, whether well-established or evolving, so as to determine whether it filled a gap and occasioned fruitful connections, or conversely it overlapped with fields that were already solidly 'taken', disguising well-known problems and questions under new jargon and enthusiasm.

Semiotics takes culture as its model referent and construes itself as the study of the intentional sign, or at any rate sign adjusted to cultural, human behaviours. In this sense it spreads all over culture, with a necessarily all-encompassing trajectory. Since culture is given only as meaningful communication and unfolds by means of receptions and emissions, the way to view culture as a unity is as signs, and semiology is the science that unifies the various aspects of the artificial, human world. Except that this very assumption is what gives rise to the various questions. First of all: does semiology, as the study of culture in its essential aspect of communication, aim at the roots of communication and its mechanisms, thus becoming identical with the study of knowledge, or does it consider a more 'discursive', superficial layer, that is the modes of communication in an already-given language, whether natural or artificial?

The fork in the road is fundamental, and so far there have not been hints towards definite choices: one can only ascertain that the majority of semioticians have a background in linguistics, and that the second tendency is certainly the more represented. The questions raised, then, habitually concern factual correlations that can be analysed in the mechanism of communication, rather than critical problems posed by the physiology of communication.

Evidently, both deal with the same body of communication, but the standpoint of their inquiry is very different. If one chooses the path of the

mechanisms, that is of physiology, one must delve into the logical and psychological aspects, in a framework of 'a natural history of culture', where communication organises itself as a characterising element of the manners of the new species and its differentiation, that is, where it is tied to the kind of environmental contacts and the organised – and therefore cultural – prevalence that the interpreter gains over the environment. In this sense, semiology is the study of the historical organisation of cultural modes of exchange, and of the collectivisation of exchange, on the anthropological, economical, linguistic, aesthetical level.

If this is the path, however, the discipline risks ending up with little autonomy. Reconstructing it as a unitary fact from the ashes of the many disparate data and from those (the majority) that are only known as absence – as gaps – requires an effort that will easily slide into some sort of metaphysics: in this perspective, if semiotics exists alongside anthropology, sociology, the historical analysis of documents, it must exist as a norm, as a unifying moment, as the soul of the other disciplines, capable of organising the scattered limbs of communication. Semiotics is the science of these laws. Outside of this idealistic perspective, semiology would be of no more use than to highlight the necessity of considering moments of connection within and between the individual sectors: in other words, no more than a road sign or a warning notice – "Be Aware of Communication". This unifying emphasis often materialises as the fabrication of words with no real content but capable of creating the illusion of an objective domain. Thus to speak of man as a symbolic animal gives the impression that there exists a science that decodes this human specialty, while what we get in practice are the data of the individual disciplines; what connects them is nothing more than an ingenious emphasising of the term, which in and of itself says nothing.

Under this aspect, semiology is forced to fight a rearguard action; which is no obstacle to a certain triumphalist attitude, as happens when a theology is justified only by the existence of theologians. It is for this reason that objective or even quantitative analyses often conceal an interpretative key, and a motivation, of an idealistic bent.

Therefore, by choosing this first path semiotics spreads itself heavily onto other disciplines, and distinguishing syntactical, semantic, and pragmatic sides to it means nothing more than adding to the name "semiotics" a series of operations that are already established or investigated in other fields and with other techniques.

As for the other path, which is decidedly prevalent in quantitative terms, it takes human language as its starting point and becomes a sort of general linguistics. To examine language means not to address the reason

of language in the context of the differentiation of the species; to start from a highly differentiated moment and accept the individual modes as ready instruments without dwelling on their origins in terms of the reason of communication and of the evolution of what is specifically human. Conversely, it is stated that genetic problems can be marginalised and that it is possible to analyse what is given through a comparison of uniform – or diverse – modes of exchange, so as to create that linguistic tabulation that may bring to the surface the rules of discursive communication. Here too, then, through the appearance of positive glottology and phonology, through the critical or experimental alignment of factual data that emerge from quantitative and empirical inquiries, the metaphysical soul of unification rears its head. If semiotics is something more than comparative linguistics – *i.e.* if it is unifying – it is so in that it defines the synchronic soul of discursive communication. Since there is no doubt that the world of culture is, wholly and integrally, a world of discourse, what is specifically human is theorised by its authorised science – semiotics – as a quality that erupts miraculously from nature, without antecedents, characterising a species created *ex novo* in Linnaeus' final chapter. Discourse and the word are breathed into man, and man moves from his clay, transfigured in the image of the word. Structural analyses of verbal communication lead to the discovery of a pre-existing scheme, which pulls the strings of the words by infusing them with life, that is, meaning. Relations between words do not represent a function that emerges from use, but an embodiment of the rules of meaning. And if, in such a systematic, totalising vision, some digression is made towards the realm of animal communication, so much the better: the rules are so general that they make one think of Teilhard de Chardin rather than Darwin.

Another reason of the crisis resides in techniques. It is they, diverse and difficult as they are, that give the irksome impression of a conglomerate that is hard to master: it is they, therefore, that push towards adopting clean, unitary models that have not much to do with the individual analytic processes. For what technical familiarity is there between zoo-semioticians, phonologists, psycholinguists, scholars of artificial languages and of social behaviours? If they do somehow regard themselves as semioticians, they need to be able to understand each other beyond the technical specifics, and they will do this by gestures, as it were, on a common ground that consists of – precisely – gestures: some uncompelling nod, some utterly general rule, and a terminology that makes no reference to the genetic area and physiology of the individual discourse. So the emphasis placed on rules – not necessarily synchronic, but also those of a bland, recent diachrony – arises also from technical reasons, or rather from the necessity of avoiding technique.

If, on the contrary, one maintains that the technical, experimental side must precede any unitary speculation, unity can only – perhaps – be reconstructed from an examination of the individual mechanisms and the individual contexts of communication, in order to establish a sort of general physiology of communication, which will be merely an analysis of those modes of interaction which, in the human realm, we call cognitive. Therefore the experimental mindset causes semiological theory to devolve into semiology *qua* study of knowledge. At the same time, starting from a cluster of mostly linguistic techniques based on accepting discourse as a given, experimental analysis invites recourse to very diverse techniques, not only psychological and behavioural but also physiological and neurological. Since experimental analysis is in itself a discourse that seeks out connections, it becomes necessary to explore models further afield, for instance in biochemistry and comparative anatomy, so as to see if a discourse on "the whole of communication" may be led away from metaphysics to the discovery of genetic mechanisms common to the various aspects of communication or meaning. Therefore the unity of semiology and its *raison d'être* as a discipline lie in the validity of such a quest for connections, in order to establish if there exists a physiology of communication, one that is also comparative physiology and therefore differentiation. The perspective is thus one of "natural history".

The key point – and the topic of the present book – is therefore the following. Semiotics can give its field of inquiry a date of birth, and it can establish conventionally the nature of its objects. At that point it invents its own discourse, creates disciplinary boundaries for itself, exists, and flourishes. The date of birth of the objects themselves remains in the dark and there it must remain, because its experimental study can only turn up an ancestry and refer back to areas of uncertainty. One is therefore content with positing as the date of inception the 'intentionality' of the sign communication, its organising of itself as a human activity, its assumption of an already-born, already-communicating man; with construing the history of this being with no earthly father, or the timeless laws of its heavenly father. In any case, behind human communication here is the void, or the weak backing of bird cries and scent calls. Instead of analysing the enormous pressure of use in the genesis of sign, they incentivise the construction of graphs and anthropomorphic situations, the "categorisation" of sign-intentional situations by dismissing from the field of analysis the various impurities, the improper codes, the natural situations which only our ingenuity regards as sign.

Otherwise one assumes an indeterminate field of observation, hypothesising that the possibilities of human communication – from its first

anthropological organisations to formal logic and poetry – are given as the fruit of ever more ancient natural antecedents and that the possibility of receiving and transmitting signs is an ancestral fact, or even the very way that biological objects have of organising themselves, progressively more differentiated until they can produce complex cultural systems of transmission of signs. In that case it is impossible to fix *a priori* a semiotic threshold. The field must be totally open towards the origins and remain indeterminate in any case.

If one adopts this second criterion, the manner of proceeding must needs be experimental and concrete: however, the question becomes correspondingly broader and deeper in time, and disciplinary boundaries disappear, while the objects in question appear and become more definite. At that point, semiotics is an interesting opportunity to talk about things that, in any event and under whatever name, concern us closely. Its operative validity as a discipline is determined precisely by the impulse it may give to historical research – in natural history as well as cultural history – by determining the physiological modes of communication.

The viewpoint adopted in the present essay is this second one. Its experimental and objective claim to being defined as "the biological genesis of semiotic-cognitive functions" does not imply that the points of the analysis are all circumscribed and scientifically located. On the contrary, this analysis is full of massive gaps. Yet it remains to be seen which is more scientific, whether a lacunose analysis where a few certain points are connected by many hints and hypotheses, or a construction that is clear, precise, and totally invented, built on imaginary foundations. Our choice goes to the first way of proceeding, which is that of scientific research.

The reader who is attentive to the use of words (since, presumably, such is the reader of a book on semiology) deserves a preliminary warning. They will notice that some terms are used initially in a reductive way. Near-synonyms like sign and signal, interpreter and interpretant, and so forth, actually have very different meanings, and it is wrong to conflate them. Yet their differentiation, or opposition, only arises on the level of theory, at a certain stage of the development of our topic. According to the kind of analysis which we have set before us, initially they are amorphous, and they can be used as such. So the reader is advised to keep a low cultural register initially. Attunement to the text consists of holding to the level required by the text, without raising issues of "semiotic high treason". We shall take care to put between inverted commas those terms on which we wish the reader to suspend philological activity.

First Part
From the side of Nature

Some fundamental models of specificity, complementarity, correspondence, etc. are examined at different levels of complexity, proceeding from an elementary concept of sign operative at the level of molecular biology till the concept of sign as considered in semiotics.

1. Analysis criteria

To begin with, criteria must be defined, capable of delimiting the domain and the techniques of observation. We believe, above all, that analysis has to do with the objective world: *i.e.*, that the exploration of the world is a verification of actual things. We do not claim, however, to be external to this state of affairs, but admit, on the contrary, to be part of it. We are among the things that we identify and we can verify their existence only in so far as we can interact with them and be modified by them. Knowledge of things is, in this sense, both objective and inescapably subjective. The required criteria are thus subjective and serve to organize the exploration of the existing world: from the outset, the central issue of the philosophy of knowledge is the relationship between categories and facts, between criteria and things. This is a thorny philosophical problem, but one which semiotics can go a long way towards formulating and, in our view, towards resolving. The semiotician cannot simply avoid the issue by defining it – as often happens – as "extra-semiotic". In other words, the basic criterion is that of allowing the horizon of the semiotics to coincide completely with the horizon of knowledge, and the semiotic enquiry itself with the mechanisms of knowledge. This means that the world (real or possible) in which semiosis occurs is not an area detachable from reality and confined in the human world. It is, rather, the world – open before us and indefinitely extended beyond what we see – that can be talked about.

The process of semiosis is throughout subject to the state of affairs of which we are part, and to our own position within the network of exchanges in which we are involved. So we accept the initial hypothesis of a use, and a physiology, of communication inevitably translated in terms of the derivation and evolution of its very function in the natural world domain, beginning from elementary conditions.

To return to the argument already broached in the premise, these criteria force us to reject a definition of the term "subjective" which places its meaning in opposition to "objective". The customary anthropomorphic criteria which postulate the data of evidence and of consensus as primary facts – not at an individual but at a cultural level – are quite improper. These are what are normally meant by "subjective". If we accept, in defining the field of semiosis, intentionality as a condition of evidence (whereby semiosis

begins with the "intention to communicate" and is thus distinct in a self-evident fashion from other natural functions), we are guilty of an anthropomorphic operation. The discriminatory criterion by which we delimit the field is "consciousness", with all the ambiguities that the term involves. Thus the semiotician who rejects as extra-semiotic all psychological and in the broadest sense biological influences, and who limits his attention to strict correlations (discarding both actual things and the speaker's introspections), becomes conditioned himself by powerful psychological and introspective presuppositions.

On examination, the facts of "consciousness" are seen to be rooted in unconscious and automatic natural bases, and can only exist with their support. Consciousness is merely the tip of the iceberg, and if we wish to explain anything at all (in the sense of simply connecting it with other things) we are bound to resort to the submerged part, to that which holds the top above water. On the other hand the very juxtaposition of these two terms (intentionality and consciousness) is ambiguous. There are many animal attitudes which can legitimately be defined as intentional or intended but the "consciousness" of which it would be vain to seek.

Even at the level of the habitual actions of man, how can we distinguish behaviour and facts on the basis of a man's consciousness thereof, without entering into inextricable and fruitless psychological questions? And how can we delimit and measure the zones and acts of consciousness? We must inevitably adopt, in this way, other presuppositions (autonomy, interiority, liberty) which prevent us from seeing how the instruments of language are rigidly fixed and prevail over individual consciousness thereof. If we define the objective world by means of such criteria, our approach – quite fatally – will no longer be that of studying how intentionality originates in preceding behaviour, but how it is *opposed* to preceding behaviour, thus creating a specifically human field.

This sets up the myth of a "radical human novelty", *i.e.* an easy and timely point of view which effects a division into opposing phases and oscillating moments, whereby the appearance of man is the only possible unit of measurement. Dialectic is the most deeply rooted anthropomorphic vice. In semiotics it coincides with the presupposition regarding the intentionality of communication: differentiation and opposition, within a general theory of communication systems, tend to become synonymous. Actually, if the system is fixed and every operation is considered as a fact occurring with it, then differentiation has nothing behind it to justify it and so is deprived of history. It can thus be understood as an epiphany of the rules of the system. It will not be explained by the history which has produced it but by the

dialectic within the system itself. Historical differentiation will therefore be a "tending towards".

We reject the criterion of the anthropomorphism of intentionality and the methodology of an oppositional dialectic. We underline, instead, the need for a functional and objective investigation of the field, which will never be closed and structured by universal rules, but open and structured by its functions.

2. Situations of correspondence and specificity

In the material world we observe changes and our observation is a participation in change. Knowledge is modification of the world in the sense that the interpreting mechanism is altered by the phenomena or things it deciphers. We are *inside* changes, we become aware of them and interpret them in so far as they change us. It is a general condition that changes take the form of correspondences. To a variation in one object corresponds a correlated variation in another, or in a series of objects. The extremely long sequences produced are based on these single or multiple time-located correspondences which take place serially in a material context. It is this which defines the tissue of what is in reciprocal contact. It is the tissue that has produced us and that we act in. It is our non-contradiction. We interpret changes with our own changes and cannot but give a subjective account of events. Yet these, and our deciphering of them, would be meaningless outside an objective, material framework. Idealisms crumble before the objectivity of all that is subjective. We see the material correspondences of nature as a constant condition, as a state of fact, erecting them into the concepts of causality and probability – and they are real enough to sustain some of those flights of idealism that researchers occasionally indulge in.

In any case, correspondences are identified through modifications in the system, that is, through exchanges of energy. An explosion is a thermodynamic event occurring in a change of nexuses, it is physical correspondences in material strata, which release a certain quantity of energy. Thus, if there is an explosion in a distant star, we try to identify the situation of unknown correspondences that have caused it, just as, when an individual dies, we try to define the framework of correspondences surrounding this death. However, we do not succeed in defining the essence of things but only their characteristics revealed by energy exchanges. Experimental science consists in "provoking" objects, in rendering correspondences evident. It is hardly necessary to stress that the present argument is built on a very definite

and essential assumption: namely that the framework is homogeneous and thus has no "reserved areas". We ourselves are within the framework on a par with everything else. There is thus no point in posing ourselves problems regarding the creation of the world by human intelligence: such hypotheses simply cannot be propounded.

In nature, however, there are particularly complex situations of correspondence where energy exchange, which is always the mark of a correspondence, is conditioned by reciprocal relationships that we shall simply label "adjusted" for the moment. These situations constitute a second category of natural facts which obviously cannot be separated from the former but are interpretable as a development of these in the direction of a differentiation of exchange conditions. Their basic characteristic is that the material correspondence which acts as a trigger for the energy exchange is a specificity condition, in the general sense that the two terms of the correspondence are reciprocally adapted. Whereas with phenomena of the first type – for example, a falling body – the framework of relations is extremely general (*e.g.* the mass of the earth and the absence of constraints), with the second type, the exchange occurs only if the condition of correspondence expresses the reciprocal adaptation of the objects which form the site of the change.

In nature we thus find the general situation of a material object whose conditions are varied by a correspondence in the form of another material object specifically adapted to it. The energy conditions capable of producing the change depend on reciprocal adaptation. We are not interested at present in the genesis of the specificity or of the adaptation. What we wish to stress is that the liberation of energy requires the evidence of a specific key and needs to be triggered by the contact with it.

All these phenomena come under the heading of what, in the broadest sense, we can call biology. It is a very extensive domain whose origins are uncertain. We are not concerned with drawing boundaries or establishing oppositions between the "biological" and the "non-biological".

We are concerned, rather, with the basic characteristics of the condition of specific correspondence. First, there must be two material objects that interact (*i.e.* that come into contact, in the broad sense used here). A change will occur only if the two objects correspond sterically in some part. The concept of specificity is thus found, materially, in spatial correspondence, reciprocal adaptation, or complementariness, which can be roughly represented as an interlocking, or key-and-keyhole condition. The concept, however, is more general than the image of spatial correspondence suggests. In knowledge, too, the identification of forms is a prerequisite for triggering exchanges. The same holds for artificial, man-made machines.

In any case, we can define this condition as follows: the reciprocal change in two things is subject to their being complementary. The change is represented, for instance, by the formation of a metastable complex between the two terms. We do not need to assume initially a primary role for one of the two terms, but simply must postulate the kinetic characteristics necessary for A and B to meet in the sea of possible objects and events. "Reciprocal specificity" does not mean "tending towards". Any more we shall take the existence of reciprocity as entailing an "external design" or "plan". Thus we rule out any recourse to models of tropism. All that needs to be posited is the possibility of movement (the simplest condition of which is random) of A and B in their context, with a certain probability of meeting. Whereas contacts with other material elements present are collisions (and these elements are indifferent), the accidental contact between A and B turns into a reason for change. A and B, that is, reveal themselves as contextually correspondent precisely through the reciprocal modification regulated by selectivity. This is how A and B select each other in the context of indifferent presences.

A number of issues need to be faced with regards to this general condition – or general model – of correspondence. They have also terminological aspects. First of all, correspondence is a reciprocal configuration of objects. We can call this an "order" or an ordered condition, or a situation of ordered structures, bearing in mind, however, that the concept of order is independent of the concept of an ordering entity. Order, in its elementary state, is a condition of reciprocity between two things revealed by a material event. It does not dwell in one or the other, but in both, at least in the initial model. There is no "container of order" but only one thing ordered in relation to another. All this needs stressing because many misapprehensions arise from distinguishing between order and structure, as if a structure could be nothing more than the container of an extrinsic, metaphysical entity called order (and, naturally, at higher levels, intention, consciousness, plans, etc.).

Secondly, the correspondence, and the occurrence of the metastable complex and the change that follows, are based on material states which render the process physically possible. To say that correspondence is regulated by form does not mean that form is superimposed on matter or is the arbiter of exchanges; the form of A is felt by B to be complementary, and vice-versa, because it is materially superimposable via a process which involves energy. We can exemplify this from macromolecular chemistry: "adaptation" and "recognition of complementariness" occur because molecule A comes within the range of action of molecule B's weak bonds, and a number of points of A adapt to the correspondent points of B. On the other hand, the

"internal structure" of A and B, too, from the molecular point of view, consists of energy bonds which must occupy space and are inevitably orientated and endowed with a proper configuration.

The distinction between form and matter, structure and function, is misleading. There are realities which come into contact with each other in so far as they are structured. A material complex cannot exist without a given volume and a given form. On the other hand a form can only be identified by interaction with its matter and through the energy exchanges produced by this interaction. Material structure is something built in a way defined in relation to something else.

If we consider specificities not immediately verifiable as the corresponding by the senses and far more complex than the single structure of A in relation to B (for instance, the correspondence between a word and its thing), we shall not on this account say that they are immaterial or that their existence is evidence of a different world, but simply that the situation of material correspondence is very complex. The situations of correspondence must be explained in genetic terms, that is to say, in terms of derivation. To define an ensemble as a "structure" involves making a hypothesis about its functioning, its mechanism, and above all its derivation. This holds true for all levels, even such higher levels as cultural interpretation.

Structure, then, is a material state interpreted by another material state. This cannot simply be taken as given, as if it were a photograph, for the reason that material states do not exist as simply "given" but derive from a history of interactions leading to their assumption through knowledge. This in no way alters the objective value we assign to the term "structure".

These remarks are necessary as a warning against the incautious manner in which the term "structure" is currently employed, for it has been much abused by contemporary cultural fashions and its meaning distorted by quite illegitimate analogical operations.

It needs stressing that material correspondence, as exemplified by two objects-molecules, is an extremely general issue. We cannot conceive of cognitive processes without a moment of reciprocal contact and the creation of a metastable complex upon which the continuation of interpretation is dependent.

A third issue, of a terminological kind, concerns "reciprocal meaning" in reactions of specificity. We say that A reads (deciphers, explores) B and vice-versa. In nature, complementariness is above all a reading or interpretation, that is, an exchange subject to reciprocal meaningfulness.

But reading or interpretation does not make sense if we consider it solely in relation to the two terms which come into contact. Reading, in order to

be defined as interpretation, must be seen objectively in the material context, otherwise we shall be waylaid into the most facile and absurd interpretation that A seeks B because it is made for seeking B. Rather, what we have is A and B plus an indefinite number of indifferent presences. If A and B can meet, it is above all because they can "review" all the presences. This process can be either an entropic and random agitation, governed by a certain degree of probability or an ordered series of contacts in sequence.

The terms "interpretation", "reading" and "meaningfulness" are used here at the most basic level, as a sort of amorphous linguistic allusion to the "correspondence of specificity". However, they have an analogical function, as well as foreshadowing the direction this study will take later on.

The process of finding each other is therefore a reading or interpretation of reality carried out by A and B according to their constitutional modules. Thus for A and for B, reading reality consists in reviewing and rejecting indifferent objects and choosing significant ones. In its exploration that terminates in the contact with B, A makes a judgment about reality, since it is moved to change only when it finds its complementary significant reality. It is this which is A's interpretation of the environment: its being moved to change by B. Thus the material presence B is detected by A as follows: it elicits a change by means of complementariness. We shall say that A "reads" reality and knows B. It can only know B through its own structure, which is what makes it reject the indifferent presences. Reality is always known (and this is an extremely general condition) through the modules of the exploring structure. Knowledge in this sense is inescapably subjective, or perspective-determined: it is A's perspective on B, or B's on A, according to their structures. "Subjective" is here, of necessity, taken as the opposite of "arbitrary". There is a necessary logic in this subjective operation which goes back to A and B's reciprocal genesis. At the level of the most complex – *i.e.* human – knowledge, the terms of the problem do not change substantially.

Meaning in nature is thus the relation of correspondence between material states which appear as triggers for change: though it is often understood in the same way as order, as something that is transferred to a container in the present context is "the existence of an object which is significant for" (*i.e.* which is capable of inducing a specific modification). Meaning, therefore, is neither the essence proper to a given object nor the essence proper to the totality of the objects of a system. Totality does not exist in this sense: there will never be a total or overall interaction. Meaning and the attribution of meaning are sequential material processes that presuppose both a world to be explored and a structure capable of exploring, and, in all cases, the limited and specialized possibilities of this exploration.

Hence: B is a "sign" for A, and vice-versa. This is the ground of semiotics. For the moment we shall not distinguish between signal and sign. We must go back to the roots of elementary situations and on the basis of these we must reinterpret complex situations. Of course, we do not pretend to exhaust complex situations simply by tackling elementary ones and we are in no way proposing to assimilate, reductively, the linguistic sign *sic et simpliciter* to the univocal molecular sign. On the contrary, it is only an awareness of the extreme complexity of the biological situations upon which culture is built that can protect us from the oversimplifications of purely cultural interpretations, which usually appease interpretative demands by simply coining a name. It is important to point out that, for all the enormous, often inextricable complexity of language phenomena at the human level, we cannot interpret them other than by starting out with the phenomenon of elementary complementariness, for the simple reason that the things of which language is composed passed through this stage at some point in their development. The objection that our present state of knowledge is extremely limited for this issue is not a relevant one. It is a mistake to think we have an answer to everything. The most serious mistakes are those made when we simplify things artificially on the basis of analogical and anthropomorphic assumptions.

Reciprocal meaning, then, is manifested by a process which selectively modifies the states of the terms. This in itself is a signaling process, which is one and the same with (*i.e.* contextual to, not superimposed on) the reactions that take place. The signal is embodied in the event, of which it is the symptom in that it is the mode of occurrence of the event. It is not a poster attached to the event, or a pointer indicating the event, but the event itself signaled by its being triggered off or its developing. We can imagine a blind object examining what surrounds it (excluding any perceptive and, above all, human implications from our image): it will identify certain things that correspond to its parameter and identify them by their shape and with its touch. What the blind object performs is a process of material knowledge.

3. Remarks on the methodological standpoint

We have postulated a situation which is both concrete and general, assuming from the outset that generality is not to be found in some common substance or idealistic organic unity. Our schematic model is neither the essence nor the law of the situation by the concrete situation itself at its simplest level. It reoccurs, variously combined, in more complex situations. Thus, to our

a priori premise (which is assumed but not demonstrated, and explains us but cannot itself be explained) that the plane of reality is homogeneous, we must add a further premise of a methodological kind: the complex exploration is made up of simple ascertainments and its roots lie in the material knowledge implicit in the simplest model. Single material events can be linked to form extremely complex situations and highly unitary reading machines: but we are by no means entitled to assume that the increase in complexity at some point involves a radical, qualitative leap forward. The situation we are faces with is composed of single, particular events in which particular exchanges and signaling take place. The possibility of interpreting them as a whole with the aid of a model implies highly sophisticated cognitive procedures but not new faculties involving a leap from the particular to the universal.

The only possible way of extending the particular is in the direction of a greater degree of generality, which means widening the area of interaction. The network consists of the occurrences of particular correspondences which influence one another at a distance (in space and time) via a chain of material occurrences. There can be no gaps in its tissue. It is worth stressing that this does not mean we are ascribing "totality" or "universality" to the tissue. All we can say is that this horizon is external, too, *i.e.* greater than the sum of the reading machines, and that these must be interpreted by means of the horizon and not vice-versa. Human knowledge is necessarily a product of material knowledge that has been developed and complicated within the tissue.

A typical objection to this kind of assumption is that it degrades knowledge into mechanical atomism. Unfortunately the term "mechanical atomism" is quite meaningless and thus has no value as criticism. It is precisely by breaking down complex situations and reconstructing their historical development that we are able to see that they differ from the sum of simple situations and are in fact built up of structures capable of complex interpretations.

When we talk about specificity – and our premises show how important this concept is to our argument – it is a mistake to think that it consists of something "new" opposed to and superseding the "old". Whilst it is reasonable to insist on the specificity, in nature, of human cultural situations, we must not overlock the fact that these are new arrangements that presuppose what preceded them and could not appear without the sum of the previous construction.

Briefly, then: our assumption is that knowing implies a world of things all on a par which can be interacted with and that this is the all-embracing

a priori of whatever we are able to do, write or interpret. Things are the starting point: things in their singleness and capacity for exchange, things connected by the network of facts and thus things in their overall connectibility. Any interpreter acting within this network and in a given sector is *secondary* in respect of the network and must be seen as a thing capable itself of being interpreted, as a thing among things.

The framework of our analysis is thus a complex of given things, a sum of things capable of interacting and of interaction events. In any operation of knowledge, we are an A equipped with single interpretative parameters and form part of the framework of all possible Bs. We cannot remotely conceive of escaping from our context.

It follows that semiotic discussions of the referent, in particular of the so-called "referential fallacy" need to be reconsidered from a different methodological angle. The referent, of course, has a complex relationship with human knowledge and with semiotic processes on a cultural kind. This is why it is usually kept in quarantine and has become something of a skeleton in the cupboard. Man's modes of semiotic contact with the environment are highly complex, so that to promote the things named into fully-fledged participants in the naming process certainly seems puerile. But if things themselves can, in a precise and predictable fashion, be modified by scientific knowledge (*i.e.* by a particular way of naming them), this means that there must be some sort of link with the referent in the chain of meaning. The referential fallacy cannot be eliminated by adopting an idealistic approach to the problem. There are two ways of verifying how name and referent are related: the one consists in accounting for the complexity of human knowledge by a discerning and critical epistemology (*i.e.* in explaining the modes wherewith science registers objects), the other in studying the birth of the exploratory function itself. The second kind of approach reveals how, at the onset, the referent is so far from being fallacious as to coincide, without any need for the mediations of codes, directly with the sign – obviously a "sign for" something capable of "being modified specifically by".

4. Consequences of specificity reactions

Some concepts derive from A B model.

(1) The concept of environment. We have seen how the material presence A reviews indifferent material presences. It does not enter into relation with them or find meanings, and it does not "identify" them as corresponding

to its parameters of exploration. It does enter into relationship with B. B is a meaningful environment for A and vice-versa, but the environment is larger than these and contains the indifferent things which must be able to review without "feeling" them. This means that we cannot take A and what is complementary to A as our sole parameter for the action of A, for this would amount to an idealistic interpretation or the knowledge of A. There is, in fact, a general situation which is not measured by A alone – not even as regards what is specific for A. The system as a whole has enough motion and exchanges to enable A to carry out the process of screening. It has a total energy which is greater than A and of which A takes advantage. Thus the single is always within something and is a particular case.

The complex surrounding A in the totality of the presences is A's environment. This has an important consequence: just as A's mode of interaction is particular, so is A's knowledge-response to the environment partial. The situation taken as our model is thus purely schematic. If some things are indifferent for A, they will not be so for a U. An observer connected to the whole of presences would be able to see the network of single meaning-relationships – a network of particular but interlinked events that force us to recognize that there are not simply two categories of things, some indifferent and others meaningful, but a quantity of things, each of which is indifferent and meaningful in relation to the others. What counts is their "being specific for". A sign is a thing which is complementary to another thing, and reality observed in a given area is a network of reciprocal meaningfulness and of exchanges conditioned by these: a network of transformations regulated by meaningfulness. We shall see that this "environment-area" of the terms of the interpretation is not simply a geometrical space, but a genetic area. It is from this that meaning derives its meaning.

(2) The concept of generality. When A interacts with a B, it can interact with all Bs, that is, with all the objects that come within the realm of its reaction capacities. For instance, the complex [AB] can be reversible, and A can again meet another B. The reaction is thus particular, since it can only take place under the physical conditions that constitute the single B, but it is general too, because it can occur with a plurality of Bs. In the process of identification of meaning, then, there is no strictly and exclusively particular (*i.e.* individual) moment. Recognizing meaning is, from the outset, recognizing a condition of generality. It is the reaction of identification of meaningfulness which identifies the class of Bs. In a universe made up of A, B, and indifferent objects, the experimental definition of the class of Bs is their relationship with A, and that the category is relative to the interaction. Indifferent

things reveal themselves as members of the category of Bs as they come to react with A. The "perspective" (the category) of A makes the category of Bs.

(3) The concept of complication. Let us suppose that an A is bi-functional, *i.e.* that it interacts via two given points with a B and a C, feeling two different things as meaningful. What we have is an elementary amalgamation (combine) of meaning reception. This situation is only slightly more complex than the previous one: collisions permit the recognition of two categories of objects, Bs and Cs. If we imagine a tri- or four-functional A, the number of objects identifiable increases, but A's mode of interacting with its environment (the categoricity of A) does not alter, so the effect of complication is solely apparent. But let us suppose that destructive and non-destructive contacts are possible within the same environment. A will be faced with two possibilities or results: a metastable complex A-B involving the loss of functionality and destruction of both, and a more stable complex A-X. Clearly, whether A encounters B or X will radically affect A's history. If A is bi-functional, once it has been stabilized by X it can react with an *n*, producing an AX*n*. Suppose A-X "gains from" the interaction with a given *n*, that is, not only is the A-X interaction not destructive, but it is also facilitated and stabilized by reading an *n*. The reading complex A-X will thus be more "constructed" in the sense that it has reading advantages in the context of its sign environment given that it can read *n*. Complication, therefore, is linked to real reading advantages in the interpretation of the environment.

The reciprocal, non-preferential reading of A and B was taken as basic model, necessary for defining the beginning of the condition of meaning in nature: but the construction of more complex readers occur, that is, differentiated and specialized reading machines whose possible area of interpretation is larger. Thus situations of interpretative asymmetry come into being. Given that it is a real situation that occurs within the horizon, asymmetry can be interpreted solely in terms of *actual* complication, *i.e.* of differentiating and evolutionary processes that can be understood only in their historical development (in terms of *natural* history). For the moment we shall deal only with the possibility of "centralized" interpretations (those converging in a single entity with high identifying powers) and of more or less vast areas read or deciphered by the interpreting structure. We can thus here draw the distinction (an extremely relative one, of course, which derives from a basic situation of non-preferentiality) between objects read and a subject that reads. Here the contraposition between individuals and environment comes into being. If the "interpreters" increase and grow more complicated, the number of non-indifferent things – *i.e.* the "signs for some

reader" – grows too. The environment is thus a set of signs connatural with and contextual to the interpreting machines. Neither recognition nor, on higher levels, knowledge would be possible if all elements were not of necessity on the same plane, without any "qualitative preference". Preferences are determined solely by complexity. With an increase in complexity goes an increase in the meaningful environmental area or section of the world with which the reader interacts. For a given complex reader, the sign-things increase and the indifferent things diminish. But the primary condition that generates complexity is the interchangeability of interpreter and referent. In the elementary model, every A is at once the interpreter and referent of B. Each referent is itself a sign. At the same time, we do not find an A face with a B, but an A and a B moving in a thicket of presences simultaneously with other reader-referents. Each has its sectors of meaningfulness, and each is susceptible to alterations in its interpreting capacities.

This means that the possibility of distinguishing sign from referent and from sense (together with the rest of semiotic subdivisions, their various triangles and nomenclatures), as well as the distinction between a "specialized reader" and an object of reading, are "recent" developments, produced by a mechanism of evolutionary complication and differentiation. If we have deliberately mixed up the terms of Ogden's triangle and those of various others, this does not mean that our position is unrigorous: on the contrary it is a clear point of view, which precisely identifies an elementary and primary situation. If we decide to situate the beginning of semiotics at that point where the sign begins to acquire in the exchange the meaning semioticians ascribe to it (which may be quite legitimate), we shall still need to situate this sign as a point in an evolutionary process.

(4) The "discrete" nature of reading. Reading is a "thing by thing" process, a singular, biunivocal process. Even when complicated, it continues to be built upon singular contributions. This characteristic is maintained even in the most complex interpretations, in which reading has to break up a process into its fragments and segments for the purposes both of deciphering and transmission. Facts mingle, accumulate and are complicated, but the resulting combination is always that of single phenomena connected with single things. The discrete character of interaction by no means rules out an overall structural interpretation of it, nor is it synonymous with atomized, dispersive interaction. Here again we must reject various "either/or" which cultural dogmas would bully us into accepting. No overall interpretation makes sense unless it is based on (and explained by) a coordination of discrete events.

Undoubtedly, "singularness" is relative to the scale of observation: at a certain degree of approximation the discrete will appear as continuous. Nevertheless, a complex construction that takes the continuous as its starting point is still built upon discrete events, each of which is governed by specificity. It is no accident that scientific analysis works backwards through the stages of phylogenetic complication. Even the functioning of knowledge, which appears to be based entirely on the continuous, is the approximated overall resultant of discontinuous processes; often enough this resultant, if it is to be described with precision, has to be based on statistical assumptions and thus presupposes a plurality of discrete events. As regards the transmission of knowledge, hypotheses as to its mechanisms again involve re-segmentation of the continuous.

(5) The physical ground of reading. A "chooses" B on account of material correspondences, but this does not become a purely qualitative, immaterial, metaphysical choice between a "yes" and a "no". It is a natural fact expressed by the stability of the metastable complex formed: the phenomenon occurs with a given "affinity", the recognition has a given "force". The reading thus has a certain degree of precision. Specificity does not consist in finding one's absolute partner: from the history of A and B we cannot extract a dialectic of contraries or complementaries. It is governed by conditions of equilibrium, affinity, stability, and bond energy that can be exemplified by thermodynamic situations. The process comes entirely within the domain of natural processes and is not endowed with any new quality.

(6) The "function" of the recognition process. It was remarked earlier that recognition is the condition of the exchange of energy. This means that recognition, in the exchange economy, makes the "money" available. The potentialities made available to the reciprocal referents (and then to the reading machine in a position of vantage) by the sign process are those inherent in the energy of the ensuing process. But the liberation of energy in a sign-referent chain means an exchange governed by sequential reactions of meaningfulness. This places the stress both on the physical and material consequences of reading (which is always a natural process), and on its status as "exchangeable material". If an A is transformed by a B so as to reach a state of excitation enabling it to react with a C, this clearly constitutes a chain of reactions which is at the same time a chain of complementariness and of meanings. The environment is interlinked by these exchange actions. In a chain of readers, communication is a primary, essential fact for the phenomenon of meaning, and not an accessory feature (as if a fact, once ascertained, could the at will be communicated).

5. Material logic

The things which make up the world (whether they are known or unknown) are the datum which precedes our reflecting upon them. Their "behaviour" is an *a priori* with respect to ours and includes ours as a particular instance. We will never understand the world if we do not start from the assumption that the interpreter is an object among objects of the same kind, presupposing that the entire semiotic process, whatever its nature or mode, takes place on a horizontal plane of basically "non-preferential" verifications. The idea of homogeneity of the world is expressed roughly as follows: given an *a*, around which are situated *c*, *d*, *e*, such that when *a* is transformed into *a'*, *c*, *d*, *e*, are transformed into *c'*, *d'*, *e'*, we shall say that *a*, *c*, *d*, *e*, are linked to each other and, more particularly, that *a* is correlated with *c*, *d*, *e.* in the field of specificity correspondences, this can be translated as: "every time A is able to interact with a B, the complex A-B is formed". Specificity, however important, is nothing more than an expression of homogeneity established through correspondence. The "form" directs the exchange, prevents its dispersion, makes use of it by "aiming it" at an A and a B, and subsequently at the other elements that intervene in the complication of the reading structure. This "orientated direction" of the consumption of energy is not a qualitative leap forward. It is a particular case included in the vast domain of natural homogeneity and connaturality.

Here, then, a general situation of "non-elastic" exchange appears. However we interpret it (whether by Newtonian or probabilistic mechanics, microphysics or macrophysics) and whatever our instrument and techniques, the correspondence between phenomena is the datum from which we begin and conditions any interpretation. Correspondence is material and given, and the fact that it is possible to influence it does not prove that we are introducing new dimension into the phenomena. On the contrary, it means that we are so completely immersed in these as to be included ourselves in the number of possible correspondences. Knowledge can change the world because it is an element in the world and partakes of its possibilities.

This absolutely objective framework (most of which we do not know, but presuppose) consisting of things in a relationship of non-elastic change transformation, which is our world, is logical in itself. We are accustomed to associating logic only with the capacities of thought. But if these capacities exist in nature, it is because they have been differentiated in nature; and given that they act upon nature, they share a common origin with the material exchanges they are capable of interpreting, since they are founded on the logic of material exchange differentiated by increasingly more complex functions.

The material logic lies in the facts themselves and the relations between elements forming the horizon. These are simply what they are. They are given and they can only be influenced in so far as their orientation and possibility of relation is concerned: we can exploit the non-elastic, material logic upon which they are built in order to direct them. Even phylogenetic complication, which has given rise to an enormous variety of complexity conditions, has acted on the material available and adopted the only logic possible – that inherent in things. Things which undergo alterations due to the action of other things are logical in that they cannot be otherwise. They are immersed in the logical situation. It does not seem reasonable to pose further questions in order to try and "explain" the logic. Our logic can go as far as ascertaining the more general logic of things, one of whose aspects is knowledge.

In this sense, at its lowest level, logic is a material tautology. What is, is logical. In the sense used here, the verb "to be" is thus an integral part of the logic. There is a material logic, because the tissue of correspondences is thus and thus, and the relations of correspondence are non-elastic and cannot be altered at will: they are given and uniform. If an A interacts with a B, and if every time A meets B it interacts, this is a logical operation, a logical type of material relation; it expresses the inescapable tissue of the real. Our logic is inevitably built upon the objectivity of material logic. If we say a thing "exists", we are referring to the operations that identify it through modifications. These will be both subjective, as for every A that identifies a B, and logic-connective, in that they belongs to the uniform, homogeneous plane of the real. This is why logic and existence are synonyms if considered in the framework of the dominant *a priori* which constructs us. A human logic can only been constructed by retrieving the material logic underlying extremely complex exchange situations and ridding it of the arbitrary modes and improper uses to which certain cultural situations have put it.

As regards correspondence conditions in their aspect as signs, it is obvious that material logic and material semiotics coincide. If a thing interacts selectively with another, discovering it as a referent-sign and as an operative trigger, this is a logical condition, connected with the impersonal assertion "every time that...", and it expresses the non-elasticity of the tissue in which everything is immersed, and which extends beyond all reflection and encompasses all reflection.

It simply leads us to our "particular", *i.e.* to our single environment where we find only particular, single things. From these, we try to reconstruct (in a particular, single way) both a connaturality – a state of "deriving from" or "being born of" – and a generality capable of connecting us also with not

strictly genetic areas. The interpretation of things is basically a matter of recognizing that they "come first" and are "what they are", neither preferential nor influenceable.

It is important to interpret in this respect the transformation of the world effected by human logic. Elected to a central role in science, logic has come to be identified with that myth of man as a shaper of reality from without. This myth is not essentially different from those pre-scientific and idealistic myths which assign man the role of interpreting the world and giving it meaning. Yet it is clear that if man is able to act upon things, interpreting them and directing them, it is only because he himself is a particular thing among other things – one endowed with material volume and a large, specialized, connecting structure that has fully preserved the material logic upon which it is built. Man with his possibilities of knowledge is thus a center of very complex connections – so complex as to give rise to that special state of vision and control of his total situation that we call consciousness. He knows because he is connatural and homogeneous with the logic of the world to which he belongs, and because he himself derives, historically, from the very material logic he is capable of interpreting. We must thus reject any idealistic strivings and temptations in favor of a totally objective interpretation that is both more embracing than, and wholly anterior to man. It should be clear by now that this absolute objectivity in no way amounts to a "metaphysics of the object": on the contrary, it is an interaction.

The introduction of human logic into material logic is basically a sign situation. Man as a complex connecting center is a center for the reception of signs and the identification of meanings; these exist because the relationship between interpreter and environmental referent is non-elastic and logical. Of course, situations of elasticity, ambiguity may well arise from this, but they are generated subsequently to the first natural, non-elastic constructions.

Broadly speaking, from our present standpoint, logic and semiotics coincide at the human level too. They themselves have developed in the context of material logic and material semiotics. Thus the relationship between inference and meaning is much older than the modes of human interaction.

The roots of our present logic-semiotic situations, which characterize us as cultural beings – with all our ambiguities and obscurities, should not be sought in some "specific class" of "the ambiguous" or "the obscure" that mysteriously emerges from the depths of a quasi-divine, new, mysteriously primitive being. They must be traced back to progressive combinations (objectively, these are always logical and semiotic) which have prospered as material situations in a natural context. These combinations are not abstract possibilities but the product of the specific situation of man's phylogeny,

whereby he is differentiated as an animal capable of complex connections. Human differentiation has progressed by means of interaction and signaling situations. It is clear that "logic" in this sense is by no means the contrary of irrationality. Also natural facts of an instinctive kind have their own logic for the simple reason that they have come into being in nature. Here again, then, we must dismantle certain facile dichotomies that have vitiated our culture – all of which stem from our idealistic-dialectical tradition based on fictitious symmetries, oppositions and oscillations of a prevalently dramatic and emotional type, in which man casts himself in the hero's role and fails to make due allowance for the tissue he derives from.

It is worth emphasizing here that the recurrent use of the term "material" in these pages should not be taken as a harking back to 19th-century positivism or to dialectical materialism. It serve simply to denote the homogeneity of the horizon, which is nothing other than "*x*" (*i.e.* material). The term could be replaced by various others, such as spiritual, given, present, provided this were done uniformly throughout the whole text.

6. Systems of complementariness and signaling

Many semioticians start from artificial communication models consisting of circuits, channels, emitters, receivers, etc., and make direct use of the concepts of information, redundancy, background noise, and so on. Our model A-B is not of this kind, and A and B are not meant to represent circuits and feed-back (though clearly, if this model is valid, it will also cover the latter).

Neither does our use of the term model coincide with that of the philosophy of science or of mathematics, where model is a theoretical construction that "embraces" and simplifies numerous specific cases. Our model constitutes an elementary situation. Because the whole of our argument is based on the presupposition that this situation is objective and determines our very ability to reconstruct it cognitively, our model will thus *also* be a fact. It implies the existence of a real model "situation A-B". This means that the substantiate terms like "material knowledge", "material logic", "elementary sign situation" (all more or less synonyms of the situation represented by the model) we must find specific natural situations and explain the complexity of the model as a complication of these. We must therefore analyze actual situations from an experimental standpoint, rather than analyze formal models.

With regard to this issue, we may underline the following assertions, some of which have already been foreshadowed in propositions advanced earlier.

(1) The model of specific correspondence came into existence and asserted itself in the biological domain. What we call living beings are such because they are based on, and organize, specificity correspondences. Thus, given the original identity between sign and specificity correspondence, we can roughly identify the area of signs with the area of biology, and interpret the latter as a collection of sign systems.

(2) This area is not sharply demarcated from what lies outside it and what precedes it. It grows, little by little, out of conditions of selective adjustment of correspondence. Life rises from the realm of the inorganic in so far as it specializes in the reception and manipulation of signs. The domain of the living and of the inorganic are thus homogeneous and continuous. The living beings known to us – even the most elementary – are extremely complex, so that we have to postulate an intermediate stratum for which there is no actual evidence, and try to reconstruct it by experimental research.

(3) The "domain" of living beings is not a class characterized by an essence or a distinctive feature, but embraces extremely diverse, real material objects whose common property is that they interpret an area, correspond to a given neighborhood of signs (which constitutes both the reference and environment of the organism). This variability is itself a natural fact in the sense that it does not take accidental or fantastic paths but rather standardized ones implying some basic procedures. Evolution is the complication that occurs in the natural history of correspondence systems, always in single objects and single situations and with particular mechanisms. Differentiation is the evolutionary process as it appears in the single individual examined.

(4) Evolution, the growth of complexity, is based on mechanisms that are part of material logic and cannot be interpreted as finalized or directed. If complexity arises (and it is a synonym of order, as we have seen), it does so as an accidental event carrying reading advantages – *i.e.* it increases the chances of setting up relations with the referent. This means, broadly speaking, that the reading of the referent is linked to the "emergence", the "persistence" and the "predominance" of the structure. It is thus not a formal reading like that of the semiotician but one with a metabolic and survival function. This reading is basically a destructive process: as soon as a system has a reading advantage over its environment it will read the referent because it gains by so doing – which means that it uses the referent to stabilize itself whilst destroying the latter as such. This is the path that eventually leads to the formal reading of the semiotician via successive complications of the

possibilities of identifying the referent by material, destructive operations. An objective, necessary texture is set up between reader and what is read.

7. Methods for analyzing structures

The only way to analyze real, elementary models belonging to the biological domain is through scientific research. It is a complex procedure in which the "provocative" role of the observer is an essential factor.

There are two types of experimental approaches. One consists in working backwards from the complex to the simple, collecting and classifying traces surviving in nature in the manner of paleontologists. The other consists in analyzing the spectrum extant in the present and interpreting the complex as deriving from the simple in a dynamic, evolutionary process.

There is no doubt that the latter is the more concrete approach. Paleontology is extremely useful for identifying "options" that have taken place at already highly complex levels, but the traces of elementary levels have all been definitively cancelled. Following the second approach, there are again two possibilities – that of what we can call comparative anatomy and that of biochemistry. The approach of comparative anatomy (an umbrella term here that also includes zoology, comparative physiology, ecology, ethology, genetics of populations, etc.) is, however, too embracing and deals with systems too complex for our purposes.

When it approaches simple situations it analyzes these as a whole both morphologically and functionally, and considers them both in themselves and in relation to their environment. What we need here is an approach capable not only of analyzing the most simple elements that have survived till the present, but also of carrying out a componential analysis from within – *i.e.* through the constituent parts of the object. On the contrary, the biochemical – structural approach "dismantles" the structure of the object and enables us to reconstruct extant complexity as an assemblage or composition of simple situations. It endeavors, in other words, to pick out those very units capable of selective interaction that we have postulated as our general condition or elementary model. Under the heading of "biochemistry" a wide range of disciplines is included: molecular genetics, molecular biology, biophysics, as well as those "analogical" sciences, such as cybernetics, bionics, etc, that can be considered subsidiaries of these. We do not intend, of course, to tackle this problem from the biochemical standpoint, but simply to draw attention to the relationship between biochemistry and the matter in hand.

It is worth noting that a third kind of approach is possible, namely a sort of "artificial biochemical paleontology", reproducing in the laboratory the conditions. This kind of research is that being carried out on the synthesis of amino acids and nucleic bases under temperature, pressure, and irradiation conditions presumably corresponding to those found on the earth's surface some billions of years ago. It has so far led to the construction of over-simple situations and thus suffers from the opposite kind of defect to that of the "comparative anatomy".

8. The initial phases

There is a lacuna at the level of what we have called "reciprocal signalling" of specificity where the terms A and B are each both sign and efferent for the complementary term, without having any reading advantages over the other so far. The simplest biological systems are already, by definition, systems with reading advantages and use the sign-referent-environment complex for the purposes of metabolism. The identification of the complementary element is, in fact, carried out by a reading machine which already has an enormous "predominance" over the section of the world it deciphers and exploits. A bacterium has an overwhelming complexity compared with the environment on which it survives and with the referents-signs that it metabolises and exploits for their energy. Even a single compound isolated from this integrated complex (an enzyme, for example) has a phylogenetically well-established advantages over its substrate. It is precisely these advantages, combined with others, that go to make up the overall advantage of the reader-individual over its referent-environment. The enzyme has a marked advantage over its substrate because it has a natural history of information and options behind it.

Thus even those rather artificial *in vitro* systems in which we try to break down complexity provide situations which are rather complex and inevitably "biological" in the normal sense of the word. Our initial system (non-preferential A-B) could be defined, from this standpoint, as pre-biological.

However, many stable reciprocal reading situations are to be found in biological structures. These are many cases in which the specificity conditions are well established and yet give rise not to a metastable complex followed by the destruction of one of the two terms, but to a stationary integrated complex – for instance, the macromolecules forming the cell membranes and all the other relatively stable structures of the cell. Each macromolecule receives signs from, and sets up relationship with, the others and

gives rise to a structure. This may be the product of the situation of elementary reciprocity, though in each case it has become an internal and constitutive signalling situation, and is no longer simply a relationship between a reader and the world it reads.

9. Real biological situations

The evidence supplied by biochemical analysis concerns a relatively advanced stage in the development of "natural semiology" or the organization of specificity. The basic feature of this stage, which distinguishes it sharply from the previous one of pure reciprocity, is that one of the two terms has an advantage over the other in the sense that the interaction is not destructive for it. If this term is A, it interacts specifically with B and destroys it, appropriating the energy released by B's destruction. Which is to say that A's form in relation to B constitutes the trigger permitting the release of the energy contained in B without this causing the destruction of A. On the contrary, the destruction of B in some way reinforces A or the aggregate to which A belongs. No doubt this sounds a very anthropomorphic way of putting it. Yet it is what actually occurs in metabolism, as exemplified by the structures that carry out the various phases, namely the enzymes. It is an objective situation, regardless of the fact that we intuitively describe this "orderly energy release connected with steric complementariness" as "exploiting" or "degrading" or "metabolizing" or "feeding for the sake of survival".

What characterizes the enzyme is its specificity with respect to the substrate. In the enzyme macromolecule there is a section which is structurally complementary to a given substrate. An enzyme is specific in so far as it enters into interaction with, and can metabolize, only one substance – its specific substrate. We can imagine it (though structural analysis has already described this in terms of amino acid sequences for many known enzymes) as a structure with a complex socket or hollow into which only the given substrate fits; the latter, once captured in this way, is subjected to an energy-releasing process which is exploited either by the same structure or transmitted to others.

Here all the concepts found in our model are exemplified. The enzyme comes into contact with all the indifferent elements present in the system in a purely statistical, thermodynamic way, and enters into relationships only when it encounters its own substrate and no other. The substrate is thus the referent-sign for the reading machine, or interpreter, and the "reading", *i.e.* the signalling phenomenon, consists of the destruction and utilization of

the substrate. Here too we can employ the normal terminology of semiotics: an interpreter is "one who interprets", a synonym of interpretant, and the two terms, though quite distinct at a higher level of semiotic analysis, are equivalent at this level.

What gives the substrate its "meaning" or "specificity for"? Obviously the presence in nature of a structure capable of reading it. The basic step is that one of the two terms becomes not destructible (*i.e.* acquires structural stability): it outlasts the single reading event. This means that A can read-and-destroy as many Bs as the thermodynamic conditions of the system and the concentration of Bs allow. The reaction as a whole does not "outrun" the natural terms of the system; which is to say that the energy released by the substrate is such as is actually present in it and could be released non-enzymatically (and thus not be exploited). The elementary sign reader is thus fully encompassed by the world in which it operates and in no way creates a "special" situation. Moreover, the reaction of complementariness is based on a formal – one might almost say "qualitative" – recognition of a "key-and-keyhole" type relationship, but it takes place because this relationship is a manifestation of both a structural and an energy situation, since a metastable complex will show varying degrees of affinity, and may be broken up by the input of greater or smaller quantities of energy, and each hollow or socket in a structure that adapts to the complementary substrate structure consists actually of weak bonds – in other words of given physical interactions. The organization of living beings is based entirely on thus type of situation of complementariness. The generalization is the extension of particular cases and tends towards a greater degree of concreteness, whereas the philosopher's "universal" fades away into the indefinite. Looking at the modular nature of extremely diverse biological situations, without a single exception they are built upon a situation of sterile correspondence or signalling. Thus elementary systems are really contained in complex ones. They are the prehistoric phases living on within present situations and are by no means forgotten. Differentiation should not be thought of as the appearance of qualitatively new situations, but as a combination of elementary situations. What is new is the way they are differentiated from their sign environment and how they are combined and integrated at the level of the reading machines they come to form. The advantage of A on its referent-environment consists in the natural history of A. Molecular contraction and movement, hormone correlations, the transmission of impulses in the nerves, the systems of perception, the antigen-antibody reaction, the control of cell proliferation, protein synthesis and genetic coding, are all without exception based on situations of complementariness.

Even pathology as a whole can be defined as an interference on the systems of complementariness.

To come back to our enzyme model, for instance, we can "cheat" the enzyme by inserting in it, as a substrate, an almost identical molecule – an analogue – on which the enzyme fastens without then being able to manipulate it or to detach itself again. This confirms that reading is a natural phenomenon which, though precise, can never attain to the absolute, flawless precision of a supernatural fact.

There are areas of biology that we are quite incapable of exploring today at the molecular, biochemical level: for instance, memory, the logical function, the psychology of behaviour. Does this mean that it is intellectually arbitrary to see these functions too as being organized on the basis of complementariness? On the contrary, an assumption of this kind is necessary, and the only possible experimental procedure in these fields too is to break these functions down into their constituents. In any case, biochemical physiological research inevitably dismantles and reassembles complex situations, isolating particular compounds and identifying their functional interactions with other compounds.

The breaking down of situations into their modules carried out by biochemistry in no way leads to the substitution of a series of dead elements for the living one. This is just one of the many scientific clichés current among laymen. Actually, the complexity and unity of structures, far from being destroyed by this anatomical operation, are heightened by it, and what emerges extremely clearly is in fact the unity, the coordination, the interdependence of the modular components. Whether the structure as a whole is simply the sum of its parts or something more is, quite frankly, a superfluous question.

To search for the elementary situation means to seek the "reason" for a mechanism. Its "essence" lies only in the combination of the elementary situations. The dissection which, with the aid of our techniques, we carry out today is, in a certain sense, as we interpret it, an operation inverse to that carried out by nature from the start of phylogenetic development during evolution.

10. Origins of complementariness

If certain objects within the horizon are specifically complementary to others, the problem arises as to "why" this should be so. "Why" in this case simply means "of what origin": how this fact has come about in nature, and

also how complementariness has expanded and amalgamated in nature so as to construct individuals which can be seen as organized centres in which complementariness is both internal and self-regulated, and directed toward the outside in relation to the environment.

The general principle is that reading systems construct themselves upon signs. They become reading systems because they complicate themselves interacting with signs, and are solicited by referents. If, out of an original state of "parity" of correspondence (model A-B) states arise in which a reader is constructed (*i.e.* a stable complementary structure capable of non-self-destructive reading), this is because, among the combinations that have accidentally aggregated, some which are specific to a given substrate are also produced; the latter in some way represents an advantage for the combination which is complementary to this given environmental referent-object. Thus the specific structural combination is selected by the environment. We can imagine, at a very early stage, that accidentally-formed structures are labile and that the structure accidentally specific for *n*, by forming a complex with *n*, is more stable (that is, tends to preserve its complexity) and is saved from destruction by the possibility of reading an *n* that really exists. Of course, a stabilized structure of this type may be accidentally complicated by being further stabilized by another *n*, setting up a sort of mechanism for safeguarding the stability and complexity achieved step by step against the lability and decay of ordinary thermodynamic situations.

Some points of this scheme can be outlined.

(1) The referent, which can be said to be noumenal and illegible, becomes a sign when in nature a machine that can read it is constructed: when it becomes itself meaningful for another piece of the world. The machine for sign interpretation builds itself on the referent sign.

(2) The reader and what is read, the interpretant and the interpreted, are contextual and on the same plane. Out of their reciprocal dynamic and through the progressive logic of their interactions and the homogeneousness of correspondence situations, further situations of specific correspondence are produced which in their turn lead to complex, non-self-destructive reading systems. A reading machine makes no sense by itself, but in connection with the thing it "has learnt" to read, upon which it has built and exercised itself during evolution: a structure "interprets" its own genetic area and can only be related to that.

The situation of a complex cognitive reader of the human type is in no way different. He too is built upon his own genetic area; he can interpret the

things that have produced him; his knowledge of the environment is necessarily acquired through his modes of interpreting environmental signs. The idea of an absolute reader, the touchstone of all possible readers, is absurd. Each extension of the reading area (and man's reading area is extremely vast) is achieved through operations translating possibilities of natural readings, and these themselves are natural operations.

(3) This sets up priorities, not of a hierarchical kind but natural-chronological, or factual, in our view of the terms of semiotics. Signs come before the code. A code does not make sense by itself, nor does it make sense to speak of a given artificial code linked to its signs by rules. A code in this sense is the fruit of a highly complex sign activity which the code does not explain, but by which on the contrary is explained. Code is constructed on signs, a structure is constructed on her environmental sector, which is the sum of things that, indifferent at first, become signs via a series of natural processes. The connection between code and interpreted signs is the history of the complications of a structure capable of stability with respect to the signs it has learnt to interpret: it is thus a natural history relationship. There is no such thing as a pre-established relationship between two given orders of things; no relationship is "occasionalistic" or anterior to the event of co-formation. What exists is a relationship established by history in the framework of things. But the code is the key, because it represents the unitary result of the reading capacity of the reader.

(4) Complication as a natural fact is based on advantages that complication itself confers on structures. Originally accidental and ephemeral, complication stabilizes itself by a more advance exploitation of the environment. The transformation of indifferent things into signs is linked to the stabilizing of the reader and confers advantages on the latter (taking the word advantage in a non-anthropomorphic sense as signifying stability, and subsequently competitive advantage too). In this kind of dynamic, a sign establishes itself as such because it is useful, in other words it creates new thermodynamic and energy conditions for its user. Thus the signalling phenomenon has a concrete natural basis and retains this even when the signalling machines attain to the level of cultural complication. Obviously the term "advantage" must in this case include "situations held to be advantageous by the reader"; it must, that is, be taken in a much broader sense than when it is used in its biological, metabolic sense, and the functions on which signalling is based imply exchanges of an analogical-hypothetical kind – including complex memorizing and combinatory mechanisms.

(5) Complication is a gradual adaptation of a reader to its reading area, which thereby becomes its genetic area. Signs construct their reader in the sense that it adapts to the signs, building itself on the things to be interpreted, learning to interpret them and exploit them. Genetic space and sign-exploitation space are the same thing. Thus complementariness (as increasing complexity) is always a correspondence between a structure and its correlated sign complex. Considering a slice of the "reader-environment" complex at time t_1, the reader is distinguished by an "entry section" for meaningful things: this defines the signs-environment as interpretable things. Things can come specifically into contact with the reader because they pass through his "entry section": they are "picked up" by his interpretative parameters (by his categories). These differ from structure to structure and, correspondingly, the single sign complexes differ too. The connection between a structure and its area-environment is thus at once contextual (visible on the same plane at time t_1, as a single structure-thing complex, or adapted complex) and genetic.

There are different structures that read different environments of different dimensions. Ecological interaction niches vary from the extremely narrow ones of bacteria which can read water, nitrates and little else, to those of man who can read human surroundings and, with the aid of particular devices (which are what make up human knowledge), can extend his own natural reading area at will.

(6) Natural mechanisms of contextual adaptation and of complication are based on the selection of favourable results, in a mixture of random events. Order is thus a natural condition resulting from selection of some structural configurations rather than others, fixing and stabilizing them. Order is thus always:

(A) an order with respect to something, *i.e.* to a referent which becomes a sign: it is "complementariness in respect of";
(B) an actual state of real structures and not a characteristic inspired from outside;
(C) a structural configuration achieved by trial and selection through performing on large numbers, on things, in a statistical, thermodynamic system. It cannot occur in evolution unless there is repetition and iteration of individuals, *i.e.* long generation spans, and large numbers of individuals exposed to selection.
(D) a situation resulting from the noise of the background, which comes before and remains outside (and will take again its prevalence, through the death). There can be no building of structures if there are no

non-preferential collisions. Preferentiality enters the framework as an *a posteriori* advantage.

The relationship between life and non-life is quite different from that suggested by the myth of a progressive order that invades nature and transforms it. These two aspects are always contextual and form part of the same horizon; they are, at bottom, the same thing, a kind of distribution of roles. The possibilities of interpretation exist because they have been elicited by collisions between things, and they maintain their contextual relation with collision and disorder. Each structure can thus be interpreted as a history of little advantages in the general development from the inorganic and in the continuing presence of the inorganic. History as a whole is itself a return to the inorganic.

(E) Complementariness is based on phylogeny. Order is genetic and historical in essence. For structures – especially those capable to some extent of "seeing themselves" (*i.e.* those that possess self-awareness) – interdependence with things means genetic interdependence – a filial relationship or constitutional connection with the genetic area. We form a single whole with our surroundings. We can interpret them because they have made us. Structures grow upon signs which are legible because they are connatural with them. There is only one horizon, and the subjective roots of the objective reality lies in returning to the roots, in seeking our parents in things as a whole – both remote parents, and recent parents in our own environment.

11. Natural structures

The domain of specific complementariness is, as we have remarked, roughly that of biological objects (though it would be as useless as it is impossible to try and define and delimit this domain with precision). These are the objects which can read their complementaries for the purposes of survival. Thus structures of complementariness are not abstract entities, but concrete, modular-type molecules. The direction taken by evolution is quite definite and is based essentially on two types of modular-sequential macromolecules, proteins and nucleic acids. Nature – this collection of colliding elements – has developed and perfected these two in particular. The reason for this – which is usually considered inscrutable – is really fairly simple. It is not necessary to carry out a detailed biochemical analysis here, though two facts need taking into account. The concept of complementariness entails that of specifically complementary structures, *i.e.* macromolecules endowed with

complexity. A situation of this kind can only come about via carbon. Silicon, the next best candidate after carbon, admits of an extremely low degree of complexity. Complexity could not develop other than through organic chemistry. The physical conditions suitable for complexity are extremely critical, and it can only exist in a very narrow temperature range. In the realm of carbon chemistry and the temperatures permitting complex aggregation, the environmental context is represented mainly by water, which is indispensable as an "immediate environment" for the movement and structural integration of organic molecules, while the thermodynamic conditions are represented by solar energy. The modular elements that have asserted themselves by aggregating to form more complex structures are the amino acids, and the purinic and pyrimidinic bases linked by monosaccharidic units and by phosphorus. To ask why, within the range of carbon structures, these in particular have been "selected" is rather pointless: they have been chosen as the fittest, and any other structure could only be proposed by an artificial and hypothetic activity which itself is in some way derived from the sequences of amino acids and bases. There is no doubt that our real *a priori* is the natural invention of proteins and nucleic acids.

It is also immaterial to ask whether life or some other planet could be based on something other than amino acids and nucleic bases. Allowing for the fact that, in this case too, the alternatives to carbon are eliminated by Mendeleev's table, and that the homogeneity of the real is the *a priori* of all possible interpretations, any other lines of development of complexity will be explicable in terms of the selective characteristics of the environment, and each will be characterized by its own natural history dominated by selection events. Hence, there may be differences corresponding to different environments, but the mechanisms will be uniform. In principle, we may assume that the co-formative, evolutionary relationship between structures and environment in the context of physical conditions of the general environment is a constant: reading mechanisms and the mechanisms for building structures on signs are always involved.

As regards proteins, their complementariness with respect to the substrates is ensured by the sequence of amino acids (primary structure which, however, being rigidly determined for each protein, conditions the proteins' development in space – their hindrance and their specific conformation with regard to a given substrate. Enzyme-proteins can be taken as a general example: in nature we find an immense number of proteins which are in some way specific, that is, adapted to their specific substrates. This is the result of the assembly of a very limited number of amino acids.

The general rule, or rather the path actually taken, is that of a great variety of situations of complementariness, and hence an extremely wide range of complexity derived from the use of a very small number of elementary structures. Clearly, it is a matter of a large number of possible permutations. The number of combinations that have actually been retained is vastly inferior to the number of accidental combinations possible. Enzymes, hormone receptors, antigen receptors (antibodies), membrane receptors, coordinated repetitive structures forming films, contractile and elastic structures, are all made up of proteins, integrated by other structures such as polysaccharides and lipids.

The structure of nucleic acids is less "proteiform", more definite spatially, and more monotonous in its sequences. A typical case is the two-strand, evenly-spaced structure of DNA, where four different entities (bases) combine, with far fewer possibilities of combination than the twenty amino acid units of proteins. Nucleic acids are particularly suitable for coding-type structures because they are more monotonous and more stable and can thus be more easily read and translated. We shall return to this point later and shall see that basic complementariness arises precisely between these two types of macromolecule in the mechanism of protein synthesis. This, however, from the semiotic point of view, implies other concepts, such as that of code, which we have only mentioned in passing so far.

12. Simple evolutionary situations and their generalization

Let us suppose there exist a large population of bacteria in contact with *n* sign-things, such that each member is capable of reading-metabolizing the *n* referents. If, thanks to a mutation produced by an accidental disorder, one of the individuals is enabled to exploit an *n*+1*th* metabolite, then an evolutionary step has taken place in the bacteria in question and in all the clones that descend from it. This is manifested in an expansion if the reading area. What was happened to the *n*+1 thing is that it has acquired a natural possibility of being read, and can be deciphered as a sign, thereby joining the *n*s that preceded it. The microorganism's environmental range has thus increased. What chances have the new clones of being stabilized? Neither more nor less than the advantages deriving from reading. If *n*+1 is concentrated in the environment and provides energy, the mutation gives the clone immediate advantages over the others and will certainly be stabilized. The new clone fits things better, is adapted better, and is more coherent with its ecological niche. Furthermore, if *n*+1*s* are denser in zones outside the niche

in which the mutation took place, the new clone will occupy a broader area, namely that of *n*+1. And since the new area will presumably be different from the previous one in other respects too, containing for instance things or properties *n*+2, *n*+3 etc., there is a certain probability that a mutation will take place in relation to this new environmental situation. A condition of this kind might seem to be very mechanistic, given its selective automaticity. But we shall see that this is by no means the case, because it is not primary situations which have to be selected individually (accepted or rejected) that come into contact with the environment, but individuals which have already travelled a certain distance along the path of evolution and are equipped with an overall stability. Thus the new circumstances and reading possibilities are not only external aspects (in relation with the referent) but also internal ones (consisting of a rearrangement of the sign relationships that make up the individual). There is no doubt that *n*+1*'s* capacity to be read arises only if the new reading system appears, but the new reading system is inconceivable without *n*+1. The possibility of reading is thus constructed on the referent. And this becomes meaningful for the structure capable of reading it. The mutation that reads *n*+1 is inconceivable without *n*+1. All a structure can do during evolution is expand into the forest of things surrounding it and learn to decipher more and more of them, modifying both itself and the things in the process. Little by little the forest is converted into a place of family, connatural presences utilized by the structure; it becomes an interpretable sign complex, an environment. In the last analysis, it is things that have themselves read, building suitable structures to this end.

This is an extremely general truth. Things have themselves described by the structure and are spoken through the structure. Reading modes are extremely varied and depend in all cases on the single structure and on its entry sections, *i.e.* its genetic area. There is no natural function which is not based on this. The natural knowledge an enzyme has of its substrate is extremely circumscribed. There is no doubt that for the substrate there exists in nature a machine capable of interpreting it separately, with given, specific parameters. Human knowledge, which is obviously extremely complex, is characterized by being able to interpret things through its own particular entry sections. But even here the parameters are particular, not universal, and the area of meaning is so large not because qualitatively new conditions have occurred in connection with the referent, but because complexity has enormously extended the chain of interpretative operations, rendering possible memory, hypothetic simulations and logical operation.

The purpose of scientific knowledge is to decipher the referent objectively with the subjective parameters of the human entry sections. We originate in

the referent and return to it, and on returning there we find that the referent is a sign and makes sense to us precisely because it was already meaningful during the natural processes of construction of human complexity.

13. Internal signs and internal complexity

In the actual evidence of signs, namely in biological structures, we never encounter isolated signalling situations. Even the example of the enzyme and its substrate is artificial, since we have isolated an enzyme from its context, a cell or a complex virus. Of course, this complexity must, as we have seen, have been achieved via biunivocal situations, but it has established itself in a position involving reading advantages achieved by aggregation. What we must now try to understand is how this step was taken, from the point of view of the complementariness and the cognitive-metabolic identification of the referent.

We have already examined a hypothetical path towards complexity whereby a bifunctional structure links up with another bifunctional structure. This system indicates how simple readers can aggregate by amalgamating their ways of reading what lies outside them thanks to a complementary, internal aggregation. Nevertheless, this model needs working out more thoroughly. Let us suppose that there is a relationship between A and B such that

(1) they form a stable spatial complex,
(2) one term supplies the other with a reading "mediation" (*e.g.* B binds to a substrate *n*, modifying it so that one of the metabolic products can bind to A and be metabolized by A in turn).

In this case it is the complex A-B that obtains advantages from reading the substrate. The referent-sign is such for the complex and not for A or B taken separately. Clearly, a state of affairs like this favours aggregation since, in the area of substrate *n*, it gives the combination A-B an advantage over A and B taken singly. In other words, the amount of energy that can be tapped from the environment increases and the "knowledge" of the substrate is deepened by means of the aggregation.

Let us now suppose that A and B are "stabilized" respectively by *a* and *b*. If A and B find only *a* in their surroundings, then B will eventually disappear. Let us now suppose that *b* is a piece of *a* released after A has acted on it. In this case B will be stabilized (and survive) only if an A is present; B is thus a kind of saprophyte because A supplies it with its *b*. But suppose B is stabilized only if the *b* is provided "immediately" (for instance, because *b* is

labile). In this case the form A-B in which A and B are spatially continuous or contiguous will be favoured. In an environment where there are A and B, but only *a*, the stable complex A-B will be favoured because B too cooperates in exploiting a better, by exploiting the *b* contained in *a* as well.

The new condition which has arisen here is the interiorization of the sign, that is, the formation of the individual. Reading remains an operation toward outside, but its development is conditioned by presence of an internal signalling process. This new development of meaningfulness in relation to the environment is bound up with progress in the complexity of the exploring machine, namely the aggregation of single interpreting units by means of the "interiorizing" of meaningfulness.

The two-element model is obviously greatly oversimplified compared with that we find in bacteria, but on this pattern, we can imagine an indefinite number of internal reading sequences, all based on complementariness.

This gives rise to two mutually dependent aspects:

(1) the internal reading is complicated by the complementariness of evermore-correlated internal structures which tend increasingly to stabilize "individuals", since the amalgamation and interdependence of single reading structures is advantageous;
(2) the external reading, too, is complicated: the section of the world the structure can interact with is widened and deepened. Thus the complex and interrelated reading of reciprocal of external referents (which thereby acquire meaning and the status of signs) are necessarily integrated.

All this may sound very schematic. Nevertheless, it is exactly what happens at all levels of complexity. Not only are the basic mechanisms of synthesis and metabolism based on complementariness, as can easily be seen by examining the mechanism of protein synthesis, but so are homeostatic, self-regulating processes, from the simplest types in which a bacterium regulates its enzymatic activities according to the substrate concentration, to the extremely complex one regulating ontogeny in vertebrates.

The product of the federation of reading structures by interiorizing their meaning is a unitary reading structure. Disconnected readings – which can undoubtedly occur – get dispersed because they are not advantageous. An organism is a unity in the sense that it is actually involved in reacting unitarily and specifically. This has nothing to do with the "unity as totality and perfection" to which the exegetes of biology have accustomed us. Unity is coordination. Just as a sign is a "sign for", so unity is "unity in relationship

to". Unitary types of reaction – that is, the types of individuals actually produced in nature (these can be exemplified by the species, considered as standard modes of aggregation with regard to a given environment) – exist in enormous numbers, and it is hard to see what connection there could be between them other than that of reacting univocally with respect to their own environment, which is also their genetic space.

It is the individual as a whole which deciphers external things as signs, and the latter are characterized by being signs for the whole of the individual: they are meaningful for it, a specific trigger (in the sense of "peculiar to the species" too) for changing it. Reading is never piecemeal. The adaptation of a type of individual to its genetic area is shown in the way that the environmental things are not indifferent for the individual, but are there "for its sake" – in other words, they are meaningful, and the referent has the quality of a sign.

With the expansion of the internal area of meaningfulness and the increase of the structure's size in its environmental space, the size of the signs read increases too. What permits the structure's "cognitive-metabolic exploitation" is still a complex of discrete internal reading at the molecular level. For a lion a gazelle is a sign in exactly the same way as glucose is a sign for bacterium. The way this referent-sign is deciphered involves a chain of enormous complexity and implies a vast history of selection an adaptation. But the lion as individual feels this section of the world as a "unitary" sign of complementariness. In nature the two things (the lion's hunger and the gazelle's fear) have forced their way through natural history thanks to a long chain of aggregation of meanings.

There is certainly no contradiction but on the contrary a profound unity in the fact that the gazelle – recognized through instinct and eaten by a complex, adapted macroscopic machine like the lion – should be digested by the protease synthesized within the microscopic, molecular level of the same reading machine. The macroscopic sign "gazelle" is supported by the entire past history of the reading machine, whose roots lie in the integration of A and B in the elementary model discusses. Between the kind of readings we can for convenience call microscopic and macroscopic, there is a rigid, logico-material sequentiality.

This does not mean that a complex machine is simply an accumulation of simple reactions added together; it does not work in the mechanical, automatic way suggested by our usual engineering criteria. On the contrary it is its capacity for internal adjustments that enable it to make an eventual "decision" with regard to events and facts in the environment. There is nothing strange about the gazelle's becoming a rather indistinct sign, almost

a shadow, for the satiated lion, since this is how feedback mechanisms regulate the "acuteness" and "discernment" of the reading machine. It is worth recalling that even at the simple macromolecular sign level (that of A and B) the concepts of affinity, kinetics and thermodynamic bond energy are applicable. The "precision" with which a sign is recognized as such – *i.e.* as meaningful and complementary – is strictly bound up with the physical nature of the interaction.

The interpretation (or knowledge) of surroundings is always subjective, since it consists of the identification of signs by means of the interpreting structure's modules. What is identified is what the species is capable of identifying with the aid of the parameters it has acquired during evolution. Thus knowledge – the exploration of signs and the recognition of meaningful presences – is always subjective and always explores real objects. The subjective/objective antithesis is simply one more of those numerous false problems besetting our culture. Subjectivity is a particular instance of a relation encompassed by the overall objectivity of sign relations.

14. Levels of reading

Reading consists in deciphering a connecting event, of which the basic form is the reciprocal modification of A and B when they meet and form a complex. However, if we speak of a "connected complex" of A-B which is itself interpreted (a fact that expresses something and is "meaningful for") we must also postulate a C with the following characteristics: it must be external to A, B; it must be able to interact on the same objective plane through an (A-B) C, however this comes into being; and it must be of a higher order of complexity than A, B. The last of these conditions is very important because if C was at the same level of complexity, the result would simply be a polyfunctional situation of A and B – not (A-B) C, but A-B-C.

In the formation of the complex (AB) C, C does not enter into connection with A or B separately, but with (AB). C deciphers a connection-phenomenon A-B, it is a "second degree" reader. C is structured in a more complex and environmentally-adapted way. It can be outside A-B but it can also be inside the structure that contains the connection-phenomenon A-B. In the latter case, the adaptation of the elementary units appears as a part, or basis, or phylogenetic starting point of a more complex adaptation. Given that any adaptation is a natural fact, this in its turn can select and orientate other interpreting structures which occur in nature and are n+1 order readers.

The relationship of continuity between a fact (content, contextuality, adaptation) and its position in a higher, and broader, circle of interpretation (the plane of expression in the context of a more complex interpretant) introduces the concept of levels of reading. A structure has a given range of, and capacity for, adaptation and interpretation; it is able to capture the meaningfulness of given levels according to its own material status.

Levels can appear as single individuals that interpret external reality or as amalgamations and hierarchies of readings inside the reader, like a system of filters wherewith the complementariness that interprets the environment organizes itself internally.

If, as the species most favoured by evolution, we are in a position to view the road thus far travelled from a standpoint of mythical anthropology according to which the sign-using animal is the crown and apex of things, it is precisely because this connective capacity has developed through structural options that have produced both the nervous system and the genetic code. We are able to theorize about human communication models because nature has actually provided the communication systems. Nevertheless, and it is worth repeating this, the presence of levels does not imply a theory of the hierarchy of levels, and the structure of which these are the manifestation is not "The Structure", some entity which is self-contained and specific in its own absolute world. What we have is simply levels arranged in series on the plane of horizontal contacts.

Things, facts, phenomena (*i.e.* referents) are signs for a level capable of reading them. We cannot simply, at some point, label a thing as a "sign". It is things themselves that promote the construction of adequate reading machines. They are always "sign for" a given reading level. We can, if we wish, accept the concept of a transition from signal to sign, and the distinctions made by semiotics in this respect are certainly valid: however, as we frequently remarked, what interests us is the prehistoric layer, the archaeology of communication. If we start by analysing what is "meaningful for man" we will be misled from the outset into accepting that meaningfulness is a product of something prior to each communication act, something that "legalizes" the latter – in other words, the code. Even if this is true in the specifically human field, in a more generally historical, phylogenetic sense it is the single, repeated, selective reading (productive of natural effects) that constructs codes.

We are thus perfectly entitled to posit that interpreter and interpretant, in symmetry with sign and referent, are initially equivalent. The process of semiosis, precisely because it takes place materially at various levels, is never unlimited.

In man the capacity for multilevel reading has developed. He has acquired a complex analogical system which explores things and connects present experience to systems of encoded experiences. It must be remembered, however, that:

(a) This sign system is tailored to fit the world. What we find then is not an unlimited number of situations but structures built through reciprocal adaptations brought about by a succession of facts and interactions, in which the interpretant in Peirce's sense is strictly dependent on the interpreter and the interpretation. The physiology of cultural semiotics is no less rigid in this respect than that of natural semiotics.
(b) If horizontally-connective interpretation exists, it is because vertical reading exists: culture – horizontal connection – is only the most recent development of nature, being a phylogenetic progress on vertical connections. Neither complex connection nor codes could exist without the natural capacity for making complex connections and for building codes and using them – in other words, without the development of the human nervous system, the highest achievement in vertical reading.

The semiotic function is indefinite but not the semiotic field itself or the historical processes that have shaped it. It is finite because it is built on a finite environment and out of a finite number of operations and individuals. It is easy to see that the process is drastically limited and that our ability to influence things and languages personally is minimal. Thus the texture of the semiotic field, which may easily look as if it gives free rein to the imagination, is actually a standardized situation, a uniform process established by the things and the language already in use. Novelty does not lie in the use of language in itself (*i.e.* merely in the interplay of interpretants), which would be meaningless, but in the relation to language functions to our particular position in the world, for it is this which is really different and specific.

A physiologist, on the other hand, is inclined to consider discourse not as the identification of elements in a classifying system but as a process reproducing what has been created historically as discourse. Semantic markers and syntactic connections are nothing other than the history that has enabled us to identify what we want to communicate via discourse: something that remains bound up with environment and referent. The generative sequence is a historical one, even if we are tempted to see "generativeness" as inherent in the entity called language itself, accustomed as we are to seeing it exhibited in standardized, artificially-codified situations. From the standpoint of a historical-physiological interpretation, the range of meanings covered by the word "bachelor" is quite immaterial, since all

words are built up, altered, differentiated and rendered independent. What is important, on the other hand, is how the single semantic unit gets formed during exploration of the world, how it is stored in the code, what interferences it sets up, what readjustments it gives rise to when introduced into man's logico-syntactic circuit, and above all in the situations we are able to pull it out of the repertory of language and demonstrate its fitness for actual situations. We can only extract myths, not rules, from the flat surface of the page on which words are traced; we will draw a blank unless we follow the thread of history out of the page we are reading. Contextual value, which is inseparable from meaning, is the product of a process of experience which renders the interpreter interdependent with his predecessors and the world.

The problems of ambiguity and synonymy in reading are relatively marginal and can be disposed of by observing that it would be unnatural if there were no ambiguity or synonymy. Communication, though highly complex, is obviously an approximate process. As far as possible the reality of language should be unravelled by reference to the formation of language and not by transfiguring it into absolute rules where even ambiguities are seen as proof of an unambiguous substratum. Language has always solved ambiguities passably well in practice, meeting the requirements of a given historical moment in relation to a given environment. The obstacles man has had to face in the course of his natural development have not been linguistic ones.

The return to our description of the levels of internal reading (*i.e.* those organize in relation to an overall interpreter): we may say that each level organizes itself as a set of correspondence which are meaningful for a higher system of interpretation. But at the same time the reading machine remains a unitary whole for the simple reason that it is organized with reference to the lower levels.

However, a theory that formalizes the organization of levels statistically, transforming the organization of one level into material for the level above, risks being at once obvious and impracticable. We must accept that in the physiology of interpretation there is a system of meaning which is filtered by an interpretation at a given level and introduced into the next level, and so on. In other words, a system must exist whose complexity, whatever its degree, organizes itself by turning denotation into connotation and setting up the latter as a denotation for a further level. But to formalize this system in reading levels set up by ourselves would inevitably be an anthropomorphic operation. Let us simply say that natural selection has extended our possibilities of connections with the referent thanks to a number of filters and levels of which we at present know very little.

Semiotic evolution viewed from the standpoint of the organization of reading levels shows that the problem of the relationship between expression and content is extremely ancient and not, as is often supposed, recent and human. There is always a content (a state of affair that triggers an observation process, for which it constitutes an operation-expression – that is, an inducement of change).

15. The role of generation and code in producing complexity

Our model of the internal complication and amalgamation of interpreting structures illustrated in the last chapter is not imaginary; it is simply incomplete. We have made a hypothesis about a state of increasing complexity but have not shown how this can arise in nature. Since we are seeking real phylogenetic complexity and not cybernetic models (which can describe systems *a posteriori* but cannot prefigure them), we must find out how internal self-regulation and adaptation to the exterior have come into being.

It is necessary for the purpose to posit a plurality of individuals in time, and hence the possibility of their being repeatedly copied – in other words, generation. For changes to be brought about by the environmental selection of accidental mutations, the individual must subject itself to its environment in a multiplicity of copies. It is this qualifying test that renders adaptation possible, and it cannot but be statistical – that is, it must involve large numbers of individuals over long periods of time.

Each type of development (for instance, each species) sets its individuals in contact with the environment at the level of complexity so far attained, and the individual confronts the environment from the vantage point of the previously-won internal complexity present at that particular stage of its evolutionary development. We need to postulate both a multiplicity of copies and a continuous linear sequence. We cannot conceive a kind of dialectical phylogenetic hypothesis.

So far we have talked about a one-dimensional individual "flattened" so to speak against its section of environment, a being nothing more than a relationship between internal signs in action and environmental signs. But this individual is an abstraction. In the course of its material development he has a kind of internal dimension of which its external development vis-à-vis the environment – the structure that reacts to the environment – is a manifestation.

This is the structure that ensures the stable reproduction of the copy, *i.e.* the multiplicity and the continuous presence of the species throughout the

evolutionary time-span. All changes must pass through this structure. In short, there is a kind of "assembly-manual" – the genetic code. Obviously, by "internal dimension" we mean molecular structures and not some kind of teleological proclivity, and when we talk about the continuity in evolution of these structures, we mean the modifications that take place within the uniformity of replication and alter it.

The relationship between these fixed, informational-type structures (which vary only on account of the accidental mutations and of selections which the phenotype containing them undergoes) and their specific single manifestations in the bearer individual (the environmental-related-sign mechanisms and the internal signalling mechanisms) must not constitute an exception to the rule. It must be a relationship of ordered complementariness: in other words, it must also be a product of the function of internal aggregation and signalling.

It is not necessary to examine the mechanism of genetic coding in detail here, with the exception of those points that affect our argument.

(A) The basic relationship between the phenotype (the real individual actually operant at time t_1) and its genotype (the sum of information that forms a single copy of a basic type proper to the species) is correspondence-complementariness between nucleic and protein structures. The key to this lies in the steric correspondence between the nucleic and protein chains, and the existence of a process that translates the former into the latter. Each nucleic chain (according to the sequence of the four possible bases) *corresponds* to an amino acid sequence, *i.e.* to a protein with a given spatial shape and given zones of complementariness that is capable of reading internal and external things-signs. Each information unit is specific in the sense that, by means of a correspondence – developing process (*i.e.* translation), it can give rise to another specific, active, operative structure. There is thus a code (the sequence of bases along the strand of DNA making up a single piece of information) that contains, in a simple, linear, compact, repeatable and potentially flawless form, all that is necessary to guide the development of a correlated protein. The protein, on the other hand, is an object with an extremely varied development in space, it has its own functional specificity, it is continually renewed and its production is also regulated quantitatively in keeping with internal and external demands.

There are thus two planes, one continuous and historical which perpetuates itself, the other single and contingent, an efflorescence of the former, a product of its translation.

(B) The individual is unitary because it develops an overall, interdependent signalling mechanism, but it is also unitary in a much more "historical" sense that might appear from the kind of interdependence achieved by a single individual. All its useful correspondences have been accumulated in the course of time in the code, and are preserved, reproduced and translated. Behind the single correspondences we see in action, there is a further correspondence with informational structures.

The path followed by phylogenetic complication when reading the environmental referent thus has more than one level. Here too, there is little point in asking "why this path and not another?" What has emerged is what has proved fittest for the situation. The logic appears in the facts themselves.

(C) The sign builds the reading machine through a precise mechanism of *a posteriori* options. When we argue that it is the efferent that elicits description by constructing suitable machines, we certainly do not mean to suggest that this is an intentional process, or that it corresponds to some universal design of things. Nothing could be further from our position than this kind of mysticism. The unity of things is far deeper, and far more generational, than our mystical fantasies. The referent does not build anything at all, because it has neither hands nor brain. It is simply a touchstone for accidental errors: the variations retained are those which have "passed through" the code, and can be replicated and translated into all subsequent copies. In other words, to go back to our example of the mutant bacterium that learns to metabolize the substrate n+1, this phenomenon occurs because an information error produces a protein capable of utilizing n+1. Thus an indifferent presence is transformed into a sign by passing through the code, and it is only by means of this procedure that n+1 can select its specific reader and therefore can be read. The adaptation of the interpretant to its section of the world of signs occurs in this gradual manner because the code does not end with the individual but is a super-individual continuum that equips each individual with the sum of selections carried out on previous individuals.

(D) Contributions to the building up of complexity are provided both by the cumulative selective action of the environment and by the fact that each positive result is preserved in the continuity of the code. The possible variations do not interact singly and isolatedly with the environment, but through the individual as a whole. A mutation may imply the appearance of a new phenotypic property; it is the whole individual, altered in one of its features, that enters into contact with the environment. The process is in no way mechanistic, fragmentary or purely cumulative: it implies, on the part of the

individual, a high degree of self-regulation and self-reaction with respect to the environment. Thus a single variation can lead to a shake-up of selection possibilities as well as of internal signs and meaningful interactions of the homeostatic type. The action of the environment is thus far more complex than that of a filter sifting useful combinations.

It is clear that these statements could be supported by a battery of explanatory notes on particular sectors of genetics and biochemistry. However, our aim is to reinterpret the data of present-day biology in a semiotic key or rather, perhaps, to reduce semiotics to the concreteness of biological analysis: we are thus not interested in giving a detailed discussion of the purely biological side of the matter. Nevertheless, since contacts between semioticians and biologists are few and far between, for the sake of clarity it will be worth specifying that the kind of framework postulated here is Darwinian, enriched with structural information about codes (the biochemistry and biophysics of nucleic acids) and with the investigation of the replicable "errors" of the code – *i.e.* mutations – of which today we have a very thorough knowledge, due, among other things, to their importance in the genesis of cancer. However, both the standard Darwinian framework and the neo-Darwinian one too are insufficient. We need also to take into account the importance of the individual's role in modifying the environment, and we shall later be stressing the importance, in selection, of the collective role of the species as a super-individual organization of adaptation producing communal behaviours. This is the line of approach which will be followed in the chapters on human knowledge of the environment. It will nevertheless be worth mentioning (above all for specialists) two issues that are usually left somewhat out of the picture.

(a) The "broad" presupposition of our mechanism is that there are accidental errors: information decay, background noise, increase in entropy. It is on the basis of these errors that a small amount of order comes into being and separates itself off, accumulating and progressing. We have already discussed this at length. These errors are illustrated by "point mutations" induced in DNA by alkylating substances, radiations, etc. However, what counts is the information variation, in whatever manner this is produced, provided it is retained and is replicable. The term "mutation" is thus used in a very broad sense. In a world with many structures and codes, it may not be rash to ascribe a degree of responsibility for selection also to variations produced by a "mixing" and "integration" of separate codes, as in the integration of viruses or in cell hybridization. Horizontal transmission of information is probably very important. If, moreover, the mixing of information also takes place between already-complex codes, complicated inferences may occur,

with the possibility, therefore, of evolutionary leaps forward. In any case, the evolutionary model proceeds by "fits and starts".

(b) The basic condition for anchoring the new reading to the interpretant as a whole is that the complementary structure that carries it out passes through the code. In other words, the following condition must be fulfilled: new meaningfulness of referent = new arrangement of reader's code. This is how material interdependence between a structure and its genetic area is brought about. However, it is not essential that this should take place through processes acting in the first place on the code and then emerging in the phenotype. Without impairing the validity of the mechanism, we might imagine an inverse influence from the phenotype to the code, provided this leads to situations of discontinuity-selection of the code. All we can say is that this does not happen in practice and that the direction selected is one-way, from information to transcription and translation, and that all influences or importance for evolution must take place at the source, in other words at the level of code (leaving aside the issue of inverse transcriptase, which might lead us to admit some amount of inverse information flow, perhaps important in evolution).

This chapter cannot be concluded without a reminder of a warning given earlier: a code is a structure, not a concept. The information it contains consists of choices made by the history of events and sequences of events. Order is "order in relation to things that can be explored". Obviously, in complex individuals, most of the code is devoted to information of internal meaningfulness, "interiorized" complementariness, self-regulation and the control of embryogenetic and morphogenetic mechanisms. The fact that a code is a particular structure also implies that it has a precise location and distribution. From a certain level of unicellular organization onward, it is situated in the nucleus. In unicellular beings, the basic rule is that each cell has its own copy of the code, and that this is "realized" variously in the variously-differentiated cells (in other words, in each type of cell a different section of the code is operant and can be translated, even though the code is identical in each cell of the organism).

16. The translating function

We can now define the typical situation of all biological organization: complementariness always takes the form of complementarity reactions. It is simultaneously being and happening, confrontation and demonstration, a matching in possibility and practice. Thus complementariness is work

and energy consumption, and transformation of the structures involved. The deciphering of internal and external correspondence and hence of the meaningfulness of the environmental referent is an exploration which must take place and which makes sense only if it develops in the genetic area and in time.

Since with increasing complexity of structures complementariness takes the form of multiple coordinated interpretations, the latter give rise to sequences of processes that witness to and realize complementariness – authentic chains of coordinated processes related both to inside and outside. If an external sign is identified by a complex structure, it cannot but be the result of a chain of coordinated sequential processes which develop in cycles characteristic of the particular organization of each species. To what we have, in somewhat synchronic terms, called the "entry section" of the individual with respect to its genetic area, there corresponds a diachronic development of "internal routes of interpretation" (exemplified once more, at this level, by interpretation – utilization – that is, metabolism) which are fixed, and form a cascade of reactions of complementariness.

In internal signalling too, where signs are internalized, complementariness develops in coordinated sequences. Structure A produces a substrate that is meaningful for B which is thereby brought to state B_1, becoming meaningful for the reader C, and so on. This can be ascribed to the fact that, as we have seen, structures are not static and given, but develop and interact, and are built as a result of the expression of information.

This brings us directly to the definition of an important concept – that of *translation*. In fact, complementariness that occurs as a process in time and in space is a process of translation. Two corresponding, complex, complementary structures (for example, DNA and protein) are yoked together by a process of translation and not by similarity or by extrinsic laws. They correspond because they are united by an actual or possible mode of correspondence. Their complementariness manifests itself in a series of operations in material structures: these operations (constituting life) are what demonstrate complementariness or specific correspondences.

Let us examine the basic mechanism of protein synthesis. There is a rigid correspondence between the sequence of bases in the strand of DNA and the sequence of amino acids in the corresponding protein. Three bases arranged in sequence "stand for" (correspond to) an amino acid, though it would perhaps be more correct to say "stand towards" an amino acid. The parallel between the two structures is not static but is set in motion by a synthesizing process whereby the DNA order is translated into the amino acid order. This process is complex, however, and has various stages. First DNA

is transcribed into RNA, then the latter is translated into proteins, each stage taking place in a particular site and organelle inside the cell.

A more careful analysis of this situation reveals the following points.

(A) First and foremost, the complementary structure are quite different from each other. They are reciprocally meaningful not because they are the same, or almost the same, or similar, but because they are linked by a translation process. This is in general feature of meaningfulness. To interpret a sign, to interact with a meaningful referent, does not mean – even at elementary levels – to incorporate and absorb it, or to collect its essence as in a receptacle. It means to interact selectively. To identify what is external does not mean to confound it with what is internal; it means to locate it in the outside. The same can be said of the signs of internal correspondence. There is no mixing, only interdependence. They must remain distinct if they are to influence the organism as a unitary whole. Complication is built in all cases of separate structures linked together in the translation process.

A strand of DNA has, in itself, nothing in common with its protein. If they are corresponding structures it is because they are yoked together by the logic of a process – that of protein synthesis. The protein as an internal sign "means something" to the DNA in so far as there is a physical mechanism connecting them. The translation process promotes those equivalences and correspondences that go to make up what we have earlier called "material logic". A process may have various stages and be subject to numerous interferences – it may, in other words, appear (and be) extremely elastic and open to modulation: but it remains based on an ordered series of logical, inelastic correspondences. Elasticity is a sophisticated product of complexity in the chain of translation and complementariness. If we insist on the concept of the material logic of correspondence, it is because it is here that the interdependence of what is internal to the individual and what is external to it is demonstrated.

(B) The same principle of translation of meanings is at work in the identification of an external sign. The sign-presence, the thing, is quite different from the deciphering structure. It is absolutely heterogeneous, even if the two "things" are reciprocally adapted. The source of connaturalness must be sought, as we have seen, at the level of ancestry and generation, in the phase in which the reading machine was being constructed. But when reader and horizon are face to face, they are quite heterogeneous, and there is no mystical bond uniting them. Identification of a sign, then, equals locating the heterogeneous. And this is precisely what complementariness is, when

conceived against the general background of the homogeneity of the horizon. Identification always takes place via processes of translation and chains of meaning. Locating an object always consists in recognizing otherness by indirect methods (indirect in the sense that they are implemented via mechanisms with various stages and with a temporal extension). There is no such thing as the assimilation of a particular essence by the self. The self does not identify with the sense of the things or immerse itself in its soul; nor does it confer its own sense on things. This relationship is simply a process whereby to things in nature interact, one of them being specialized for exploration and recognition. The process of meaning is this.

Knowledge at all levels is an indirect, mediated dynamic of successive locating operations performed by various entry sections – *i.e.* from various angles by the reading machine in cases of complex reading. This is particularly evident in the case of human knowledge, which has developed highly sophisticated locating techniques by gradually objectifying the referent-sign, interpreting it on a hypothetical basis, and reducing it to a segmented, exchangeable form.

There is no doubt that those mysticisms according to which inner knowledge is a connaturality of essences are the most serious anthropomorphic pitfall besetting analysis of the process that links us to the world. Inner knowledge can only be that of the analysis of our origins; this is our only "interior". At the human level, also the relations with the human referent are equivocally considered "interior" in this sense, whereas, in all their complexity and their cultural nature, they too remain indirect locating process mediated by translation processes.

(C) The translation process is never one of "useless equivalence". The constructions of structure M on structure N is correlated to a specific function of N. M, by translating itself into N extends the range of meaning. If we accepted an "essentialist" theory of order, the degree of order would be equal in each case and basically M would be equal to N, whereas actually the functions are quite different. For example, the mRNA is fairly similar to the DNA transcribed, but its function is to carry the information from nucleus to cytoplasm, to extend the range of action of the information so as to locate elsewhere the constructed sign, thus setting off a further phase of the physical mechanism of translation.

In nature there are no cases of different structures that are perfectly equivalent and interchangeable. Translation is always linked to functional novelty. It is not to be confused with the simple replication of identical copies. Obviously the whole of biology is based on the repeated reproduc-

tion of the same structures (nucleic acids, proteins etc.) but this is not what we mean by "translation".

The synthesis of a "perfectly identical" object would imply an indefinite, non-economical process: why consume energy to produce an "indifferent" synthesis? This too illustrates the concept of material connection or of a logico-material chain. The translation of signs extends the frontiers of contact and knowledge.

(D) A final remark on the concept of analogy. Complementariness equals "standing for". What is complementary is an "analogue for" and can "stand for" something. Translation is a process of analogy. The analogous terms (what translates itself and what is translated) are different and non-interchangeable, yet are correlated situations in a process of translation. A sign is by definition an "analogue of", but this is not a peculiarity of human signs, because any sign-referent is received by an analogical chain and is the last link of this chain. The nature of analogy in human communication is not essentially different, the sign being an analogical operation inserted in the sophisticated translation chain that makes up human knowledge. From this point of view, analogy reveals the material logic of translation processes. The whole of knowledge is an analogical chain, and it has a logical structure. The referent is reached, identified and transmitted (known) by a rigid analogical chain.

By way of a conclusion to these remarks on translation, we must repeat that the relevant processes are "facts of the world" – chemical and physical ones. These facts can all be handled by a quantitative treatment of information content (considered from a thermodynamic standpoint) and can be described with the aid of cybernetic models of information transmission.

The rigidity of transmission does not rule out information decay, and therefore implies self-correcting mechanisms (like the repair enzyme); not does it exclude non-univocalness – *i.e.* redundancy and errors of translation.

17. Sign localization and process

At a high level of complexity, the paths followed by reactions set in motion by a structure for the reading of a referent may be very numerous and interfere with each other in various ways, giving rise to a multifocal identification of the referent – locating it, that is, from various angles. The entry sections can be of different types. The phenomenon, of course, remains subjective – in the sense that it depends on the entry sections and the internal

routes peculiar to the individual – but it is "located" more accurately. For the moment we shall have to settle for the rather imprecise term "locate", though it does suggest an exploration of an external referent with the aid of give parameters. What needs stressing is that the recognition of an external sign is, at high levels of organizations (ignoring for the moment objectifying and hypothetical functions of human kind), a complex reaction, made up of successive phases, that can:

(A) differ greatly from structure to structure, obviously, and must only be considered in connection with the structure for which it is a sign;
(B) develop differently in different situations in the same individual or in equivalent individuals. The process of recognition can be developed to its utmost or kept to a minimum as regards the location and distinguishing of the sign; this will be particularly important in the most advanced stages of sign knowledge;
(C) appear as a confluent process of several entry sections, each linked to a sequence forming an "internal route", the various routes being coordinated. External meaningfulness (that related to signs in the normal sense of the word) is coordinated just as internal meaningfulness is coordinated in homeostatic process. Things in the environment are located by tropisms depending on concentrations (and on the concentration's reading structures) in very simple systems such as bacteria, or on highly complex perceptive coordination (sight, hearing, touch etc.) in some organized being.

It is clear, anyway, that even at this level the sign location process taken as a whole is not an "all or nothing" operation that lays bare the essence of a thing, defining its sense and illuminating it as a sign. A sign is an identification, a recognition of meaningfulness, a more or less approximate translation operation that depends on the nature and working of the interpretant. Even at a level devoid of history in the cultural sense what we get is a "loose" identification of the sign which can be "tightened" to a certain extent both by the structure's entry sections and its internal routes. At each reading the reader discovers things to which it is adapted; in other words it rediscovers its genetic area, recognizes that it is connatural with this, and reconstructs its own history. It goes without saying that this operation (which is a natural one) does not take the form of an instantaneous insertion of external data into an immutable mosaic. It is, in a certain sense, an experimental adjustment. Moreover, since the reader itself is altered, subsequent internal testing on the modification cooperates in verifying the sign.

The reader also carries out the identification by means of a process of feedback on the sign. It is as if a first adjustment were made and this were followed up by further, more precise, circumscribed adjustments (this takes place at all levels of complexity).

There is a moral to all this: when we talk about signs, we must resist the tendency – so dominant today as to have become a kind of cultural reflex – to consider them as "one and univocal", endowed with the metaphysical property of meaning. They can be so only with the mediation of conventions, in other words, at the level of sophisticated, self-conscious, human knowledge, as an extension of the adjustment procedure just mentioned. The science of signs cannot possibly take statistically given signs as its starting point. A sign is a process.

Words too are processes. The way words can be used loosely and connotatively shows that it is not true that "in the beginning is the word"; what is true is that "in the end lies the most probable meaning of the word". The adjustment procedures referred to above obviously are the judgements based on context. As we shall see, there is no such things as an isolated sign, but there are references to what is contiguous. A science of signs that takes signs as absolute, ultimate data, independently of the processes and structures for which they are signs, in other words independently of their physiology, is doomed to be a formal science in the negative sense of the term.

18. Contextuality and representation

Without allowing anthropomorphic conceptions to interfere, we can maintain that an individual who has a number of entry sections for different objects in reality, or signs, builds a complex, multi-parametric picture of reality. Each entry is attuned to the others, for there are processes of correlation and internal meaning such as the individual's reaction does not simply follow the route that identifies object *n* by means of the complementary structure N, but passes through a multiplicity of mutually attuned structures.

Thus, if we continue to call the identification of meaningful objects for metabolic ends "knowledge", given that it is directed simultaneously at various objects via various, mutually-attuned parameters, knowledge will be the specific structure's overall representation of the environment; it will be an exploration of the horizon. It is the totality of the representation and of the operations identifying meaningfulness that exhibits the individual's adaptation, evolutionary differentiation and phylogenetic development. Moreover, as we have seen, each single situation of complementariness is

of necessity attuned to the others, so that the individual's exploration of the environment is not a mechanical process of breaking-down resolution of signs. Each expression of meaning is linked to the others – not by a consciousness (which we rule out completely at this level), but by procedures of mutual adjustment. Thus each sign feature of reality is "pin-pointed", in the sense that, by means of internal translations, other complementariness functions that are not those specific to the sign in question converge on it. It follows that each sign, in addition to being a recognition of complementariness, is also the location of a process in a context of other processes – *i.e.* the differentiation of a thing-sign from others in the horizon. The process of identification is accompanied in advanced stages of evolution by a process of location and differentiation.

It is hard to avoid misapprehensions about consciousness at this point yet it is essential that we do. We are not talking about a conscious representation of the world or a breakdown of its various components into units of a conventional, potentially communicable kind. What we are referring to is simply the sum of sign reactions an individual is capable of and which are to some extent correlated and hence do not function separately. At this intermediate stage signs are never without surroundings. For that, more complex differentiation and exchange procedures based on more sophisticated analogical capacities are required. A sign is always either near or far; it is situated in a sign-perspective and is integrated with other signs. This is usually thought to be a later stage than that of the identification of the single sign as a unit, whereas in fact it is an earlier one.

In order to rediscover the situation of single point-to-point correspondence at the level of representation (the original situation of bi-univocal correspondence) we need a more complex cognitive function that is peculiar to human sign exchanges.

Thus in the phase the identification process no longer takes place at a stage consisting simply in finding meaningful complementariness in the midst of a multitude of indifferent presences (which form an environment merely because they are scanned). There is a sort of background (a general dimension or representation of the situation), itself a result of sign processes produced, however, by a lower order complementariness: it is from this that higher-order meaningful referents capable of eliciting overall reactions and entering the circuit of the species' complex routes – *i.e.* of being recognized as signs – begin to detach themselves, emerge and take shape. The situation is rather like that of the new born child's inchoate perception in which the mother's face gradually begins to delineate itself, with all its sign and referen-

tial implications. This too confirms the sign's complex nature (it is never a "one hit" event) at an intermediate level of complexity.

This of course raises the problem of the relation between sign and reflex. Not all reflexes are signs, but all signs at lower levels enter into environmentally-triggered circuits – which is to say that they act like reflexes.

The representation of the horizon from the subjective point of view – from the standpoint of the individual parameters and the entry sections, that is – involves all the things that can be explored. If at some point this representation becomes so complex an self-attuned as to be conscious, this is because the biological connections preceding consciousness permit it. Consciousness cannot simply grow out of nothing but implies a gradual complication of the adjustments converging on the referent. The result is that, at a given degree of complexity, the representation as a whole influences the reader's attunement to the single referent, which is further identified by being distinguished from the others. Thus context, contiguity, location and differentiation come to be important in the identification of meaningfulness at much earlier levels than those of the literary analysis of connotation.

It will be as well, here, to discourage the out-and-out structuralists who support the notion of a total system. One can imagine them remarking "even a phylogenetic approach to cognitive problems cannot do without totality, then, and has to admit that signs are formed by opposition and differentiation processes". This is not the way things are at all. The "system" does not exist. All that exists is the complex formed by the readable horizon. The only system is that which has in reality grown out of this horizon and is capable of reading it in a way that remains subjective, partial and reconstructed. The only "whole" that exists is the one we cut out of the surrounding world when we fix our attention on it (unless we want to define the reader as a "whole" because he reacts unitarily – but this would be a very imprecise use of term).

These observations on the totality of the horizon and on the importance of contextuality enable us to add one or two further remarks on that widely-used concept "intentionality". The term normally defines a specifically-human cognitive way of behaving, and is phenomenologically equivalent to the attribution of meaning. Yet this process too has its roots in earlier phases than consciousness and can be identified as "location of sign areas" or "definition of areas of interest" or "convergences on referents-signs". We have seen that originally the sign directs metabolism: it brings the reading machine to bear on the object to be read. Thus intentionality is not so much a matter of giving sense as of receiving it. Even in more advanced phases, where intentionality becomes conscious and involves planning, the terms of the cognitive problem are never completely inverted. It is not the interpreter

that gives a meaning to things by means of his intentional predilection. It is things that are genetically and topographically predominant. Man remains like the other structures – he moves among things already given. What in particular about him is that he moves farther abroad, and is more highly differentiated from the things outside.

19. The sign and the collectivity of structures

One of the chief features of human signs is that they are social. In other words they are exchangeable, artificial-cultural objects which are inconceivable without a plurality of human interpreters. They are generated collectively and this is the only reason why they can be exchanged and used collectively.

However, even this feature does not appear out of the blue and it is not this which characterizes qualitatively man's semiotic condition, or knowledge. Signs, in the basic sense of things in the world endowed with meaning, play in fact a decisive role in the evolution of interpreting structures in the form of collectivities and species. As we have said, a sign is originally an external complementariness, an object in nature, a referent that finds a correspondence in a structure. Thus the sign directs the structure, makes this converge upon it, and guides and promotes the structure's metabolism. It is thus a reference-point, a goal necessary for survival. We have also seen how the sign retains this characteristic even when it grows more complex. From the point of view of utilitarian or metabolic interpretation, the gazelle has the same meaning for the lion as the glucose molecule for the bacterium.

A structure, however, is never isolated, but is replicated in copies and persists throughout generations and time. Thus what the sign directs, and maintains as a population precisely by virtue of its power of attraction, is a collectivity [*collettività*]. The sign prevents it from being accidentally dispersed. Moreover, even when we talk of a sign in the singular, we actually mean a plurality of presences, and these are not randomly distributed but concentrated preferentially: it is this variety of densities that goes to make up an environment. It follows that the relationship between a collectivity of presences and the density of its reference-point is what defines the ecological niche in which the collectivity develops.

This has an important consequence: to see evolution as operating on randomly-scattered individuals merely by environmental selection is an oversimplification. The collectivity itself forms a unit endowed with solidity and resistance vis-à-vis the environment and is a promoter of evolution.

Furthermore, its reciprocally-binding social habits make for selection advantages. Yet this could not happen if it were not for the fact that a number of individuals converge in the same environment, of which the other individuals, as signs, come to form part.

It is thus the environmental sign complex that maintains a sufficient density for selective mechanisms involving social behaviour to come into play. This should not be interpreted simply as if the sign created the opportunity for density and hence the statistical conditions for selection. The sign as such is a collective meaning in the sense that all the members of the collectivity identify each other (here, again, no connotations of consciousness are intended) precisely because the sign is equally meaningful for all of them. Which is to say that they are born, objectively, of the same genetic area.

The solidarity between individual and species must also be viewed as the motive force that constructs the individual in relation to things, a sort of ice-breaker, a progressive accumulation of conditions of collectivity or interdependence. The genetic area is not simply a physical environment but, constitutionally and historically, a species-environment. Hence the sign is, and remains, a meaningful datum for all. Its value lies in its being the reference-point for a collectivity that recognizes itself in it. In this sense eve, a collectivity is an organism.

The collective condition at its basic level forms the first scheme of an operative logic for the inter-subjective interpretation of the sign through material logic – which thereby becomes a kind of material logic of classes: a sign that can be interpreted by all Ns defines the class of Ns. Moreover, every N that can enter into relation with any *x* defines the class of *x*s by the criteria of the substitution of equivalents. Let us remember that *x* is a referent-sign and that it is formed of a plurality of copies. Its "unity of meaning" is given by the equivalent substitution of an indefinite number of single copies vis-à-vis a single reader. This is one of the first operative generalizations in the interpretation of the sign.

Examples of collective situations at lower levels are necessarily schematic since they refer to purely competitive situations. The tropism of bacteria towards their substrate takes the form of population density and competition for the substrate, without the development of collective systems for acting on the latter. (Nevertheless, we know how important this condition is for the emergence of a clone capable of learning to use a different substrate present in the environment and devoid of meaning for the non-mutant bacteria.) The only reactions are forms of saprophytism and integrated cohabitation which do not yet amount to organic collectivities. At higher levels, on the other hand, we find examples of collectively-orientated,

even interspecific, meaningfulness. It will suffice here the mention (though already at an extremely advanced stage) social insects whose collective existence is organized around specific sign nuclei, which have given rise to social selection with modes and functions that differ from individual to individual. Just as we cannot conceive of an individual structure without the signs on which it is built, neither can we conceive of a social structure – *i.e.* collective behaviour – without a referential complex in which all the members of the collectivity come to share.

This remains strictly true for cultural sociality too, where behaviour is organized around nuclei of meaningfulness that may be extremely complex but clearly orientate and structure the society. And obviously the entire social body, by organizing itself around these nuclei, contributes in its turn to maintaining their status of signs. This means that the purely referential sign becomes a criterion of differentiation and meaningfulness for interpreting other members of the collectivity. They will be interpreted according to the functions they have vis-à-vis the sign: they will be the same or different according to their relation to it. If we take as the ultimate referent of bees the object of their metabolism identified through specific apparatuses, then it is their metabolism identified through specific apparatuses, then it is their function vis-à-vis this referent (in other words, the sign process) that distinguishes one sub-population from another. At the same time this referent is also the origin and cause of this organization.

The concept of class as related to the collectivity of structures and to processes of generalization requires further discussion at this point. Reading interpreted as the identification of a single referent ends up by banishing the referent and becomes nonsense. It acquires semiotic value only if it moves from the object read towards something more general – *i.e.* the class.

This is usually held to be a higher level operation: from *token* object to *type* object, from real object to Frege's *Bedeutung*, with a qualitative leap that is basically extra-semiotic. It is for this reason that the referent is usually shunned by semioticians. Not only does it not suffice to explain communication, but it is not even useful: the best thing is to get rid of it then!

Nevertheless, in our view, the construction of classes is an operation already included in the material process of reading and the *Bedeutung*, is to be found at the level of the construction of the interpretation on the object. In other words, on the bottom right hand side of Ogden and Richards's triangle we have things as they are – reviewed one by one by a system which is by definition an authentic "classifier", a constructor of classes. The construction of classes is implicit from the outset in the material interpretation of the sign; it is in no respect peculiar to a higher level of reading, nor

is it an "abstraction", still less is it a construction of a "universal" that can be superimposed on single events. Rather, it is a process of generalization that unfolds sequentially ("hit by hit") and "experimentally" identifies the series of objects that form the class. That the concept can then pass over into the sphere of human knowledge where its possibilities of use and formalization are more extensive is quite comprehensible. Nevertheless, in the last analysis, there is no such thing as an intentional interpretation that is not based on extensional-sequential operations. It is at a higher level that extension can, for convenience, be re-interpreted as intension, and during evolution, in fact, structures capable of an intentional use of extensional interactions come to be formed. Yet one type of a structure is simply the continuation of the other.

In making these remarks we do not intend to raise the problem of normalizing the terms used here with those found in other domain – terms like reflexes, behaviour, instincts, learning. Standardization, however, is certainly both conceivable and possible. As a conceptual framework, the sign's power of attraction and selection is more general that that of schemes derived from sectorial issues such as, say, the relation between instinct and learning, between the rigidity and modifiability of reflex chains, and so on. For instance, if man's cognitive function is interpreted as attuned to signs, the problem of what to ascribe to reflexes and what to learning is relatively secondary: in adjusting itself to signs, a structure implements the whole of its evolutionary acquisitions, which, of course, in the case of man, also includes the capacity for evaluation, comparison, hypothesis etc. On the other hand, all these functions are built upon things that have acquired the status of signs, so that a purely behaviouristic criterion seems inadequate. Between complex structure and sign we do not get a reflex-type relationship that can be explained simply by the punctual behaviour of the structure interacting with the sign. This would be true only if we had access to all data on the overall behaviour (total, internal and external, individual and collective) – but this is never the case. What experimental psychology calls "behaviour" is a very limited part of the whole.

20. The social sign

It is only in the previous chapter that we have approached the problem of more than one interpreter, of inter-individual communication. Up to that point we dealt with a fairly schematic situation consisting of a single interpreter and sign, linked by a chain of translation reactions. In the last

chapter we began to explore sign reference as a collective process, though what interested there too was mainly the relationship between individual and environmental complex. However in a society built upon signs – which serve to direct and standardize the behaviour of a number of individuals – the capacity to recognize signs as meaningful is common to all. This is why all attune themselves to the signs and why the latter become a meaningful presence that regulates and mediates interpersonal relationships. The "commerce" and exchange of signs have their roots in an earlier stage that that in which the human sign as artificial analogue comes to be constructed. In this stage the sign is an objective referent and does not lead to any kind of cultural circulation or to any conventions of meaning. It is a much earlier phase than that of symbolic communication, then, though the latter develops from it. If in the general framework of its environment the individual can observe both the behaviour of the others and signs, and if the others' behaviour is his own or in some way equivalent to his own (for each becomes equal to the others precisely by virtue of the meaningfulness of the sign), then the signs can be viewed through the mediation of the behaviour of the others. Behaviour thus comes to signify an environmental condition and is thus itself a sign. Since this phenomenon occurs in a socially organized collectivity, connections of meaningful interpersonal behaviour are established, and these are signs. They differ enormously from case to case in correspondence with the genetic area and the social structure, and extend from the functions of ants to the display colours of birds. In short, we are in the field of zoo-semiotics, which presupposes complex identifications and relationships in which, however, the sign still remains a meaning-capturing process attuned to reality.

What are the instruments with which meaning is captured then? Clearly they are not only those of perception (that derive from the sequential organization or elementary complementariness), but also form part of the social structure – that is, of the overall relation of complementariness between one individual and another according to the phylogenetic differentiation of the species. It will be, for example, sexual complementariness, which is connected to the "general metabolism of the species" – *i.e.* to reproduction. Obviously the sexual sign is a referential datum that stands out very sharply, linked as it is to the exigencies of the species. Thus all sexual signs (odours, calls, colours) strictly linked to the environmental complex (seasonal cycles, geographical habitats etc.) mark the species. At the same time they are signs that reinforce themselves, creating a situation whereby they function increasingly as sign references.

An important feature which derives from this is the beginning of an exchange regulated by signs – the beginning, then, of the "commerce" of signs.

We have repeatedly stressed that the sign-thing acts as a trigger for change, regulating energy exchanges. Likewise the sign-individual (*i.e.* the meaning carried by the behaviour of other individuals) is a trigger for action, which is thus brought about by social signs. Life in a community ceases completely to be a relationship between structure and objective referent and becomes that between the structures as a whole and the objective referent. Clearly, each structure comes to be a referent for the others, so that social life is a network of relationships triggered off by the meaning found in the surrounding individuals, regardless of whether this triggering is purely a reflex, or acquired through learning, or mediated and conscious, or denied even. In each case, just as the environment prevails over the single structure, so it prevails over the social structure, which in its turn, like a broad environment, prevails over the single structure, in the sense that the individual is largely moulded by the collectivity during phylogeny.

As we shall see, it is not simply a matter of phylogenetic dependence, but of ontogenetic dependence too, since the first signs to "move" the individual are social: it is these which start up the reading machine and bring its functions into play. The social structure is held together by a dense skein of threads composed of intersubjective relationship of sing-complementariness. Yet, in spite of the complexity they have attained, there are no grounds for supposing that they are in any way new compared with the chain of identification and translation we have frequently mentioned. Rather, they can be seen as a prolongation of this chain and its projection onto a multiplicity of individuals. These relationships cannot exist without the mobility inherent in an exchange situation which, moreover, they themselves bring into being. The whole species in fact is attuned to the reality of these relationships (metabolic, sexual-reproductive, competitive) and each individual lives the overall reality through the identification of meanings in the others.

The collective relationship with signs is itself a factor of cohesion and exchange and hence promotes an ever-increasing differentiation in the reading of signs. In a certain sense it thrusts the individual closer to the world, forcing them to adjust more perfectly to their environment. The consequences of this are that (A) signs succeed in having themselves read more and more accurately and extensively by fostering the development of adapted, progressive reading machines, as we have already remarked on several occasions; (B) differentiation evolves in the direction of more

subjective interpretations of signs. Which brings us to the next sections of this book which are concerned specifically with man's interpretation of the environment.

21. Sign storage: internal signs and memory

From what we have said so far, evolution could be envisaged as a succession of individuals developing in the course of time and generations but, as single beings, remaining fixed and faithful to their genetic blueprint and maintaining with the environment purely complementary relations depending on the correspondences in play. Once the triggering and the transformation is produced by the sign it is immediately lost. The energy exchanged by the metabolism of the sign is in fact used for internal meaning processes, for new contacts with the environment, for growth and for reproduction, but it is no longer to be found as such in the structure because immediately transferred. This is implicit in the concept of translation. Once the structure has reached the non-destructive stage it remains unchanged and sets up relations with subsequent complementary objects without preserving any traces of them. The concept of information, too, is homogeneous with the structure's "fidelity to its blueprint". The single structure is a-historical, then. And even if the structure is complex it does not preserve any trace of the sign relationship, which is dissipated in the maintenance of complexity and connections with the environment.

However, it will be clear from even a superficial study of real, functioning structures that this is an oversimplified picture of the situation. At most it reflects what we find in the most elementary forms where history, in fact, is simply wear. But very soon, even at elementary sign levels like that of the *Protozoa*, some degree of "historicization" occurs and internal traces of the sign are preserved. Somehow or other the encounter with the sign is preserved, and above and beyond the process of dissipation an element is stored and accumulates in the individual. The structure changes and remains different after the specific contact with the external referent, whether natural or social. In this way the individual becomes "historicised" and, alongside the fixed information it will hand down to others, accumulates individual information about its personal experiences that cannot be transmitted genetically. Since the experiences in question are introduced via entry sections and are thus tied to the "fixity" of the structure within the framework of the species, the way they are stored will be "specific" – *i.e.* peculiar to the particular structure. Moreover it will depend also on the particular history of the

structure – the sequence of encounters and attributions of meaning in which it participates.

It is this, then, which constitutes the field of memory and learning and it is now widely accepted that these two structurally-related functions are extremely ancient phylogenetically and appear in elementary stages.

There are thus two ways in which the individual is historical: as a genetic copy or structure it is a result, a product of things (its history, in other words, lies entirely behind it); as a single individual in a particular situation it takes part in a series of contacts with things, and is never identical either with itself in its different phases or with another copy present in the species. However, these two ways of "being historical" are not independent of each other since the second is based on the possibilities provided by the first. This is a situation found at all levels, above all at that of man. Man is a historical being par excellence because the opportunity to construct himself a personal history is furnished by his phylogenetic progress or natural history.

What interests here in particular is the relation between the sign and the memory of the sign. A more or less lengthy sequence of ordered complementariness is set up and simultaneously with this an internal analogical situation corresponding to the sequence is formed. If the framework we have developed so far is correct, this internal analogical situation (by virtue of which the new state of the structure "stands for" the sign) cannot but be a sign itself, an internal sign – that is, like all other internal signs, a structural-material complex endowed with meaning for its reading structure and thus a trigger for changing the latter. This sign "persists", remaining available to the structure for a longer period than that of the sign-interpretation that produced it, though there is no need to postulate that it has a particularly long time-span or that it lasts throughout the life of the individual. Moreover, since it is analogous and complementary, it has nothing in common with the nature of the sign-event from which it derives. It is a completely different phenomenon and lives inside and is contained by the structure, whereas the sign and its interpretation are, or can be, external, consumable and irretrievable. What links it to the sign-event is a process of translation.

Since a deposit of this kind is only conceivable as a product of a differentiated function and takes place within a complex individual, it must presumably be linked up with other internal signs, whether memorized or not (together with those that are memorized it forms the memory as a whole – the succession of chronological sections of the structure). If it is a trigger for change and is meaningful for other internal and external structures complementary to it, this sign may be introduced into the internal routes: in other words it can be evoked. This does not mean we must posit a

conscious memory or a consciousness at this stage. All we need argue is that when the structure comes into contact with a punctual "exposure" it reacts by forming an internal analogical deposit which can interfere with the routes and the reactions pertaining to these.

At this stage there is no external "projection" of the sign, no "memory" of it, which is why we must insist on the fact that the memorized sign is in no sense a reproduction or miniature of the sign-event but simply a possible translation situation. It is not as if the individual contains inside it a micro-world corresponding to the world of things. It would hardly be necessary to insist on this point if it were not for the fact that an idealistic presupposition of this kind is extremely diffused, and has directly or indirectly influenced the whole history of philosophy – at times even under the guise of realism. The individual contains only traces (heterogeneous sign-traces and translation-traces) of the contacts made via its entry sections, and they are necessarily partial and incomplete. If it so happens that this store then develops a large number of connections and becomes forcefully "present" by recalling and adjusting behaviour – in other words if it becomes conscious – this does not mean a qualitative change has taken place but simply a further differentiation. This internal sign situation can take two forms: (A) it can interfere with sign-process routes: *i.e.* the individual's past influences its current behaviour, thereby laying the foundations of learning; (B) it can be triggered by an external event: it seems unlikely, in fact, that each deposit is stored in a random manner. It will somehow be connected to the sign-circuits it translates, hence it will be called up and activated each time the original sign sector is brought into play.

These two aspects are open to a vast range of phylogenetic development, especially as regards the capacity for evocation. In fact it is possible to arrive at a form of internal evocation whereby a memorized sign act as a trigger for another memorized sign, the working of this chain being entirely internal and without any connection (of an immediate kind at least) with the external trigger. This is what takes place in human knowledge, though further requisites are necessary for this.

We might ask how deposits of this kind are "historicized", *i.e.* arranged in a chronological sequence: whether, for instance, this is based on an internal biorhythm, and what the rhythmical unit of measurement is for storage. Whilst not ruling out the possibility that this activity may somehow be linked to modes of internal time processing (which all structures have and which are correlated with phylogeny and external rhythms: heartbeat, breathing, length of day and night, seasons, mating period), the problem seems to be incorrectly formulated. It is the depositing of the sign-equivalents that gives

rise to the time dimension in a suitable structure. If at time t_1 the structure changes from S_0 to S_1, and subsequently to S_2, S_3 at time t_2, t_3, it is the change in the structure which forms the orientated vector that measures time. The irreversible flux is measured by facts that are irreversible, and among these we may include those that gradually accumulate sign-experiences.

It is interesting to note how at advanced levels ontogenetic characteristics (the "experience of the world" derived from single events and stored inside the structure) are linked to fixed characteristics of a phylogenetic type. The phenotypic appearance of information storage is possible only if the individual is subjected to progressively more complex environmental stimulations. This is a common experience in psychogenetics as regards human knowledge. Individuals endowed with a set of genes that is complete and efficient as regards the cognitive mechanisms remain idiots if they are deprived of the stimulation of the environment; in a short time, moreover, this situation becomes irreversible. Individual history is possible only because phylogenetic history exists, but at the same time the realization of phylogenetic potentialities is possible only as a result of the stimuli of individual history.

It should be noted that, though particularly evident in the case of human knowledge, this situation is quite general and concerns all individual ontogeny. Normally it is the internal signs that act as a reciprocal stimulus for the genome (as happens, for instance, in inductive gradients of embryo), whereas for the processes concerning the organism's adjustment to the world – *i.e.* knowledge in the usual sense of the word – this function is carried out by the sign-data of the world stored in the form of material analogues.

Here it would be appropriate to examine some experimentally-ascertained memory situations and their corresponding structures. On the basis of our reasoning so far we may postulate that this translation function we call memory occurs via a process and is performed by a structure (or rather by a number of processes and structures since various types of preservation of traces are possible). We shall simply mention to systems or functions that could be analysed in this light, without attempting to undertake a detailed investigation here.

The first, obviously, is the evolution of the nervous system in mammals and in man (in all his complexity and for all our ignorance) and the experimental psychology connected with this. The second is the immunity system, another memory mechanism built phylogenetically on quite different principles from those of the nervous system and particularly deserving of investigation from the point of view.

22. Segmentation and reading

When we talk about "signs of signs", what we mean is now the logical sign chain (of which stored internal signs form a part) linking the structures to the efferent via what is normally called knowledge. Knowledge, in all its various phylogenetic stages, is a function of the meaning relationship with any objective exploration and any referent-sign. This is why we have called the logical relation of complementariness "knowledge" (or material knowledge) from the outset. Knowledge as it is normally understood – *i.e.* human knowledge as interpretation, manipulation and modification of the world – is nothing other than the prolongation of these complementary connections by the lengthening of the chains of sign analogues.

How can we interpret this internal sign, this "turning inward" of the sign phenomenon? The complex phenomenon of sign interaction produces a stable modification of the structure. This must be taken as a microstructural, molecular state. We do not need to know here (and in fact we do not know) whether the "modification" is an RNA, a protein, a complex of these, or simply a structural state that facilitates neural exchanges. There is no doubt, however, that the sign is "re-segmented". In other words, we must postulate that the contact with the external referent, attuned to numerous routes of the sign interpretant, is re-segmented into a finite number of internal material states that are in (some kind of) correspondence with it. The possibility of segmenting and translating certain aspects of experience is already present in the facts and in the structure before any such thing as an "intentional" exchange – which is why these aspects offer themselves as potentially "exchangeable".

Of course no-one would argue that the sign phenomenon is translated into a single thing (a whole, an "all-or-nothing") like, say, a nuclear molecule of RNA. The concept of the memory as a kind of filing cabinet is too static to be realistic. The sign is a complex structural state capable of entering into relationships. It is probably mobile, and certainly partial and labile. Nevertheless it is based on a finite number of correspondences linked – when activated – to a finite number of possible behaviours. Which is to say that, although we can imagine the retranslations of a stored sign towards the outside, there is obviously no "reconstruction" of the objective fact (which is lost and no longer has any connection with the individual) but a translation into behaviour – the sign being a trigger for changes – which is a sign in its turn. We have already seen, in fact, how within a species the display of a given kind of behaviour constitutes a sign. What makes communicable, artificial signs possible, then, is a situation of internal analogical re-segmentation and its exteriorization in corresponding behaviour (though the exteriorization

varies enormously from situation to situation and is governed by the kinds of circuits peculiar to each species). We can thus imagine two levels: one in which a sign enters the circuits and is reflected immediately as action (a reflex arc), and the other in which a sign enters, is stored in segmented form, and can be evoked as behaviour. In the first case the reaction to the sign is total and does not lead to a sign but simply to a sequential process that ends where the chain ends, even it can be read as a sign by other observers. In the second case, the external sign is retranslated into an internal one which will obviously be very different from the former but will nevertheless be linked to it by a long process of translation. Thus the structure's behavioural display sign "stands for" the sign which this structure once identified, and the mediation is supplied by a structurally specific internal analogue integrated in its circuits.

Cybernetic analogies are usually rather ambiguous; however, for what it is worth, we can imagine the first sign event as being translated into an informative diagram, a sort of perforated card that produces a series of actions when inserted.

This second stage too is susceptible of almost unlimited complication. How are the deposits linked up? How are they evoked? The relation "sign → deposit → sign behaviour" is obviously a simplification. To many signs (the complex of contextual signs and references) correspond a sort of "overall world-view" in the shape of analogues and possibilities of reaction to the various aspects of the world. If the structure is attuned to the external context, this is because there are connections between the internal signs. No matter how segmented they are, they do not form a sequence of accidental units; if this were so we would be quite incapable of explaining that connective function which we call knowledge. Even the evocation of the internal sign involves the interference of several translation processes: if we were to admit that what goes in simply comes out again without the structure "stirring it up" in some original way, we should be faced with a total, even if complex, automatism, and adjustment to the environment would be impossible. Human knowledge would be inconceivable in such a framework.

What needs to be postulated above all is that since stored signs are "meaningful for", they carry meaning for a specific connecting apparatus that can review them, see which are meaningful in relation to a given situation of adjustment to the environment, and link them together.

The stored signs, when retranslated to the outside (a somewhat intuitive expression given that what occurs in human beings is prevalently internal retranslation), are reassembled in an original fashion. If their deposit is segmented, they are re-segmented, rearranged in a different form

corresponding to the connecting function of the interpretation and the richness of the deposits.

The sign which is produced and "returns outside" is thus an extremely complex analogical construction. Each behavioural sign means something more that the sign at the input because it has been mixed with the structure during interpretation. Thus we should not imagine a situation of rigid correspondences like those found in direct complementariness processes. What we have is not mechanical translations but "retranslations": *i.e.* interpretations from the overall standpoint of the structure. In spite of this, the process remains inelastic. It is simply that it passes through many stages of a highly complex interpreting machine. The fact that we do not know how it works does not mean we should attribute to it qualities not to be found in nature.

We have already argued that any referential identification is an interpretation from the subjective standpoint of the entry sections, but it has to be added that, at complex stages, both the interpretation that ensues and its external projection as behaviour are "manipulations" carried out by the structure that organizes what arrives from the objective panorama according to the combinatory activities of its species. There is no need to insist on the fact that these manipulating capacities are, in our view, strictly bound up with the general mechanisms of interaction. However, in order to examine the interpretation of the sign and its behavioural "return display" whereby it takes its place among things as a sign, we shall have to refer once more to the concept of reading levels – that is, progressive structures adapted to cascades of combinatory activities. Let us suppose that external signs are stored in the form of elementary segments, in connection with the various circuits they derive from. They must be reviewed by a structure and organized into a first-level sign state, which will become the referent of another structure, and so on. At each of these levels a re-segmentation takes place, so that the output representation, or the corresponding sign at the exit, will be a situation of objective correspondence organized subjectively according to the non-arbitrary, subjective criteria of the species and the individual. This is the postulate upon which we reconstruct the long journey from the referent horse to /horse/. Here we have reached the threshold where it becomes possible for a sign to move from being a meaningful thing in nature to being a behaviour-thing corresponding to a thing in nature, and be seen as an analogue of the thing in the form of a behaviour; its next step will bring it to the most complex stage where it will become an artificial object detached from individual behaviour and socially constructed and socially exchangeable. This is the sign of semioticians. Discourse is made possible by the possibility of segmenting and re-segmenting sign deposits.

23. Objectifying the referent

To know always means to identify presences, but the recognition of these presences is incomplete and subjective. It is only at the highest level of complexity that recognition becomes really precise and ceases to depend on a single process of definition. We are not alluding so much to spatial definition – which is implicit in the concept of the sign as "otherness" and as "belonging to the world", *i.e.* distinct from the observer – as to the reconstruction of the object as an external presence. This is likely an extremely complex process that passes through numerous intermediate stages. Nothing like a direct contact between the structure and its referent: what happens is that contact is made by several entry sections and this is then developed as an internal sign and compared with the object. The object becomes a source of sign identifications and these are attuned to the object. It is thus source (emitter) and goal (point of convergence), and is objective in that it is reconstructed and assembled cognitively. Objectivity does not consist in "presence" but in cognitive reconstruction. A thing is identified as the point of convergence of a sign complex. In this way the indissolubility of the sign object and the reality of the thing, peculiar to the earlier stages, is reconstructed in a far more complicated manner. We can sum this up by saying that we never obtain the full presence of the object, but only a partial, indirect identification, as if it were reconstructed from various angles and then reassembled.

What we wish to stress here is that there exists a certain degree of correspondence between the output behaviour of the internal, memorized signs, as described in the last chapter, and the objectified thing. It derives from a sign process that starts out from the stored and reorganized data and is "aimed at" and attuned to the thing.

This process is what forms the "signic" representation of the thing. It implicitly involves segmentation, too, since, whereas at lower levels a thing interacts with others in its background and is seen as projected onto the background – against which its features emerge without implying any assumptions as to whether it exists separately – at higher levels it becomes single and appears detached from the others, being represented and as it were reconstructed from all angles by means of behaviours.

In what, then, does the unity of a thing consist? How is this fundamental state of oneness, of separateness, achieved? The answer is precisely through a process of convergence and adjustment. The thing is single because the process that represents it is convergent. The process which supplies us with the sign-representation of the thing confers unity on the thing and reconstructs the discrete, particular nature of the representation of the world.

Objectifying is thus linked to a reconstructed, complex representation, to mechanisms of sign integration, in other words. It is clear that the subject has a very important role in the construction, but this neither endows the subject with creativity nor the object with an essence. The connection between the external thing-referent and its complex representation in the form of a reconstructed sign remains intact, and it is actually possible to modify reality by means of this correspondence.

It seems unlikely that the objectifying process has suddenly appeared in nature in the shape of human knowledge. There are greater and lesser degrees of reconstruction of external things. It is certain in the course of ontogeny (as the child builds up an image of the world) and probable in the phylogenetic stages preceding Man that the objectifying process can be realized partially too, and even in fully-formed human knowledge there remains a considerable intermingling of internal and external. All we wish to assume is that the record of the thing at the cognitive level is transformed into the integrated complex reconstructed from its signs. Thus in itself the subjectively-observed thing is already a sign, though it is anything but a phenomenological appearance, or integument, or illusion. It is centred upon the concrete noumenon via a chain of reactions. The *a priori* categories are the circuits enabling the species to assemble the sign.

Two aspects of this issue need discussing here. The first is the fact that the objectifying process changes the sign-metabolic relationship. Up to a certain point a sign is essentially something to be consumed, since it is directly integrated into the structure that manipulates it and serves to nourish the structure. In the interiorizing and stabilizing of internal signs everything combines to "advance" the reading machine in its environment. We have already insisted on the structure's capacity for exploiting its referent by dint of the reading advantages it has acquired. The sign is an integral part of the interpretation because it is consumed. This happens even in highly complex social structures such as those of the insects.

But once the objectifying process comes into being, it is possible to save the object from being metabolized. Representation requires that the object maintain its independence as a source of data and as a site for the adjustment of representative behaviour. Thus the representation of the world is made up of "objects one alongside the other". We fit the environment in terms of behaviour, whereas in earlier stages matching is simply a matter of being actually adapted without any sort of representation whatsoever. When we talk about objectively reconstructed referents, we do not of course simply mean a spatial and physical representation of things – a sort of premise to the scientific analysis of the world – but sign nuclei that act as psychological

"presences" and produce instinct-influenced constructions which are nevertheless equally objective and external.

The second aspect concerns the fact that the objectifying process in man involves an intersubjective stage. Construction is never purely individual but, as we shall see later, makes use of transmittable, elaborated acquirements for the representation of the world, which is largely super-individual and cultural, even if necessarily located in the single person. The individual is geared to inter-individual modes of connection. This confirms that communicative cohesion is both a product of differentiation and a condition that brings about and promotes it. At the human level, the generation of the single individual by history can be observed above all in the facilities that culture offers man in the shape of language and representation of reality. It is nevertheless important to note that the emergence of "exchangeable and independent" signs from nature is strictly correlated with the emergence of the objectifying capacity. The sign at once bears witness to, and specifies the objectifying process, being an artificial analogue of an objective interpretation process; it displays objectivity and exchanges objectivity. Of course the objectifying process, as we have repeatedly remarked, is subjective: in other words, it works according to the particular modules of the species.

In this kind of interpretation of surroundings a psychological dimension is also rendered possible, and this goes hand in hand with the transmission of signs. Signs are always exchanged in a psychological dimension – but this raises issue that are beyond the scope of our discussion.

24. The hypothetical function

Once it has achieved a high degree of differentiation a reading machine reacts in two different ways to its environmental world – via direct reaction chains and via the image of the environment rebuilt in the output. It is the latter of these capacities that lays the foundations for sign-based communicative interaction between individuals. However, a number of other features are required if a reading machine is to become something more than a mechanism – however complex – capable of *a posteriori* behaviour but incapable of forethought.

What develops in man and characterizes his cognitive process is the ability to make hypotheses. This enables him to imagine possible states of reality on the basis of stored data by using the same logic (a prolongation of material logic) used to assemble the data. The individual re-segments and combines the deposits, adjusting them to reality, we have argued. This gives

rise to constructions with a certain degree of analogical correspondence to reality which can then be compared with reality via processes of translation. In this sense, internal representations themselves are signs and can be translated into communicable signs. These assemblages can be adjusted not only to reality but to other deposits taken as referents, which may be completely detached from reality.

Adjustment operations can thus be organized either in relation to external reality or to stored data. A purely internal cognitive dynamic arises based on the assumption of internal presuppositions. The machine never actually encroaches on the future – it does not need anything that has not come into existence. It simply uses its material states to hypothesize. *i.e.* to build, in the reality of the present, a new material state of the structure. A hypothesis is an operation that in some way takes the shape of a cerebral state. However, the parallel with objective reality can, at least in certain circumstances, be tested. It is possible, that is, to see whether a hypothesis corresponds to reality. The only way the structure can encroach on the future, then, is by experimenting on the present. It is important to note that all future-orientated functions – hypotheses included – remain anchored to the present, to the internal existence and development of material states.

This leads to an entirely new situation: the machine turns its attention to its own working and reads itself. The constructions this entails are still *logically* elaborated, since the logic of correspondence functions in the re-segmentation and the operations of the various reading levels too. A certain degree of self-reading also exists in the earlier stages in this sense, for even during re-segmentation a higher level reads a lower one. But what takes place now is a "total" reading. The machine has its deposits available and can use them both for external correspondences and triggering, and for constructing internal triggering. It is only at this level of the dynamic that we can speak of consciousness. Consciousness is not born automatically at the formation of memory, or when the data of memory are organized during output as representation, since the representation of what is external in no way implies consciousness of this representation and can be observed objectively as behaviour. It is born when the data can be used internally in a way not immediately correlated with reality. Consciousness is a construction of real or possible representations when the logical-combinatory interplay of deposits is so vast as to make it possible to bring all the connecting mechanisms into a single whole, as opposed to leaving them to operate as single circuits triggered from the outside and converging on the outside. The machine confronts itself and uses itself continually, and constantly draws on the whole of itself. In order to be able to exploit its internal deposits to

trigger and organize data it must be capable of reviewing its entire data store. The subject maintains at all times a given general evaluation of both its environment and itself and its own history. It possesses, so to speak, an overall "bearing" – namely consciousness, which like muscle tone, is a continuous background activity.

Clearly, the constructions made by the particular type of logical organization of the memory known as hypotheses are authentic representations. They are capable to a certain extent of referring to something, that is. Compared with representations of referents, they are even more incomplete, partial, reconstructed, indirect, and hence "historical" (in the sense that they are "peculiar to the history of the individual"). Nevertheless, they have the same natural status as representations of objective reality. Though artificial internal structures, hypotheses are nevertheless structural states and compositions of complementariness. As states of the structure, they too, then, are material objects of the world deriving from the combinatory activities of the reader.

They are thus always "true" in the elementary sense of actually existing. But they can also be "verified" in relation to the external world. In other words, hypothetical constructions produced by internal triggering and organized according to internal parameters (which obviously originate in the external world) can be tested against the external world to see if they are consonant with the latter. It can be ascertained whether the procedures of selection and material logic used to construct the hypotheses are correct.

Thus although the construction is not directly adjusted to the external world, it can be compared with it. Such, then, is the nature of man's hypothetical knowledge, even in its most elementary forms. It is by no means a purely "scientific" procedure, though the scientific method derives from the standardizing of hypothetical activities. Each cognitive interpretation consists of a series of internal adjustments, a series of "as ifs" or hypotheses that are put forward and tested.

This function allows us to make forecasts about events by drawing upon data from experience and introducing new conditions – *i.e.* those connected with other experiences that the one in hand. These forecasts are logically assembled. It is here, in fact, that we can observe the interdependence and contextuality of the logical operations, for although they may form exceedingly long chains thanks to the continual input of the subject they still make use of the basic procedures of complementariness and material logic. The result is that we can predict the development or regular phenomena by using hypothetical logic to foreshadow the logical-material relations between things and by aligning ourselves, in our materiality in the exact trajectory of things.

Of course, many hypotheses cannot be tested because they do not correspond to a physical reality. But they nevertheless exist and have a sense. Hypothetical connections obviously do not just concern perceptive-spatial deposits but also involve data of affective, instinctive, cultural and other kinds. They thus give rise to a vast range of possibilities which have nothing logical about them in the usual sense of the word but are perfectly logical according to our criteria – the logic of correspondences – since they correspond to the structure of the reader. Even such artificial constructions as poetry are objects of this kind, in just the same way as scientific representations.

The logical hypothetical function furthers our knowledge of the referent and broadens the domain of perceptive data. We have repeatedly remarked that the representation "constructs" the object from the point of view of the entry sections. But hypothetical logic also increases the number of these sections enormously by offering indirect ways of reconstructing the object. Verified hypotheses, in fact, become the basis for further hypotheses. Although all this takes place within the rigid logical constraints of the operations of representation and verification, it is by no means restricted to what the eye can see and the hand can touch. This, then, is how the interpretation of things is carried further and how knowledge deciphers ever "truer" and more-detailed parameters of the referent, which Man is thus able to interpret and modify.

However, we are less interested here in these cognitive aspects than in that of the signs as such.

If the construction of the object is a "global" sign, so is the hypothetical construction. It is a sign which is subject to verification. We can envisage a hypothesis about an event as a process that "unifies" various components around the hypothetical construction. Man, however, can assemble these sign-constructions as he wishes and verify whether they correspond to reality. He can ascertain not only if they represent reality but also if they are useful, if they influence behaviour etc. In other words, he can test whether they have consequences on reality. Thus the hypothetical activity should not be seen as designed simply for the static interpretation of things, for interpretations is related to the concept of interference and exchange. These sign-constructions are therefore not arbitrary, and extend the human world indefinitely. They are veritable artificial objects resulting from assembly of other data. Yet they all belong to nature – there is no such thing as a contraposition between the natural and the artificial.

The process of construction, although unitary, is not an "all-or-nothing" affair after which "illumination" occurs, but a process with a specific degree

of accuracy and reliability conditioned historically by the materials available and structurally by logical possibilities.

The foundations of the logical procedures of thought were laid down during the phases of differentiation that led to the construction of human knowledge in nature. What thought work on is data, and it is impossible to conceive of a differentiation of the rational activities without the materiality of things and environment to manipulate and the structures that manipulate them.

We have already stressed the importance of the concept of unity as a convergence on a process of communication. It is this concept which enables us to reconstruct the discrete character of the original processes and go beyond the metabolic and non-objectified approach to the reality proper of the precognitive stages. At this point, at the level of mental operations, emerges the logic of positing and negating, which corresponds to the original situation of finding or not finding complementariness; here the problem of "reviewing" also arises – namely the operations of addition, repetition, generalization, and recognition of equivalences. Signs are the tools with which all operations of this kind are performed, but these logical procedures remain simply a revised addition of material logic in the hands of an extremely complex structure. They, too, become the objects of hypothetical constructions: from discrete repetition we derive indefinite repetition, from "this thing" we go on to "every time this thing" and to "all things". The construction of totality thus never ceases to be a partial logical operation carried out by a structure. The concept "universal" is no broader than the structure that builds it.

Words as exchangeable signs are hypothetical proposals whose effectiveness in the world of reality is ascertained by means of an exchange. The construction of a word is an "adjusted project" – a complex interpreting process unified by its focus on reality. When we use words we once more exploit the hypotheses-making process as a tool for interpreting reality. Words are artificial objects because they form interpretative hypotheses.

All human signs are hypothetical in the sense that they are mental facts deriving from operations connecting things and events. Signs do not exist in nature outside of interpretation, and interpretation for complex readers is a postulated, hypothetical, partial, temporary and verifiable reconstruction. This is why the sign /horse/ is just as hypothetical as /unicorn/. However, in social operations, the former is an artificial object that belongs to reality and has a unity of its own, which means that it can be used for dealing with the real. It thus constitutes a useful operation.

25. Intersubjective connections

Another characteristic of the development of Man's sign knowledge is the great expansion of inter-subjectivity. The experiences that can be accumulated from a much vaster store than any individual can hold. The cohesion of the species produces an accumulation of non-genetic experiences that can be transmitted by learning. The sign function is at once a product and a begetter of differentiation. The construction of hypothetical representations takes place in a much broader sphere than that of the individual, with immense possibilities of combination and connection.

The stock of experiences is both historical and super-individual. This is a specifically human situation which, however, is not simply a matter of learning, this being an earlier function. The historicalness of the individual and his collective nature are constitutional. Man's communicative capacities are inconceivable without actual communication and inter-subjective cohesion. It follows that all hypothetical representations are accomplished by the single individual through cooperation with others and are largely social products.

Knowledge is cultural in itself. The materials with which Man builds his interpretative framework are those provided by the history as a whole. Thus what holds for ontogenetic development holds for knowledge too: the materials that set the human structure in motion derive from the environment and from history. The culturally-isolated man is also genetically mute; his informational material fails to receive expression. This demonstrates that it is the communication situation which has constructed our modes of knowledge, and that the general observation that reading machines are constructed upon their object holds true for Man too. It is this kind of inter-subjectivity which gives rise to semiotic communication and from which language, myths, institutions and scientific representations derive. It is a mistake to think of Man as a universal, for he is made up of innumerable particular "I"s whose sum will never amount to any kind of universal. Nevertheless, Man generalizes himself with the aid of culture, that remarkable "distinctive" trait based on communication, capable of accumulating and structuring.

To say that communication and the symbolic faculty are the "essence" of Man, and the Man is such "*quia habet virtutem communicativam*" is to say very little indeed and precludes a very great deal more that can be discovered. The way ahead lies necessarily through the natural reconstruction of the communicative function.

26. The human sign

The semiotician's sign is not a *deus ex machina*, then. It appears as an extension of the natural logic of interaction when suitable conditions occur – namely, a multiplicity of points of connection, a "mediation of the sign" in the shape of displayed behaviour (*i.e.* mediated meaningfulness), and an analogical activity leading to the construction of complex, artificial objects to be used as exchange currency.

At the heart of human communication lies the creation of hypotheses. Words or symbols, in fact, should not be seen as static, object-like equivalents, since they are in no way mechanical analogues. We have seen that their analogical power – which is, in fact, their semiotic function – resides in the fact that they are hypotheses about the world translated into an exchangeable form and are verifiable precisely because they can be related to the world. From this point of view, a sign system is artificial and built by means of hypotheses: it is used in so far it is continuously verified as adequate.

But what is peculiar about this type of translation, which renders the human sign so specific, is that it cannot be conceived of as an individual sequence initially a "first-degree" sign whereby we make artificial hypotheses and finally an exchange system). The latest sign – in our case the human one, the sign of semioticians – completely absorbs the previous ones: they are not behind it but within it. Thus at the human level, the sign-as-hypothesis is the only mode in which we adjust to reality. It appears to us from the first in a hypothetical, communicable form in the sense that it is an element of an exchange system.

The situation has thus come full circle: phylogeny advances towards an increasingly complex sign system, but when it reaches the hypothetical level and assumes the form of an exchange system it is the system that governs transmission and "guides" the single sign in the exchange function, and precedes and organizes signs.

As far as ourselves and our consciousness of the world are concerned, everything that is introduced has to undergo the mediation of the sign process, which is what really constitutes our "entry section". But precisely because it is collective, historical and systematic, this entry section does not belong to each of us singly but depends on the whole framework of communication. The entry section is thus the entire communication system and the sum of possible hypotheses expressed in the system. We shall return to this problem in more detail later.

The inversion of the priority between sign and system and the dominance of structurality found in human communication are nevertheless quite

natural, in the sense that they display the ever-increasing influence of inter-subjectivity in the relations gradually set up by phylogeny. Memorization and analogical-hypothetical activity make possible the formation of an exchange network that gives the single sign a sense within the overall framework of the exchange.

27. The genesis and the anatomy of the sign

The sign, than, has a dual nature, or rather it is the outcome of two different states of affairs since it is situated at the confluence of two phylogenetic movements. It is produced by representation in that it comes at the end of a process of identification-recognition, and it is modelled by communication. These two aspects –and this is the central problem of the sign – actually coincide, for all human representations are established historically (in both natural and cultural history) and thus depend on the possibility of transmission and use; on the other hand all communication consists of the transmission of "something to somebody".

These properties are extremely ancient, since even the biunivocal relationship between interpreter and thing-sign amounts to the transmission of something to someone. Where something new arises is in the transmission from the thing-sign to the artificial sign, a veritable analogical driving belt developed by the reading machine for interpreting and changing te legible world. From this point on, then, the problem of meaning concerns the genesis and the workings of the cultural sign which can only be interpreted as originating from distant forerunners. Signs can only be explained through their physiology, as historical products justified by their function in the development of the species. We can only repeat our conviction that it is quite absurd to take the sign as an independent starting-point ad see the problem of meaning as the primary issue. A sign makes sense only because it does not come into being at the human level, otherwise it would be incomprehensible – it would not serve for communication, that is. A long, gradual genesis of things, a long process of selection, a long, uninterrupted sequence of correspondences with things in the horizon – all these have gone to build up the sign. At the same time, the *use* of the sign has gradually moulded the machines capable of reading it, because, though artificial, it is a thing with a "bulk", it exists and circulates, selects an stimulates.

Thanks to the artificial, human sign, created by human presences, single existences and generations are linked up by a different reality than that of

genetic information. Moreover, it is the sign that enables genetic possibilities to emerge.

It cannot be overemphasized – if we are to account for the genetics of communication (*i.e.* the fact that man has the tools of communication in his code) – how important actual communication has been in moulding the structure via selection, and how this in turn has led to the perfecting of communication itself. It is a history of reciprocal influences within a web of relationships that extend far beyond individuals and generations.

Nor can the extent to which we are formed by others and, earlier still by things, be overemphasized, or the fact that our individual capacities consists solely in handling tools made by others.

Yet the sign has a certain degree of independence. It is a presence that can be re-segmented and reassembled. It has an economy of its own. We do not intend to try and find a "pure science" of signs, an exchange economy independent of the things exchanged. However, since the process that produces it is unitary, the sign does have a unitary function in communication, and this function is so far reaching that it practically coincides with knowledge, of which semiotics is a synonym.

28. General features of the sign

Let us now examine a number of characteristics of the sign in human communication. These are to some extent already explicit in what we have said in previous chapters.

(1) The conventionality of the sign. What we mean by this is that the sign is not absolute. It is not the same for everyone, nor is it predetermined from outside, nor is it produced by a universal adjustment of all possible speakers. A product of history, it is a partial adjustment that arises and prospers within a given group, and can be translated into other contexts only by means of appropriate operations.

Its conventionality reflects its genesis and its use, exhibiting the history – the limited history of single communities – out of which it has developed and carries the imprint of the sphere in which it has currency by dint of being used there for communication. Its use, of course, can be extended, and it is possible to find signs whose range of use is extremely vast or which are valid for everybody. Even in these cases, however, processes of specification and translation are necessary, and these confirm that it is conventional. It

is the mechanism from which signs derive that is general, given that the horizon is largely a common one and that the important features of the species are common. Hence the logic of which contacts are born is the same for all men.

Nevertheless, the historical products of various contexts are in fact the result of evolution in a single, circumscribed context. The conventionality of the human sign is its particular mode of being logical – just as, thanks to a general principle, the subjectivity and partiality of sign recognition is a particular case (or perspective) of the objective, relational texture of things.

(2) The use of the things. Signs are transmitted and carry meaning, and are useful, obviously, *because* they mean. Use moulds and adapts them just as water smooths and transforms pebbles. The existence of a sign is not fixed once and for all but varies and is shaped by use. Its variations reflect variations in cultural and environmental relations as well as expresses – at least in the case of some classes of signs – a gradual improvement in its capacity for describing and manipulating the world. The sign is at once the instrument and the symptom of this improvement. It is clear that the "mobility" of the sign is no more arbitrary than its conventionality. It is possible to conceive of cultural history precisely because signs change in correlation with the intersubjective context and themselves manifest this change, which is constitutionally – and not secondarily or super-structurally – semiotic.

Use is linked up not only with the change but also with the economy of signs. An exchangeable sign must be adapted to communication. It must, that is, possess those features best fitted to ensure brevity and clarity and its development must lie in the direction of increasing efficiency of use. In this sense we can see signs as subject to a process of selection: the fittest survive – *i.e*. those which are least ambiguous and which best represent the specific fields of reference.

The problem of the distinction between signs (which has led to so many controversies between structuralists and dialectics, between totality and opposition) is essentially a matter of use, in the context of the sociality and physiology of the exchange. It is quite natural that signs that can be differentiated one from another should be selected by communication situations, but this characteristic does not derive from a structural property existing prior to their formation.

(3) The logic of the sign. We have already seen how this derives from the material, manipulating logic of exchanges. At the human level, this takes the shape of a set of operations (addition, inclusion, comparison etc.) based on

the hypothetical activity and on generalization, which are themselves always operations on signs. Signs come into being and are used within this logical system, and at the same time they give expression to it. They are not "given" first and then manipulated logically. They grow out of the logic of Man's cognitive operations. This logic is defined with a greater or lesser degree of accuracy essentially according to the kind of use made of signs. Since these constitute a real historical fact that serves to determine behaviour, this logic will not necessarily always be so precise as formal logic. And even the signs developed by formal logic for its operations will reveal varying degrees of definiteness – *i.e.* more or less precise outlines. However, we should not forget that signs form the bond between man and his context, and that this bond is in itself logical. Which is to say that signs both derive from it and enable it to function, and will be geared to the degree of "penetration" of our knowledge of the context.

In the sphere of human operations, a word denoting a myth is just as logical as an equation of mechanics. It has its own particular function in the logic of exchanges and representation in a given context. Outside this context it loses its logic. This shows that logic and use coincide, and that use is the movement of logical operations.

The logical operations that form signs are, of course, always those of the logic of classes. Signs are processes of convergence, are finite in number, and some are interchangeable in certain contexts. On their inter-changeability depends the Inter-changeability of the operations, which reveal themselves as equivalent by this means.

Thus signs are not only finite in number (though numerically indefinite as regards their possible combinations), but each one also expresses a finite number of operations, processes or things.

The logic of sets and the concept of class derive from the definition of signs. The sign is the symptom of the logical use of the world. It is impossible, moreover, to imagine a logic without some kind of sign system.

It is worth stressing that the most formalized signs – those that are most general and least ambiguous – are not the only ones "authorized" by the "supreme logical function", according to the Platonic ideal of formal logic. They are simply the most useful, usable, general and least contradictory tools so far devised. Of course, it is part of the dynamic of hypothetical logic at some point to posit more than one logic and to raise the problem of contradiction. But to claim that this means a contradiction between Man and his genetic area and his own structure – in other words to hypothesize a dramatic rupture in the course of his development – is quite absurd. Logic can contain logics and contradictions as one of its logical developments, in other

words as the extension of operations which will never be in contradiction with the structure that performs them or with the world from which they arise.

The problem of contradiction poses itself to the extent that one believes (consciously or unconsciously) in a preordained unitary world corresponding to a scheme or set of laws. Laws are not internal rules or the soul of things. They are a way of representing the regularity (or non-preferentiality) of events with the aid of our own parameters, and they vary historically as the latter vary.

29. Sign systems and codes

Operations of "sign identification" of reality does not occur haphazardly, nor are they repeated in an arbitrary manner. They are directed, above all, at the reality which is responsible for the generation of the signs, and are performed by a finite number of individuals for concrete ends. Their union with the particular context in which they are used is, as we have seen, something more than merely "occasional", since they are exchanged in so far as they are historically and culturally created.

Clearly, in a situation of this kind, signs do not form a disorderly sequence but a system. A sign, in fact, does not come into being in isolation but uses other signs to define itself and corresponds continually to a world of signs, organizing itself in relation to this and in logical correspondence with this. There are, normally, two aspects to this process: one is historical, its factual explanation or description, the other logical, its correspondence with the demands of use and its organization according to functional principles. The sign exists in a sign context or system, just as an objective description is always built on a rational basis. Thus the organized set of signs corresponding to a given sign function (*e.g.* verbal communication) forms an organized system which is the sum of all the foreseen uses of the signs in question. These uses thus define the area in which the signs can be employed in the sign context. This confirms the concept according to which not only the signs define the system but the system also defines the signs, and shows that the link between the single unit and the system is provided by the functional logic of communication.

The logic of the substitution of equivalents in operations defining classes aims to define both the single sign and sign organization. This delimits the inside and outside of a given set – what is included and what excluded – and within the set defines the subset. The criteria of membership are functional

criteria – namely, what the single sign serves for, and what class it belongs to In this way, according to its various functional aspects, an organ or a structure is defined, whose single elements can be manipulated with the same manipulatory logic with which we explore the world and foresee regularities of behaviour. We shall examine this issue, with particular reference to language.

The presence of a system and thus of "rules" entitles us to speak of codes – in other words of references in relation to which the single sign units receive their meaning in the particular historical system being studied. Nevertheless, in our view it is necessary to be extremely cautious when using terms whose scientific analogies are appealing but which can get out of control and come to signify far more as we go on than they did in the initial stages.

The most delicate issue here is the concept of system – often used as a synonym of structure. It is quite natural for a communication complex of a given means of communication (for instance, the spoken language) eventually to become a structure in which the single parts are functionally correlated. If the coordinated reader confronting a referent is a structure, then so is the complex of historically-developed artificial constructs that he can use. We have seen how convention, logic and the use of the sign all contribute to this end. However, the concept of structure we have adopted here is a factual one, namely that of order accumulated during a history of options, and not an order imposed on things from outside nature. This is the concept of structure that must be retained.

The sign system, then, is order accumulated by use, and is always "order for" and "order in relation to" something. The degree of order, of course, can be rendered observable and measured by comparison with random configurations. But these measurements tell us nothing, in themselves, about the genesis of order. What we need to do is interpret the genesis of order as the selection brought about by use and see it as promoted (or foreshadowed) by hypothetical possibilities and by the construction of artificial objects, whose resistance and fitness is subsequently tested.

It is during use that individual features set up relationships with the other features of the system – like pebbles which are shaped not only by the water but also by knocking one against the other. All too often this situation is turned upside-down and the "empty" system taken as primary, as if the structure were somehow independent of the materials it is built out of, or, rather, gradually filled up with. According to this approach, what "determines" or "explains" the structure is simply its internal rules, the interrelationships, from which thereafter the single elements acquire their meaning.

Structure, on the contrary, is a material fact. It is inconceivable apart from the things that go to make it up, define it, and are defined by it. The rules do not belong to the structure but to the logic of exchanges that has built up the structure in the course of history. The "soul" or explanation of a structure lies entirely in its genesis.

It should not be forgotten, though, that there are clear priorities even in this kind of joint formation of structure and signs. It is things which make themselves felt via modes of reading, which means that the signs and system thus form a single pole, the other being the referent from which they derive. To contrapose a single sign and its system is a false dialectic, explaining in terms of oppositions what is interwoven and can have no other explanation than that of interconnectedness. The only real contraposition remains that between the world and the reader, and it is not a dialectic, but a matter of sequence, genesis, operations and interpretations.

In this sense, it is things which build interpreting codes and have themselves interpreted. An ordered structure exists only in relation to the things it has to represent and communicate. Any investigation of communicative structures must be based on earlier, internal – historical and logical – elements. It cannot simply be based on the purely analytical examination of the terms as given. A synchronic structure devoid of connections with logic and history, which merely organizes signs in relation to one another, is simply a verbal expression.

One more remark is called for here. There is a tendency to abuse the analogy between cultural and biological systems. Though the former are built upon the latter, the machinery of their genesis being basically the same, this does not mean that they are not profoundly different in their results. Biological systems are codes in the true sense of the word – they are fixed, transmittable structures varying only due to the selection of accidental errors; cultural systems, on the other hand, can be modulated, and are not selected by the suitability of the function but foreshadowed by the hypothetical activity.

The rules for the transmission of natural and cultural codes are radically different, and it is illegitimate to push the analogies further than the limited sphere in which they are valid.

30. Spontaneous vs. constructed systems

The distinction between spontaneous and constructed system may seem ambiguous, given that all systems in culture are in some way constructed. Yet we need to draw a boundary between fully historical sign systems like language and truly artificial systems such as the highway code constructed for limited and well-defined circumstances of use, if we are to make research methods appropriate to each of these. Here again, it seems strange that semiotics should offer itself as the unitary science of such diverse and heterogeneous situations. There are codes which are descriptive – and hence interpretative in the broad sense – and codes which, for example, are prescriptive. The latter, of course, depend for their codification on the logic of communication, but this is not their real goal; actually they are constructed in order to produce certain kinds of behaviour in a particular sector of reality, and are thus systems of norms. The overworked example of the highway code is a case in point. Its signals consist of a series of prohibitions and permissions laid down by an authority for the road-user. Obviously the most appropriate and comprehensible iconography is chosen for this purpose. Nevertheless, it is somewhat arbitrary to call these signals a system. Their system is that of language. The same holds for those so-called codes which are simply a variation of the mechanical means of transmission. It is hard to see how the Morse system can be considered a code, or how it differs from the verbal code other than at extremely superficial levels of the linguistic system. Where, in this case, are we to find a "structure" if everything boils down to the mere transcription of single letters? The situation is quite different, on the other hand, in the case of an iconic code that translates the spoken word graphically, as in ideographic languages.

Similar observations can be made about the meaningfulness of man-made objects as studied by semiotics. They are certainly signs in the sense that they bear witness to the history that has produced them, but to transcribe them into a structural limbo seems something of a divagation. As signs, they are not set up in contraposition to other man-made objects but form part of a general historical context. It is at this level that they fit into the discourse that represents them and links them.

Semiotics today seems to be afflicted by a very market degree of reductionism: shunning pre-human antecedents, it grows barren by confining itself to conventional human products. In this latter area, on the other hand, its activities tend to be all-embracing. This is the exact opposite what semiotics ought to be doing – namely to return to the origins on the one hand and to make very sharp and accurate distinctions in the field of human

semiotics on the other. Communication situations are extremely diversified and should be studied with due allowance for the conditions of use out which they arise. Since knowledge is above all a technique of identification, these situations should be studied with different techniques for each case. A universal semiotics seems doomed to be a somewhat fruitless enterprise.

Science as a sign system or discourse in progress aimed at defining the referent and involving a significant hypothetical and self-correcting element requires separate treatment and will be dealt with later on.

Second Part
From the side of Culture

The characteristics of human communication and language are examined in relation to the concept of gradually more complicated systems of deciphering external and internal meanings.

1. Relationship between natural and cultural semiotics

The first part of this book has been occupied by outlining the natural history of communication – the phylogeny of reading machines. In its later stages, this natural history has turned into cultural history and the history of human communication.

From the standpoint of the doctrine of sign and sign system, the approach followed so far may well appear improper. For the semiotician, in fact, the starting point of each enquiry begins with the analysis of language as an already given system. It would not matter if reference to natural antecedents was simply a debt to be paid to custom or a ritual gesture. But the question we have to ask is of a different kind: namely are these forebears simply shades of the past which can be forgotten, or are they an intrinsic part of the problems facing us today? Is phylogeny a purely chronological succession, or is it a sequential history in which each stage is subsequently included in the next?

Scientifically speaking, there can be little doubt today that the second of these interpretations is the more valid. Each structure contains the whole of its past history in its present working.

The delimitation of the field of semiotics constitutes a crucial issue. As founded by De Saussure, semiotics is a science of artificial and conventional systems, such as language, of course, and all the other inter-human exchange system governed by rules (*e.g.* rules of politeness, the highway code, military signs, etc.) In this respect, the general system outlined by Peirce may also be non-human, since the process of semiosis occurs wherever there is a mediation between an interpreter and a thing by means of an interpretant. But in Peirce's framework, and broadly speaking in Morris's too, the only possible domain for this kind of semiosis is the human one; at least, they both conceive interpretation in an anthropomorphic and anthropocentric manner. Unlike the De Saussure's demarcation, Peirce's does not need to postulate either intentionality or conventionality (*i.e.* the artificial nature of semiosis). Nevertheless, in his approach to the problems of semiosis, the sign is something already given as a mediator. It is already inserted in a semiotic function whose origins thus remain totally obscure. What we must do is to go a step further and eliminate not only intentionality but also mediation in the most elementary stage of meaning. A sign is not something that officially

represents something else. It is a natural object that corresponds to (and is a function of) something else. When we use the expression "stands for", we really mean to allude to a material function, even if the term seems to carry a highly metaphorical aura.

Initially the poles of the semiotic relation are two. It is the thing, which is sign in the first place, since it is both interpreted and consumed by a reader. Mediation – the sign as an independent entity – comes later, but it is important to go back to this biunivocal origin because, in such a perspective, the sign no longer refers to an indefinitely long chain (in which one sign is explained by another and so on) but to a chain of interactions which are finite in number, however many – in other words to the meaning of the sign in the sphere where it is used by a reader.

The mediation and independence of the semiotician's sign come into being gradually during the process of differentiation of reading machines.

The most advanced problems – the crucial and basic issues of semiotics – can hardly be tackled without being reinterpreted on a natural basis. Normally, however, they are treated as new problems peculiar to human communication, so that, after a specific investigation of their characteristics, attempts are made to explore them in depth with the methods of philosophy, and semiotics becomes a sort of philosophy of language. Even references to history tend to become references to philosophy, and point out, somewhat obviously, that present-day problems have their forebears in philosophical reflection and can be interpreted as elements of philosophical reflection. The training of those involved in the controversy typically, if not universally, suffers from this "short view" of history as the dimension of culture debated upon by cultivated men.

We are not, of course, suggesting that current semiotic research be replaced by other kinds of research, or that the field of enquiry be changed. Very little, in fact, has been achieved in the way of experimental results in the area we have called "natural semiotics", which could replace cultural semiotic research. Moreover, there is no doubt that the continual refinement and systematization of the latter is thoroughly justified in the sphere of cultural analysis.

What is important is to extend the field of semiotics: we need to dig *deeper* to may uncover what *precedes*. This task is simultaneous and coextensive with that of institutionally-established semiotics, and ought not to be allowed to suffer from possible preclusions against the open and experimental nature of its research.

The scientific point of view we are proposing, then, is not an alternative to, but, if anything, an integration of current semiotics. It is worth specifying

here that the term "scientific point of view" is meant to exclude two attitudes which, whether they are scientific or not, are not suited to the type of analysis in question.

The first consists in assuming that a researcher, simply by virtue of belonging to a corporation that uses the methodology of research, has a special title to tackle these problems. Competence can only derive from the confluence of an experimental training with a cultural training in the field of semiotics in the institutional sense.

The second consists in assuming that experimental science has objectively obtained results capable of resolving the ambiguities of semiotics. Science is very far from doing so, and we have repeatedly pointed out the enormous gaps in the phylogenetic framework as regards the level of the organization of complexity and communication. Even from the strictly methodological viewpoint the contribution of science hardly appears decisive. The definition of a method in the outcome of the interpretative activities as a whole, and not just of the so-called experimental science. Once physics was supposedly the fount of methods: it set out to represent all things in their modes, and not just in the modes of the analysis of the physical world. Nowadays, however, it is generally agreed that no single discipline is delegated to fulfill such a demanding task.

The scientific point of view consists rather in making the outlines defined by the various perspectives of investigation coincide, and in identifying these with the outlines of our single world. It consists in giving priority to the objective problem of communication rather than to our cultural tastes and ideological pretensions.

The tendency automatically to split the planes of our horizon into two is so deeply-rooted that we really do imagine that there are two worlds, the physical and the mental (natural/cultural, material/spiritual) and we reason and build our social behaviour on the basis of this assumption. Nor is this tendency anywhere near being eliminated by simple convictions, since it is more deeply-rooted in us than our convictions, and will only be changed by history – in other words, by an evolution of equally concrete social conditions.

Our investigation must start from the premise that we are always talking about the world we are immersed in, and that we cannot change registers at will when our listeners change. Our problem is to render a single register adequate without changing it, and to use techniques or translation and standardization when these are necessary.

We must also neutralize the conditioned reflexes of our cultural backgrounds. The theory of the two cultures (with its associated exhortation to

glance occasionally at our next-door neighbour's garden) is a symptom of our backwardness in this respect. There are *n* cultures and all are contained within a unique complex of things. Their variety coincides with the oneness of the horizon in which they have developed, and their interpretation is rendered possible, as an operation of translation, by the fact.

Semiotics too, then, as the science which aims to systematize the operations of communication and translation, must expand as far as possible and try, as it were, to "flatten itself" against the whole of the horizon, leaving no reserved areas unexplored – at least if it wants to live up to its claims to be a unifying discipline.

With these convictions to back us up, we shall now try to explore a number of general problems of semiotics in its institutional sense. Many of the points made in the first part of this book will be returned to: the reader may get the impression of something "déja vu". This impression is quite justified – in fact we want to go back along an already-beaten track. This time, however, we shall travel in the opposite direction, so what we have to say will be both old and new at the same time.

2. Opposition and universe

The typical procedure used for discovering the universe of communication is that of constructing, or simply hypothesizing, an overall semantic system governing all kinds of semiotic contact. From this basic assumption are derived the descriptions of the single domains and the general modes by a process of definition. The characteristic "*primum*" of many definitions is the concept of Opposition, that strange instrument which only makes sense within a system itself begotten by opposition and which is to be found nowhere else in the world. The operations of distinguishing, associating, existing, cancelling or comparing can be found in many fields, but there is no trace of opposition except in semiotics, where it seems to be an inescapable heritage of dialecticism. The fact is that opposition can only exist inside a system, or closed construction, in which the reciprocal roles have already been definitively assigned and where there is no exploration but only the confirmation of what is already known. The concept of opposition breaks down automatically in a semiotic world where deciphering also means exploring and knowing – in other words, the continual appropriation of the world. It then remains only as the mode of functioning or as the relation of the reading machine with the world and ceases to be the rule of the universe of signs. We can go further and say that there is no such thing as a universe

of signs, not even in the sense of a construction necessary for controlling semiotic behaviour. All this exists is systems of signs, and these are neither definitive. The universe is something for which there is no need whatsoever. It is simply a name that enables us to invert the terms of the problem and deduces from the obscurity of the system what we really ought to construct empirically, in a semiotic world where there is no lower threshold and no ceiling, no accepted starting point and no pre-ordinated destination.

A feature of the Platonism of much semiotics is the tendency to do away with the referent, constructing a semiotic kingdom and exemplifying communication with abstract reading machines – authentic automatons capable of behaving in a purely, totally "signic" manner – *i.e.* interpreting and emitting signals on the basis of a conventional framework. What fails to be noticed is that these automatons do not actually exemplify anything – least of all a universal situations – for they represent the most specific, characteristic creation of natural structures and natural languages in the field of semiotics. We fix its categories to the machine and demand that the machine itself explains the universe of the categories.

If anything is common to systems of human communication, it is neither universal nor systematic, but simply general or functional. Communication processes correspond to inter-subjective requisites and thus may, and perhaps must, be built to some extent on common modes, even if they explore different areas of reality. This means that the reconstruction of what they have in common is a generalization from the particular, a process justified not only by comparative analysis but also by the criterion of the use and usefulness of signs. If, therefore, we want to reconstruct general features of systems, the first thing to do is to analyse how they work. General semiotics, from this standpoint, is a comparative physiology of communication systems.

As we often remarked, the semiotic activity coincides with the cognitive ones. Meaning – within the approach we have adopted throughout this book – emerges from a process of contact, of which the existence of code is a facet. Codes are the resultant of the processes that precede them and these processes – univocal and standardized as they are (and geared as they are to that well-defined species called Man) have been made up uniformly and are orientated towards exchange. There is thus no division between the theory of codes and communication, and the mode of production of signs. It is a single process that deciphers what can be deciphered and exchanged (with itself and with others) and constantly links together individual, collectivity (remote generations of forebears included) and things. When, here and now, we choose a specific mode of communication, we make use not only of

materials collected by experimental knowledge and then encoded, but also of the experimental and hypothetical modes peculiar to the human species. Hence, if I choose a word and then combine it with other units of meaning to form a larger unit, all I am doing is using materials established and selected in a logical, adjusted manner, and comparing them hypothetically with the reference situation I want to communicate and understand better or clarify or falsify. Codes are an "available" world, a factual one, in the sense that they have been created by and are employed in the sphere of human interaction – a sphere which functionally expresses the process of knowledge and is a function of things and men in contact. To communicate means to be inter-dependent with a world which is in itself a semiotic world, given that we derive from it phylogenetically. The only way we can see it is through our entry sections and internal routes – and these are linguistic ones. This does not mean that the world vanishes if we do not read it. It remains perfectly whole but for the possibility of being read by Man. The noumenon is thus what comes before, which is what we see phenomenologically and semiotically. Cultural semiosis is no more than an extension of a simpler, natural type of reading. The continuum between things and their interpreter, culture and nature, noumenon and its semiotic-phenomenological observation, is the foundation of all knowledge and can be defined by saying that the reader derives from his world he reads. We constantly experience the world in communicating it; we constantly create sign situations that become part of the world – concrete connecting things which function in accordance with the material logic of exchanges. In short, to communicate does not mean to intrude into extra-semiotic areas, but to immerse ourselves in a world in itself semiotic, given that it has generated us as its readers. It means immersing ourselves actually and genetically, and retracing the steps of code formation, and, further back still, of the formation of natural structures as they increase in complexity. The perfection of a purely theoretical semiosis is a residue of the philosophical concept of an all-embracing system, a universal key that makes us lords not only of everything we behold but of all that it is possible to see. This powerful animal instinct – an instinct of possession, however intellectual – goes hand in hand with the instinct for purity, whereby we shun contact with others who have not been suitably "refined" and seek only "men" – those novel creatures begotten miraculously by philosophy and communication. But this is not a scientific attitude. It is sometimes argued that the scientific attitude consists of a detachment from phenomena and an accentuation of universal operations, in a self-contained, typically human sphere. On the contrary, the scientific attitude consists in immersing oneself in things, in accepting all the consequences that derive

from this, and in admitting that formalization and conceptualization involve mingling with things and lead us to feel increasingly bound up with and permeated by things rather than detached and pure.

Hence, from the standpoint of the need to know (which is just as concrete and deeply-rooted in man as the need to eat), what point is there in a "theory of semiosis" as such, other than that of excluding a part of our background we find unpleasant – though it happens to be our source – and of enabling us to reason about the pieces that are left, to which we give the name of "Universe" or "Whole"?

Our need to know is better satisfied by leaving everything open and, rather than setting ourselves problems of general theory, by exploring the field of communication in functional terms, studying the logical-experimental formation of codes and how these are used in connection with an environmental world. This functional field coincides exactly with knowledge.

3. Concept of communication system

The reality we must start out from, then, is the existence of actual exchange systems, which observation and use offer to us. These are of various kinds – scientific, linguistic, esthetic, behavioural – and apply to different territories: according to their referential and functional domain, they affect behaviour, everyday life, objective investigation, the rules governing our relations, mythical beliefs, social values and so on.

Each communication system enables us to explore a sector of the world, or rather, to participate in inter-subjective exchanges relating to a given sector of the world. These two formulations are not essentially different – simply, the second is more complete than the first. The concept of inter-subjectivity is in fact implicit in exploration. As we have seen, the linguistic character of communication is not something appended to our knowledge of the world or its particular objects: knowledge is an objective exploration carried out via linguistic and inter-subjective modes. The communication system is not a timeless machine that reflects the self or reality according to our whims and propensions; it is itself an artificial construction that exists objectively because it has been constructed. It is in this sense that it is independent of the single speaker and susceptible of becoming itself an object of analysis.

Thus we must first observe single communication systems and only then generalize certain of their aspects, without expecting to be able to extract

the Essence of Communication from any or all of them. What we can do is study how the various systems coexist and the resultant of their coexistence. The object in question is the product of social construction and is geared to the capacities assigned by phylogeny to the human species. These consist in being able to build artificial communication systems – cultural machines for reciprocal connection. Man, in fact, is differentiated precisely as regards the expansion of his cognitive area or realm of discourse.

We have already stressed the fundamental concept that man is specialized phylogenetically in making connections. The cognitive function is the expression of this specialization. Each system of communication, being a constructed object, is a product of biology in the broad sense: it is the outcome of an extensive evolutionary time-span. More specifically it is offspring of a history and a geography. Its domain is a given setting in space and time. A system is valid within its own genetic area and this is made up of the sequence of its constructors, for whom, in the various phases of its evolution, it has proved meaningful – *i.e.* has been used and at the same time transformed by them. Its overall meaningfulness derives from its having been continually exploited for precisely that purpose for which it has evolved – the inter-subjective exploration of that sector of the world with which it is concerned. Its coherence – the *de facto* coherence of a machine whose various parts function unitarily in relation to its environment – is a combination brought about and continually modified by use. Unity is adaptation. We can thus construct a cultural phylogeny for a communication system and study how it has developed in the course of time – not simply in the succession of generations, but also in those critical, single historical vicissitudes that have occurred, in its contacts and convergences and conflicts with other systems, in the pressures and emergencies to which it has had to respond with concrete adaptations.

Its coherence is obviously not that of an organism designed as such from the outset but that of an object that wears and is renewed, that is contaminated and purified, that recovers from corrosion by means of use. It is constructed by the need for communication and by the practice of communication, in keeping with the modules of the species. Coherence is thus always incomplete, being limited to the purpose it serves. Contradiction, on the other hand, would lead to non-use as well as to the definitive decay and disintegration of the system.

The historical dimension of a system is thus a metabolism of its single elements – that is, of signs and their relations. Behind every system lies the multiplicity of individuals that has constructed and developed it. The rules governing a system are thus none other than the directives laid down by his

history – those points of least resistance along which the elements of the system aggregated in order to further inter-subjective communication.

Needless to say, the historical dimension so evident in all cultural products is bound up with their geographical setting. The area, or geography of the system includes its users – *i.e*. those who can make sense of and utilize the system. But above and beyond a certain number of individuals whose reciprocal contact is made possible by the system, the geography embraces a sector of the world which the speakers interrogate thanks to the mediation of the system. Knowledge is indissolubly tied to this referential world: it is necessarily "knowledge of something". It can take the form of knowledge of individuals, in which case the system is not merely a network of points of contact but also a vehicle of self-analysis enabling subjects to talk about themselves as objects. Or it can be from the outset a discourse about things, whether these are seen instinctually as sustenance or scientifically as objects of analysis. Both forms, however, share a common feature: the relationships set up are always discursive and are achieved through a communication system. Clearly this geographical area (the network of communicators and the humus of "things" on which they thrive) – which appears to us in the here-and-now – is actually a cross-section of a flux. If we go back in history, we can make any number of sections in the flow of time and each of these will constitute the map of the linguistic territory – its geography in the shape of its two interdependent elements, speakers and world. If the connecting relationship – i.e. the linguistic system – changes, it does so because the terms of its geography change. Each "cross-section" at time *t* shows us the machine coherent with time *t*, capable of carrying out the tasks required of it with greater or lesser precision. It is constructed by the individuals who have inherited the system from the immediately prior phase, adapting it to variations arising in things or in the world of the speakers, and transmitting it to those who come after them. But this map also includes the territory that has been explored, and this differs from section to section as well as being itself in motion.

Sometimes the area broadens and the system expands, affecting other individuals and other zones of reality. Sometimes it is deflected by the large-scale input of elements from other systems.

History, then, is simply a succession of geographical cross-sections, in each of which, it must be repeated, the map is not the territory, since things are always explored via indirect, intersubjective operations.

We must now pause to examine the concept of the historical variability of a system. Its instability and its dynamic have nothing indeterminate about them, even if it is impossible to make forecasts about its evolution. The

dynamic is in fact historical and cumulative and is based on processes of collective memorization in which earlier stages measure themselves against later demands and change the system in an orderly fashion. Here too, however, we must avoid the temptation to hypostatize the mechanism and to argue that "nothing is lost" and that "everything necessarily tends to perfection". In practice, since the process is a historical one governed by reality and not by myth, it is subject to all kinds of contingencies and vicissitudes. Many things are lost, then, as is testified by time's immobile sphinxes that gaze into the mist of dissolved meanings. And because history is concrete, wars, reversions to earlier forms of economy and obsolete forms of society – all these and many other events have affected and continue to affect communication systems, arresting, distorting or accelerating their evolution. Nevertheless, on the whole we may say that the march forward of time and generations is the march forward of systems of communication, provided we employ "forward" as a purely "vectorial" term, purified of all positive, progressive connotations.

It follows that the term "system" as it is used here has nothing in common with the term as it is used in philosophy. It is neither a cerebral construction nor a definitive systematization. It has nothing to do with a conceptual activity aiming to give a description of or precepts for the world. It is simply something that functions. If anything – to use a rough analysis – it resembles an organism seen at a given point in its development.

So far we have examined the evolution of the system from the outside as a unitary flux; we must now explore it from within. This means enquiring into the single operations that go to make up the network – in other words from a historical standpoint, the individual acts that modify the network and have combined to set up the communication system. The individual has to relate the two terms: the communication system he is capable of mastering (the artificial object whose functioning he understands), and the reality he can interpret and segment with the aid of the former (a reality whose ambit is defined for the individual by the system itself, given that it has been constructed for that specific area). He masters new things by means of already known discursive techniques: things are predictable, they fall within the horizon of competence of the system developed. The individual can segment them and then interpret and transmit them inter-subjectively by applying the techniques perfected by those who have gone before. However, he does not always encounter phenomena homogeneous with his system, nor do these always grow into harmony with it – whether because it is incomplete, or because things are not necessarily predictable, or because he comes into contact with objectively new areas thanks to the increase in the system's

powers of description and manipulation. Thus, however marginal compared with the broad stream of its activity, confrontation with situations unforeseen by the system occurs – whence the need to adapt these situations to render them adaptable to the terms of communication already existent. This requires the admission of new elements able to interact with the earlier ones and modify their relationship. The expansion of the objective area of inquiry and the rearrangement of the communication system therefore go hand in hand. It is still the system that mediates the contact since it is the protagonist of the process of knowledge.

The rearrangement of the system produced by the contributions of new situations is possible, however, only because the innovations enter into circulation and the complex absorbs and assimilates them. The overall variation is extremely small in respect to a single event and can only be perceived by summing the discontinuous events. In other words the coherence of the system is automatic, since the only innovations that can penetrate it must submit to its logic and measure themselves against the system. They become communicable only if accepted or tolerated. In this sense, a coherent system must necessarily remain such during the course of its evolution. Its mass prevails sharply over the single events that gradually cause it to evolve. The philosophies which extol the merits of those capable of a new vision of reality and of surpassing the existing system are falsifications: if anything, it is a matter of detecting new possibilities hitherto unexpressed, or new connections. No one can step outside a system by inventing a new one, for the simple reason that any such invention is by definition a non-individual operation.

What is more, even the unforeseen occurrences faced by the users cannot be considered new and unpredictable. What we might term "catastrophic" situations can certainly exist, but catastrophes are such for the individual, and no communication system is ignorant of these, since they in fact formed the original fuel and the foundations of communication – death, dangers, the unpredictability of nature. The system functions in spite of and thanks to catastrophes precisely because it has to talk about them and provides the individual with the linguistic, relational resources of commiseration, grief and desperation. The new elements move in the direction laid down for them by the communication system. Men focus their attention on what they are told to, and is language that tells them where to direct their gaze. What they find is not what they, but what the language expects to find.

Perhaps this assertion sounds idealistic, suggesting a view of the communication system as an immobile mechanism for constructing destinies. But this is by no means the true picture. It is the interpretation of things

by means of the linguistic system that brings about the circularity. The exploration is guided by discourse and the things encountered modify discourse. Thus, one by one, things are transferred into discourse and become as exchangeable heritage. The modes by which this transfer takes place are those processes of translation of complex signs of which we have spoken earlier.

When the "new" things encountered are inherent to man, the system may undergo profound changes. Yet man in these grafting recognizes – howbeit in different shapes and contexts – analogies with his own constitution or the underlying logic of his construction. Even here, then, the basic tenet of coherence holds: data are transferred in so far as they maintain and consolidate the coherence of the whole. This can be expressed directly in terms of selection too: that which is not useful is not accepted. If the system as a whole were to accept something capable of undermining its functionality, it would cease to be an object. This is why there are no cases of incoherent systems.

So far we have talked about the communication system without specifying further and have used the terms "language" and, more vaguely, "discourse" as synonyms. If we are to render the study of the system more concrete, we must examine single languages and the way they are spoken and written, single scientific languages (including mathematical and logical formalisms), esthetic languages (music, painting, etc.), systems of social meaning expressing authority, acquiescence, subordination, etc., systems of norms, systems of meaning developed through myth, and collectively established modes of psychological meaning of a non-linguistic kind connected with pain, love, hate and so on.

From this list – which could obviously continue – three types of communication system need to be excluded, for reasons already touched on.

(A) Those that are totally conventional, *i.e.* not developed collectively such as the Highway Code, the Morse Code or computer code. We are not excluding these because they are different from those considered above, but because they cannot properly be considered autonomous. The Highway Code with its system of road signs is simply the last stage of formulation – in a totally conventional and easily standardized form – of a normal discourse involving a situation of inter-subjective exchange and the need for rules. To assign it the status of a particular "type" of language and set it side by side with natural language hardly seems justifiable. In so far as it has been developed historically, it belongs to linguistic and normative systems; purely as a set of signals, it would be unintelligible. In fact it is a synthetic

and visual mode of discourse. The same holds for purely normative systems, such as the Civil or Penal Code, in which a degree of coherence is achieved thanks to language in its normal sense. Nor can the language of computers be considered autonomous, since it is simply a formalization of a scientific language adapted for machines. But this point will be taken up again later.

(B) A number of systems whose status as communication seems dubious (for example the system or code of fashion). Although many ingenious attempts have been made to formulate these as systems of communication, it is not possible to detect in them any real process of meaningful communication. What they reveal, rather, is the display of individual attitudes or social conditioning, in other words, only a preliminary level of the exchange process.

(C) Social and political institutions. In structural anthropology it is the vogue to consider all human products as linguistic, even those which simply require language to be constructed (in which case it is banal). Yet the best will in the world can hardly make human institutions assume the shape of a linguistic type of exchange system. No matter how conditioning the social nature of the institutions may be, they remain extremely superficial compared with language. It seems puerile, therefore, to propose a horizontal connection between the two (for instance, to present language as an authoritarian social system, and other such Barthesian flights of fancy). More generally, semiotic investigations will do well to resist the temptation to see everything "*sub specie sociologica*", for the simple reason that it is necessary to stress the real social dimension of language.

Basically, the requirement of a system are dictated by its physiology. The analysis of a code in itself does not define the system, just as it cannot be defined by the pure reality of its users or by its abstract evolution.

Three common fallacies are to be found as regards this issue.

The first consists in analysing the system as a pure construction (given, not functioning) in its various parts and symmetries and establishing its "rules", which also become the rules of the code. But these no more define what a system actually is than Pythagoras's theorem elevates the triangle to the status of a system. It is matter of logical formalism and the syntactical analysis of language, and concerns the relationship between logic and semiotics. This, too, is a problem to which we will return later.

The second fallacy consists in taking the users alone as the basic reality of the system, reducing communication to a purely synchronic social mechanism in which discourse is created out of nothing and speaks of nothing,

ignoring what is outside them that they talk about and what is "behind" them that causes them to speak. Communication is the Word in itself: it is this which creates the soul of things because in communication it gives them an existence that would be otherwise unattainable. The social dimension itself disappears completely if we reduce it to the mechanism of the modes of exchange in themselves. We end up by presupposing a social texture in the abstract. On the contrary, a system, valid within a given area, is used, in practice, differently and with various degrees of intensity and efficaciousness also inside this area, according to the training and competence of the individual users. A language can be exploited to the full as regards its powers of expression, or simply used for its minimum denotative function, according to the capacity of the speakers.

The third fallacy consists in confining investigations merely to the *mode* of evolution, neglecting what has stimulated it (actual inter-individual exchanges and collisions with the world outside) and contemplating the system as some kind of extraneous embryo or collective animal which can only be defined and rendered intelligible by recourse to some strange philosophy of history (*e.g.* language as the spirit of a nation).

The system is certainly an object in the sense that it can be analysed in its components and that it has an existence which is independent of (or predominates over) the individual, but if it is to be analysed *objectively*, it must be approached via its function, in other words via its connective role in the four relationships that constitute it: that between individual and system, that between individuals within the system, that between the system and reality and that between the system and itself in its various parts and phases.

4. Signs and system: meaning and context

We started out with an analysis of the sign as the basic element. In elementary conditions, the sign is a meaningful object and the process of deciphering is a metabolic exploitation. Hence, in a complex machine that deciphers meaningful surroundings, interpretation is the sum of, and the interaction of, atomic interpretations. The communication achieved by this interpretation in the collectivity of interpretants establishes itself as a system thanks to an enforced integration of the elementary interpretations. These create a *de facto* situation which in turn affects the reading structures through selection and convenience. The complex of relations continually adjust itself, shaping itself in situations of compatibility. Nevertheless, as long as signs are processes of metabolic exploitation, they maintain their priority. It is only right,

then, in a phylogenetic analysis, that this priority be stressed, as it was in the first section of this book.

However, once signs become fixed as autonomous, exchangeable objects, they are composed on a level which is autonomous and pertains to them alone, namely on the specifically semiotic level. A system with its own overall organicity is developed, subject though it is to historical variations and influence. Thus, at the specific level of human communication though we must recognize the genetic role of single signs, it is the system as a whole that gives meaning to the signs and governs the process of communication. We were led to this conclusion by following the "natural" development of the discourse. It must be stressed that the material interdependence between reading machine and reality does not cease, because the reader still remains restricted to the interpretation of his own genetic area. However, in the case of Man, objective reality is exchanged though language in its aspect as a system of segmentation of reality for the purposes of interpretation and exchange. Interpretations is simultaneously knowledge and language: it is impossible to separate these two aspects. The language thanks to which and through which we succeed in knowing is the cumulative, orientated construction of linguistic experiences, which constitute exploration or, in other words, knowledge.

Thus the expansion of knowledge which is typical of Man – the widening of his area of competence and the world he is able to interact with – leads to the construction, renewal and connection of linguistic systems. We have seen how it makes no sense to speak of a sign in itself. A "thing-sign" is meaningful for the machine that reads it – it is a "sign for". But the human machine itself is linguistic, and in Man, a sign is such for a pre-established complex which is a coherent system. It is this which is the medium of knowledge – not in the reductive sense that we use a language for the purposes of knowledge, but in the physiological and operative sense that it is knowledge itself which constitutes a linguistic segmentation and procedure. If, as we have repeatedly argued, each structure knows its environment through its own parameters, the parameters of human knowledge are essentially those of linguistic segmentation and re-composition. Thus each process of cognition that shows Man's attunement and reactivity to his environment is in practice the attunement of the single datum to the complex of previous, collectively constructed data. It is the exploitation and experimentation of the system as a whole in a single existential occurrence.

What happens in the case of the cognition of a single object, which is interpreted within the framework of Man's objective characteristics (that range from perception to the operations of logic), is what happens for the

sign in relation to the system of discourse. It is not a matter of parallelism or analogy between these two aspects, but of identity. The sign is a real-artificial object incorporated in the framework of language by means of the same indirect, reconstructed mechanisms as those involved in knowledge. Of whatever sort, knowledge is a coherent set of data that extends beyond the single interpretation enabling us to identify the "sense" of an object. If we are inclined to emphasize the particular nature of what happens to us, to stress the novelty of the things we encounter, whether they be objects or signs, minimizing what is inter-subjective and systematic, this is because our standpoint is inevitably partial. In order to reconstruct language and its function in communication as a whole, a simple intuitive observation will not suffice: what is required is a scientific procedure. Everything of a collective nature is overshadowed by subjectivity and has to be recovered by knowledge.

Thus a single sign is such in so far as it is compared with the collective character of its genesis – with the reading machine on the one hand, and with the particular sign complex for which the machine is competent, *i.e.* a specific system, on the other. It is this process of integration, in all its historical concreteness and relational objectivity with respect to the referent, that endows the sign with sense. The sign is a "sign for" a systematic machine.

There is a tendency – especially in linguistics – to concentrate on a particular typology of signs and classify them either in themselves or according to their relation to the immediately contiguous or according to the possibility of anatomizing them into simpler signs: in other words, to treat them as elements in some way autonomous that can be analysed autonomously – for instance, as regards their genesis. This tendency is not essentially different from what might seem at first sight an opposite approach, consisting in considering signs simply as epiphanies of a fixed structure, namely the system seen as an ideal machine of oppositions and symmetries.

At every moment of the reading carried out by an interpreting machine, the real, mobile relationship between sign and system is meaning. Many philosopher-semioticians aim to set up a theory of meaning. This would appear to offer a unifying "point of view" capable of supplying an explanation for the entire communication process.

Our position is that unification consists in finding a relational collocation – *i.e.* that it implies an extension of all connections and not the search for an interpretative key. Unification is the process that reveals the continual compatibility between the sign and the system that interprets it. The reading machine constitutes the mediation of this compatibility.

In the sphere of meaning, the first temptation that lies in wait is that of idealism. It magnifies the reading machine and instead of treating it as a product of nature, sees it as a kind of priest that consecrates nature. The most semiotic version of idealism is phenomenological intentionality. Throughout Husserl we find the plane of experience separated from that of meaning, the latter being at all times a step beyond any possible experience. The rooting of interpretation in the context of the interpreters is foregone. The attribution of meaning is seen as the creative intention of the subject. The fact that Husserl specifies that he does not mean the intention is creative in the sense of absolute idealism does not alter the situation. On the contrary, the necessary correlated of this phenomenological type of communication is a strictly objective idealism – *i.e.* a framework of essences – since it is the reading machine that discovers its connaturalness not with the world, but with something essentially diverse, "outside the world" and "equal to itself". The non-homogeneousness of the plane of communication is elected to a basic principle or point of view.

Those who take the code as the generator of communication follow similar procedure. In a sense, code stands for "system of communication", but whereas in our sense it is system of functioning, for the absolute semiologists it is a philosophical system, a generator of meaning. In this case meaning is not provided by the individual or by the whole, but by an impersonal entity upon which the individual draws. Individual interpretation is a "comparison" of the event with the code, a movement upwards to the level of the code. There is no doubt, of course, that this comparison takes place, and we have already insisted on this fact. However, in our particular context, "comparison" means insertion, *i.e.* functional translation, the code-system functioning on the same plane as things and being a compatible and utilizable set of things.

After the semiotic reference (when the object is "intentional", that is), an extra-semiotic relation of empirical verification is supposed to take place. In other words, it is implied that there are two stages: first a stage involving comparison with the code and the intentional attribution of sense, then an extra-semiotic stage of verification. This is tantamount to saying that there is an illumination followed by a verification of the illumination. In this version, the code has all the appearance of a new edition of the Holy Spirit. To separate semiosis from knowledge is idealistic. The fact is that they form one and the same procedure, and the semiotic attunement to the codes implies all the operations of empirical verification. Meaning is in no way detached from the operations themselves. Interpretation goes hand in hand with verification. The collocation of a datum in its background of meaning embraces all the

operations that sanction the collocation itself. A collocation is always mobile and has always to be demonstrated. Meaning must always be conquered as a connection between the terms of the communication process.

In theories of a unifying type, it is always possible to detect a conscious or unconscious striving after a universal grammar or supreme codes. This leads to a radical split between semiotics and knowledge, with the result that we no longer know what semiotics is.

An "optional" aspect of this kind of approach is that of conventionality. The process of attribution of meaning takes place through the selection of meaningful features and presupposes the existence of an entity "already given by others" called the code. What is forgotten is that the process whereby the interpreter selects the meaningful features is at all times a process conducted on a thing: it is the thing that filters our modes of conceiving it and lets through those that are adapted for communicating it. To be adapted expresses a clear-cut concept: the phylogenetic adaptation that has taken place during the formation of reading machines.

It is true that these selected and standardized modes form an operative unit, namely that which we call the system. Nevertheless, this is quite incapable of acting on a purely conventional basis without the direct intervention of things. The biunivocal relation between Man and codes is illusory. Codes as such are always part of the process, which is not a private transaction between codes and readers. We cannot relegate the relationship with things to a lateral activity called knowledge. Codes have been constructed by things, which is the reason why they serve to handle things. They are not ghosts of things, but are related to these by a complex mechanism of translation. What difference does it make if, instead of describing the code in all its articulations (which include the typology of signs, the rules of the grammar and the manual of instructions), we opt for an elastic code in which each sign sends us to another sign? If we explicate these links in terms of conventionality, we shall never escape from the vicious circle of the code as an immobile machine.

If we turn to the radical versions of conventionalism so often formulated in the realm of logical neo-positivism, they appear completely incomprehensible. How is it possible to communicate by means of a stipulation that speaks only of stipulations? It is hard to see where objects have finished up, and where the language that enables us to use them has gone.

Faced with the difficulties of conventionalism and the myths of idealism, the more realistic of the semiologists have countered with a behaviourist approach. The response is the meaning. To ask ourselves about the nature of meaning is a scientific non-sense. All we can see is a sign and the response to

a sign. The response is the only document that enables us to say that a sign is such, that it has meaning.

This is the attitude of the most illustrious founders of semiology. Peirce tells us that the meaning of a thing consists of the habit that it implies. In the pure Pavlovian system we see the saliva of the dog; here we see more complex responses to signs which are far more closely interrelated, but the meaning does not change. Morris's position is basically the same. In the domain of scientific discourse, Bridgman's operationism and Skinner's psychology have developed in the same direction. Even logical positivism, though in some respects it represents an opposite viewpoint (it cannot be denied that logical neo-positivism has a touch of idealistic Platonism), has certain connections with this line of thought.

The pragmatic approach is undoubtedly a methodological advance on semiotic Platonism. However the "pragmatists" – to use a loose term for the rather heterogeneous category mentioned earlier – reject Platonism on the basis of the assumption that an explanation of meaning cannot really exist. To say that meaning is simply what we observe to be generated in a situation (which we term "signic" [*segnica*] for this very reason) means, in other words, that it is futile to raise the problem of the black box. We can simply record the relational effects and on the basis of our observation assign the name "meaning" to this relation. This attitude is widespread in science today. It is nurtured by a reaction to the shadowy concepts of philosophy that has driven scientists to take up a diametrically opposite position and become, in a sense, more Catholic than the Pope. Ultimately, what it amounts to is the concept of explanation. It is true that, if we exclude occasionalist-type isomorphism, there is a real correspondence between certain things and the effects they produce, in other words between signs and induced behaviour, and it is equally true that we observe behaviour as an effect. But the pragmatists maintains, broadly speaking, that the only possible explanation consists in observing the correspondence between stimulus and response, whereas it is possible to push explanation much further and deeper whilst remaining within the immanence and identity of planes linking the sign to its effects. Isomorphism must be explained in genetic terms. A theory of meaning, therefore, is possible, and must be sought at the roots of the communication process. To explain meaning consists in finding out how the correspondence between thing-sign and the effects on the reading machines arose.

The marxist interpretation of Schaff comes closer to the point of view adopted here. It stresses the sign's character of a social relationship and social construct. The genetic root of the meaning process, that is, is found in the

practical social activity of Man as it has developed in the course of history. It does not simply resort to the black box, or give up the attempt at explanation, but tries to explain the correspondence between linguistic systems and codes on the one hand and language users in their practical manifestations on the other. The explanation is the process in which the two protagonists have historically modelled themselves up to the resultant observed in an instantaneous cross-section of time.

Nevertheless, this view is incomplete. If meaning is a social product, how have men managed to become social? The origin (the explanation) should not be sought in men's sociality, but in their becoming social. In the process of formation of social man, the sign system has had a central role and the whole of society has been moulded by the evolution of inter-subjective systems which have played an active part in determining man's characteristics, orienting these towards inter-subjective connection. Man should not be seen as a social being who produces language, but as a being that becomes social by means of language. It will be clear from what was said in the first section of this volume that this linguistic "self-creation" is none other than the continuation of a biological self-construction begun far earlier. The field of semiotics is the process of humanization.

Thus it is legitimate to pose the problem of meaning, going beyond the mere study of its effects, provided we approach the issue in genetic terms. This leads to the interpretation which is at once historical and synchronic and which can be summed up in a single statement: meaning derives from context (or: meaning is position in context). This holds both at the level of the here-and-now, when we examine a sign within the background in which we have interpreted it (the word in the sentence, the sentence in our attitude, etc.), and at ever higher, "historical" levels – the meaning of a word in the context of operations that have generated and established it culturally, and, going back still further, the context formed by the system of things and interpreters and by their natural and cultural parameters. Meaning is precisely the possibility of creating references and expanding the context. The singe sign is inserted into the complex of surrounding signs and gives it meaning, and these signs in turn are sanctioned by every-widening contexts. But this should not make us lose sight of what is "the meaning of meaning": attunement to physical and cultural reality, both our own and that of others. In the process of meaningful communication, we retrace in the opposite direction a path of collocations that starts from the origins in order to identify something that lies ahead of us and that, in this sense, we do not yet know. In order to know the future of interaction in the exchangeable form we must resort to the past of interaction and compare the new with a series of

established contexts. It is this kind of operation which makes the new interpretable as a sign and exchangeable. Meaning-context represents the varying range of application and use of a given term in the physiology of linguistic communication. There is a denotative use that refers to a certain context, and there is a connotative use in which the context broadens and references change, and this can sharply modify the former or even be entirely different from it. There is no doubt that we need to know the terms of contextual reference if we are to understand connotative meaning, and this confirms how the physiology of meaning works in a continual process of adaptation between sign, system and the things meant and referred to.

5. System and referent

In the outline we have traced so far, the close relationship between these two terms is clear. The system exists in so far as it is a mechanism capable of effectually manipulating the referent, without which it would be devoid of sense. It can do so because it is on the same plane as the latter and has material existence and bulk: *i.e.* it is itself a referent endowed with particular properties. The last reason – so to say, summing up – for the homogeneity between the linguistic system and the things of which it speaks, is that the system derives from the things, and consequently the way it speaks derives from the reality about which it speaks. What makes it possible to communicate is the connatural relationship between system of reference and its reference, between interpreting structure and things, established genetically through evolutionary processes. It does not seem necessary to insist further on the overall phenomenon of communication with its historical hinterland and its present exchange network. On the other hand, an aspect that does deserve attention here is the role of mediation of the system in the process.

We know – and we have discussed this issue in detail elsewhere[1] – that knowledge consists of a series of identifications of the environment which are "centralized" or channelled to the structure, which is capable of examining them in perspective and stripping the reference of any immediately metabolic overtones, objectifying it by means of a kind of attention or intention. Here the role of the self consists above all in not intruding too much and avoiding making its influence felt above and beyond the limits laid down by cognitive techniques.

[1] *La scienza, il potere, la critica*. Bologna: Il Mulino, 1974.

However, the framework of a biunivocal relationship between reality and the adapted structure is too confining. In certain circumstances, a response is in fact triggered off by a stimulation to which the individual reacts. The response may be extremely complex from a physiological point of view, it may even be socialized, and it may be based on a certain degree of learning. Nevertheless, it remains immediate, in the sense that it is not based on the mediation of a system of artificial objects, *i.e.* on the mechanism of linguistic communication.

We have seen that in a structure with a narrow entry section – in other words, one that derives from and is adapted to a limited, uniform ecological niche – sign and referent coincide, and that the problem of the organization of signs does not exist in itself. The presence of the thing means that the structure recognizes the thing and is modified by it at one and the same time. The various signs organize themselves because they are so to speak "assembled" on the thing. The identification of the thing grows more complicated to the extent that structures arise, adapted to this degree of complication or multiplicity of sign and reference. The materiality of the interpretation coincides with the materiality of the exchange. However, when structures acquire the capacity to replace direct sign interpretation with a trace, the system necessarily gets under way. This is because the problem arises of arranging the traces within and reproducing internally the various operations of physical identification that formerly took place materially during the contact with the outside.

This does not alter the biunivocal relationship, since what was instantaneous in the reflex to the referent is simply memorized and protracted in time. Nevertheless it forms a phylogenetic condition open to further developments. We have already pointed out that the mediation via sign traces, which become internal signs, maintains the physicality of the process as well as its link with the referent. Obviously the imprecision, ambiguity and extinction of traces forms part of this connection. And there is no doubt that this translation into an internal operation leads to the subjective identification of the objectivity and reality of the thing. Yet this process of interiorization does not go ahead intransitively, as if it were a private matter between structure and thing. It is a public event into which the collectivity enters in many respects. The things recognized and memorized are objects of convergence, consent and competition for a plurality, and are objective terms of a number of structures. This is because each objective identification is accompanied by a change in the reading system and this change may be felt – and suffered, too – by others, since the relation between a single structure and a sign increases its material bulk toward other structures. Moreover, the capacity

for interiorization is itself a cause of selective preference in evolution and hence, as we have repeatedly stressed, serves to mould the collectivity in which such capacities develop. In short, the relationship between referent and structure at a certain degree of complexity is necessarily a network that involves a collectiviy. At this point the sign becomes a trace which can be rendered manifest by a behaviour recognized as a display by, and valid for, the collectivity that uses it. The behaviour itself is a material fact which can be traced back to the environmental complex by means of a series of intermediate operations. The behaviour indicates the things by means of an attitude. Reception-display forms the groundwork of subjectivity. It is on these that animal learning is based.

However, all this does not yet amount to a communication system. This can arise when two facts occur: (a) when the reception-display network is translated into a mechanism that persists beyond the immediate behaviour: in other words, when we get an analysis of objective conditions and they are segmented into standardized, reproducible behaviour units – *i.e.* when the situation of "words" arises; (b) when the hypothetical faculty comes into being, whereby possible situations can be proposed on the basis of past experiences and then checked to see if they correspond to real states of affairs (and once again it must be stressed that hypotheses are material states of the structure). It is clear that the second of these situations has generated the first, since it is impossible to conceive of a mechanism for the segmentation and standardization of behaviour other than on a hypothetical basis. This has taken place as a social fact, since the force that urges on functional differentiation is the attunement of a plurality of individuals to things and to each other.

What this amounts to is that connections with the referent are entirely mediated by the system, which comes to be an attuned complex of sign presences referring to things.

The implications are obvious: there is no knowledge other than linguistic knowledge, because language is born of the relationship with others. And there is no knowledge other than that which is concrete, bound up with the referent, because language is born of the relationship with things.

Language, knowledge, and the presence of things are mutually interdependent. At the inter-subjective level, the linguistic system is what we have termed the "entry section" and "paths" at the individual level. Each instance is subjectively available through the specificity of the structure; in other words, through the state of affairs that make the structure fitted for what it recognizes. If reality is interpreted in a complex, inter-subjective manner, it cannot be grasped other than through communication systems.

These are in particular organs with which the interpreting collectivity – a cultural complex at time t_1 – is endowed.

The genesis of the communication system is no different from that of individual entry sections and paths. We have already insisted on the fact that the system is not superimposed on natural evolution like some sort of conventional process, which would be quite inconceivable in the initial phase of cultural development. It has grown out of natural evolution, simultaneously, determining structures marked by the *natural* capacity to make these kind of connections.

Thus all systems, for all their variety and particularity, share the property of acting as inter-subjective attunements to reality (including, of course, the reality of the elements of the collectivity itself). They change and evolve without losing their *raison d'être*: to communicate something to someone.

It is precisely their function of material intermediation that prevents them from ever transforming themselves into Systems with a capital S – *i.e.* systems with internal rules independent of their cognitive purpose. This is why their coherence is a necessity deriving from the fact that they serve a purpose, and not from their supposedly being obedient to universal rules.

In other words, the relations between things and the structure that utilizes them remaining "rigid" or "inelastic" in the sense that it is the structure which recognizes the incidence of reality through correlated changes. But when the incidence is collective and communicable and takes the shape of an inter-subjective exploration, the inelasticity obtaining between interpreter and referent, though conserved, expands over the network of referents via the system of communication. There is no point in insisting further on the system's status as a material, physical, really existent object: it is literally a connecting machine developed through use by a collectivity of users, and it preserves to the full the material of its past history. The system is the proof that the experimentation carried out on things is not an individual and instantaneous matter, but a collective and historical one. We shall analyse later the linguistic system whose domain is the relationship with the referent – *i.e.* science – and deal there with the specifically semiotic aspect of the problem.

What needs stressing here is the objective-referential character of system and signs. The system too is a reality, a referent. It is not the interaction in itself that constitutes sense, but the social operations that have produced the system and made it into a concrete presence. The intention is only the act of concentrating on a specific communicative event; meaning is an objective condition independent of intention. If a sign can give rise to ambiguity, this is not a proof of its intentionality, but of its "thingness" – that is to say, of the possibility of an erroneous collocation of the thing in its interpreting system.

6. Existential situation, knowledge, language

A situation A is defined linguistically as the communicability of A. By "communicability" I do not mean a technical phase of "setting in shape" what is to be communicated, or of pure exchangeability. I mean above all communication to myself, setting-in-shape for myself, categorization. And this is nothing other than exploration in terms of knowledge-and-language. The setting-in-shape of communication must therefore have all the features of exploration. It must:

(a) identify me as subject,
(b) identify the terms of the framework,
(c) identify the relations of mutual transformation (activity, passivity).

This is the syntax of the cognitive relation and it necessarily informs any "discourse to myself". For reasons given above, knowledge is in itself inter-subjective because it has developed phylogenetically in the basis. This syntax will thus never be a private matter, but will be syntonizable and exchangeable. Thus my "subject" includes my being an object for other my being native includes others' being passive; the object implies being seen by others. All this forms part of the syntax, which is transformational in the sense that it constitutes the scaffolding of reciprocity. Furthermore, in the expression that defines subject and direct object and reciprocal terms, lies also the "dynamic" or "technique" of the exploration operations. Syntax is never simply a general and purely categorial-rational setting-in-shape of experience. It is not a static arrangement of a representation but a shaping for operative purposes.

If the object-term is not known and we want to define it, this implies the interrogative form as a resultant; if the object-term is still uncertain, this implies the hypothetical-conditional, and so on. All these constructs derive from an existential position and correspond to actions that are particular-of-everybody. This is the first cognitive-communicable aspect of the syntax of relations with the world; in it, it is possible to recognize the surface structure of a language, or sentence, retranslated into deep structure. The logic of syntactical operations makes more detailed identification possible. This too remains a general operation. From the general we descend to the identification of meaning according to our specific historical conformation (historical-natural and historical-cultural). Thus categorization and naming are simultaneous operative processes. If I identify an object in my existential collocation, I identify it as object of the syntax of knowledge

(*i.e.* "there is an object") and at the same time as object of the logical use of syntax in the specific circumstance ("this object, here").

This operation, however, is not one of "pointing", otherwise the object would be incomprehensible. It is a reference to a category established within the cognitive-inter-subjective situation of the individual, and this is defined by the system. The act of categorization is mobile and is carried out in order to interpret the situations in which I am immersed and to link them via knowledge-and-communication. I find the name by means of categorizing: *i.e.* connecting the specific expression with a stock of "encoded categorial experience" which is an *a priori* with respect to existential situation A. This complex store of experience is organized in categories precisely because it is organized naturally, in a form that can be used for communication. The entire cultural *a priori* is already so in shape in a cultural manner, not, however, for extrinsic reasons of exchange but for intrinsic reasons of the genesis of language. Categorization is thus a function by means of which we face the world on each occasion. That is, it is a process by its very nature mobile, dynamic, and exploration-oriented. To find a name means carrying out this operation using nominal categories until we have "filled them" with the experience and the syntactical "setting-in-shape". Naming operations are thus logical. To find a name means admitting a complex of perceptions to internal circuits of equivalence, inclusion, comparison, *i.e.* using the analogical function which is at the basis of categorization. This is followed by an outward movement that makes use of a series of retro-active evaluations to see if the name has been correctly chosen, if the categorizing operation fits the description of situation A. All this clearly implies the hypothetical function: it would be incomprehensible were it not for this new phylogenetic condition peculiar to Man.

To categorize also means to use categories experimentally, inserting them in the circuit from which they once emerged. They involve at all time an operative utilization, entailing operations of inclusion-exclusion of internal analogues orientated towards the external world, true or supposed as the case may be. If we examine the procedure whereby we explore cognitively the existential situation A, what we observe is the identification of an *x*. The syntax is filled by the categorization. All logical operations are categorial identifications, and identify the "particular" as the object of the discourse.

It is this which constitutes the "deep structure", which is a cognitive categorial situation already set up, cognitively, in discourse terms. Chomsky's deep structure is less true at the technical-linguistic level than a profoundly discursive-cognitive-interpretative level. It constitutes the exploration-

identification of situation A by the cognitive inter-subjective means of a subject S who can exchange things with other subjects.

The transformational component is implicit in this operation. It consists of a another series of attitudes (of a specifically linguistic-phonological kind) by means of which the known and communicable situation A becomes actually (technically) transmittable to other Ss through a concrete language. It is not a conventional translation, however, because all languages are born of an inter-subjective condition which remains always the same, and are born to achieve knowledge of the various situations A which remain always the same. Thus the various languages represent the same deep structure and the differences between them derive from their particular history. Each historical and cultural path is peculiar to a group and shows a certain degree of differentiation. Languages may differ both phonologically and as regards their surface syntactical construction, but they all display a subject, an object, certain basic relative situations (*e.g.* to be inside, outside, near or far, to go away and to enter, etc.) in which the framework of objective reference (the horizon) fully participates. They all have an interrogative form, a dubitative form, a past, a present, a future etc. and they are all based on the identification of data through an exploration that utilizes the past experiences of knowledge.

The whole process is operative: history is always called upon in the interpretation, and it is attuned to the specific situation A. The relationship between existential situation A and the phylogenetic and cultural history which creates the possibility of interpretation, is a linguistic one.

Thus it is by means of these constants of language, or syntax, that we insert existential variables in a uniform logical process. The operative process inserts existential situations, categorized into types, into syntactic manipulations.

What distinguishes the various languages, then, is the way the experience of the group is translated into categorial terms. It is partly a matter of purely phonological differences (the choice of one or another term to represent a category) or superficial syntactic structures (one construction or another for the interrogative, for example), and partly of a (limitedly) different area of categorization, to the extent that the experience of the group is peculiar to it.

What I do, then, when I try to detect a deep structure beneath a surface structure (a sentence in Italian, for example), is to discover not the sentence set in form, but the cognitive exploration set in form, and this in itself is linguistic. To look for the deep structure thus means to discover the syntactico-logical processes that enable to explore the world through that sentence. The sentence, then, is the symptom of my exploration of the world.

Knowledge is always discursive. This fact has profound and widespread implications. Given the abuse of terms, it is perhaps advisable to render the idea by turning the sentence round: all discourse is cognitive, is an operative exploration, and consists in the hypothetic interrogation of the world by means of inter-subjective instruments.

7. The linking function

Having examined the relationship between signs and system, and things and system, we must now turn to another connective aspect of communication: that which links individuals via the system. Taking it for granted that the system realizes an object of convergence, and that we can only communicate with others with its mediation (as we have repeatedly demonstrated) we must now examine the operative aspect of the problem, namely the mechanism whereby inter-individual connection is brought about.

The point on which the process is based is the homogeneity of the group as regards the particular mode of communication, the specific system, that is. It is this which identifies operatively those that are homogeneous by means of its capacity for being utilized. This is a fact of considerable importance: homogeneity does not exist prior to the system but through and within the system. This means that since systems are multiple and variable, there can be no such thing as an overall Homogeneity; in other words there is no such things as *the* Group, much less the privileged Group. What we find is an aggregation which, case by case, defines itself in practice by the use of a particular system. Its homogeneity must thus be continually demonstrated by the use of common instruments and may be disintegrated or continually expanded. It follows that, given the collective aspect of these instruments, the group forms itself upon them, so that the instruments of communication constitute the historical definition of the collectivity that creates them. This once more confirms the operational and immanent character of this inter-subjective machine. Thus the area of use is the area in which homogeneity is identified, as well as being the genetic area. At the human level, what holds true for the sign in general comes to hold true for the system. The reading machine builds itself upon things which become signs by this token. The collective machine forms itself by attuning itself to the complex of things shared, and these, by dint of being shared, constitute the system.

Of course, given that the operation is a cultural one, mobility is greater, and the time required for development is shorter than that purely natural. Moreover, the complex of things is due to a large extent to the enormous

mobility of other subjects. Nevertheless the dynamic of the situation remains the same.

Let us consider, then, a group which can be identified as homogeneous in relation to system n_1 at a time t_1. A member m_1 tests his homogeneity to an m_2 making use of the intermediary, n_1. But he has to start from a single situation and check the reaction of an m_2 to a situation transmitted to him through the system. This signifies that homogeneity is not only relative to the system, but also that it is continually tested against the particular, in other words, by the use of the system in a specific referential situation. It is true that the system is general in nature in comparison with a single identification: one of its linguistic expressions: *i.e.* an operative schema – permits the connection of an indefinite number of situations and leads to a typification and standardization of situational possibilities. Nevertheless, the direction of the process remains that of defining more accurately the concrete, single operation in question. Once again, then, generality appears as a device for penetrating the particular more effectively, and the logic of communication systems consists in being ever attuned to the particular by means of operations which for this reason are general. Generality is a product of logic and is defined historically by use and by users. Thus the system is simply a complex of standardized routes for transferring situations meaningful for the whole inside the whole. These routes do not exist if "empty" but only if filled and concretized by the referent. This is obvious at the level of language – a particular language at a precise moment of its evolution. Syntactical structures do not exist unless filled by their objects (words); they form types of connection for many different words and are thus modes of standardization. They correspond in turn to real operations. Words, too, cannot exist unless they refer to something – not in a directly denotative sense but in a much broader sense: they arose as a reference to something and for handling something. Language, then, constitutes itself as a system in which references to environmental realities unite and combine by means of syntactical modes.

It is worth noting that from this standpoint the opposition between word and language, or word and syntax no longer subsists. Syntax is not a combinatory device that comes into play once words have been produced in order to combine them and put them together. Rather, it is manipulatory in itself, since it reflects referential operations and combinations like the single things and actions that fall to words. The latter, moreover, do not come into being in isolation but in operations, and therefore are born for communicability. They arise inside the syntax. Words cannot but be exchanged, and exchange cannot exist without words. Each system is such in so far as it has a syntax;

but the latter is not general: it depends on the semantic elements connected with it. Syntax and signs depend on, or are relative to, a reality they serve to connect.

This is not merely the physical reality or sensorial identifications, of course, but also that established by other linguistic operations and that takes the form of statements, behaviour, etc. Even the most extreme form of mathematical formalization is a thing that is communicated. It is the reality of constructed operations and of the "text" in which they are encoded.

Thus – to return to the mechanism of inter-subjectivity – the system is a "filled-in" syntax which permits the circulation of operations defined by the hypothetical mechanism as probable or possible on the basis of contents of experiences elating to environmental circumstances. This is the linguistic exploitation of reality in which the individual participates actively. The inter-individual relationship mediated by the system, then, is a process of translation and attunement. This process is made possible by the fact that the system itself has been selected by use for this purpose. The problem of how to define a kind of intentionality for use, whereby, given a certain set of environmental circumstances, we must demonstrate why these are translatable and which system is the optimum one, is a badly formulated problem.

In any case, the system allows the translation of things into behaviours that signify things. These behaviours are not analogues of things, but of the attitude of reception of things. They therefore signify things by means of a translation which is a behaviour and defines itself as a sign.

Nor is this a "behaviour in itself": it is a behaviour received. Both in the case of things and of signs, what are translated are operations of identification of things and of interpretation of behaviour. It is precisely this sequence of translation processes that forms the relationship and the exchange. We have already mentioned the fact that, no matter how long the chain and how complicated these correspondences and their physiology in terms of cerebral processes, the operations are extremely inelastic. We have also noted that linking operations are efficacious because they possess a bulk and a physical influence. The system is thus an object that can be examined like a thing. We must avoid the mistake of seeing it as an abstraction, as if it had been generated outside its natural environment.

It should be remembered that systems may be very different and reveal very different degrees of complexity. They do not link one component of Man to another. They are thus not "rational", for example. Their functional character is a practical outcome of the exchange, and has nothing whatever to do with our concept of rationality or rigid categorial divisions. What we may say is that they have their own particular logic, and this remains basically the

same whether intellectual or emotive communications are involved. Their inter-individual itineraries may be extremely brief, but their mediating role remains. We may cite mimicry as an example of an apparently direct form of communication.

The conclusions to which these observations on the linking system have led us may appear, at this point, extremely mechanistic and deterministic. How can we explain "non-natural" rationality if everything depends on the connections of the elementary material model?

Apart from the ambiguities and misunderstandings associated with terms like "mechanicism" and "determinism", we shall see later that a mechanical composition does not necessarily give rise to a mechanical system. Man is inside the system, but he has an extremely broad view of it; moreover he can trigger off his memory deposits internally, construct those artificial objects we call hypotheses, and come to grips with reality. His linking system is very vast indeed. Man's freedom is not a vague new property. It does not come into existence with him, but arises in nature through him, out of previously existing materials. Freedom constantly measures itself against data, and is in itself a relational capacity. In this respect, the ability to construct hypotheses (freedom) is the foundation of rationality.

8. System as compatibility

The connective character of the system is evident not only at the level of the link with the referent, or between individuals, or between the parts that make up the system, but also in the connection between the various phases of the system itself. In other words, in its continuity, a continuity which is functional.

We have already drawn attention to the following points:
- all systems evolve;
- evolution depends on the expansion of the interpreted area (that is on the extension of contacts with the referent and on the complication of inter-individual discourse, which is based on the hypothetical activity).

Each of these two aspects stresses the coincidence between knowledge and the communication system. All acts of cognition are brought within the domain of discourse because they are carried out by, and implicate, the system. It is not only a matter of acts of cognition of what is new – *i.e.* those related to areas explored for the first time (by scientific research or by

specifically linguistic tools such as poetry). It also holds for the knowledge normally employed for everyday actions, whose operational logic is constantly confirmed, together with the system (or language) that makes it possible. In fact this latter use of knowledge is obviously the main one. It is this which forms the real internal coherence of all system which, as we have made abundantly clear, exist and operate because they serve a purpose. There is thus a predominance of discourse and knowledge inherent in the accustomed panorama and the ordinary operations. This displays what is in a sense the static, predictable aspect of the system's adaptation to the environment, though this too remains at all times an operative activity.

It must not be forgotten that the real stability of a system consists of its normal, routine performance of known and repeated operations. It is this dominant mass of connections that ensures sufficient inertia for the system to be able to absorb, in addition, whatever it can "pick up" during its exploration of the hitherto unknown. This process is similar to that of the ontogenetic formation of the intelligence, during which the acquisition of the new is subordinated to the continual recycling of the pre-existing; accidental, sporadic contacts are treated as devoid of sense and left out. It reflects the overall adaptation of the operative system to its situations, which is what constitutes its logic. The system shapes itself on the surface of things and continually maintains its adherence to them. It registers new things because it is capable of fitting them into its syntax and naming them with the means at its disposal. The new elements admitted to discourse in correspondence with new areas are not new in the real sense of the word, since they derive from pre-existing linguistic combinations. What is new is the combination or connection, the operation carried out according to the physiology we have repeatedly illustrated. It might be objected that we must nevertheless postulate some kind of starting point of discourse in the first place – in other words something "totally new". To this we can reply by observing that all modes of connection derive from pre-existing modes and that, in general, discourse derives in a linear way from non-discourse. Nothing suddenly appears all of a piece as a ready-made model. This can be observed even at a very high level in the specification of the meanings of many terms deriving from the combination of elementary terms brought together to update language to new cultural situations. From this point of view, everything is cultural. It is impossible to imagine an exploration or a logic that are not cultural (in the sense of "artificial-human"). This may sound rather like one of those pan-linguistic, tendentially idealistic assertions in which language appears as a *primum* or a specific entity.

Actually, when we maintain that everything in a human activities is mediated by the system, and ground the system in evolution, what we admit is just the opposite – namely that the system itself is nature and grown out of things. Culture means equally "artificial-human" and "natural-human".

A number of evolutionary characteristic are implicit in the genetic of the system. In the first place, a system does not move towards a state of communicative perfection where it would become an autonomous "thing in itself". Like knowledge, a system is a real fact which connects specific occurrences and consists of generalizing operations, but this does not make it "universal". Its perfection is simply a greater degree of coherence – in other words a greater adaptation to what is particular in the situation, and to the kind of particularity represented by the new as it is gradually discovered and never ceases to be particular even if reiterated indefinitely and interpreted on a statistical basis.

The generality of discourse – whereby we name all the members of a class with a single name and define unique events by a single operation – is an adaptation to the particular. It is clear that neither discourse nor knowledge is possible without generality. But this thrives entirely on the particular operations and things to which discourse is adapted. The process of adaptation is a continuous one and the reason the system remains stable is not that it has attained an ideal state but that, being based on the particular and yet both generalized and endowed with a considerable mass, it cannot waver at every single impact with the particular. This is because it is not just words or constructs that come into play in the particular discursive mode by which we come into contact and communicate, but all the behaviour of those who have come into contact and communicate, but all the behaviour of those who have used the words and constructs and found them experimentally valid in the single circumstances.

Linguistic operations, like mutations, grow out of the particular, but they are rendered generalizable – just like mutations that are not eliminated – by a uniform environment. If a linguistic element is not useful for the *whole* of the environment, if it cannot be generalized, that is, then it serves no purpose and is eliminated. It is selected by the environment as a whole. Its utility is tested by the exchange, by meaningful transmission and reception.

Thus, unless conventional rules applying specifically to the system intervene, the system is exposed to all kind of vicissitudes. Not only may it change, but it may also regress, as well as come into contact with and mingle with other systems of the same type. This happens, for example, to two different languages.

This also signifies that meaningfulness can be lost if a system finds itself faced with a reality that does not understand it and from which it is not used continually. There exists, in fact, an archeology of communication systems.

Thus at a given time the system contains a certain body of information expressing the communication operations that the system makes possible. These form a collectively constituted "order" (whose roots go far back in time) which is never purely formal – comparable, for example, with the fixed combination of phonemes in words, in their "non-accidentalness" in a language at time t_1 – but genetic. Of course a word is distinguished from another by "permitted dispositions" of a phonological type, but this is a marginal aspect. What matters, rather, is that a word is different from another because genetic exploration operations have actually shown it to be distinct and indicate it as distinct every time it is used. The distinction that counts is not the linguistic one (/horse/ or /cavallo/) but the cognitive one, though this of course has never existed without a linguistic support. The need to make operative distinctions has led to the need to make phonological distinctions in some way. Those who reduce linguistic structure to a matter of mere positional classification cannot really face the problem of the genesis of the order and are compelled to accept an ineffable "Order".

A system, then, whether rich or poor, is coherent with itself, with things and with the subjects who use it. Yet there is a constant tendency to see it as "detached organ" – structure analogous to a man, a kind of "vast nervous system". This is by no means the way things are. The analogies between communication systems and organic systems will not stand up to scrutiny. The connection between the two lies on the plane of evolution, not of analogy. We know that there is a correspondence between the cognitive structure and the communication system because the former grew up from and through systems. If man communicates it is because he has practised communicating and been selected by communication itself. Of course, communication was never something existing in itself beforehand but grew up hand in hand with the structure capable of developing it, in a physically complementary and not analogical relationship.

The system's powers of connection, then, are sustained by means of the individual's powers of connection. The system does not function outside us like a model, but acts internally via its capacity to be used and assimilated. Our term of reference, of course, is not the isolated individual, but the single being as moulded by a collectivity, both naturally and culturally. The nervous structure of reception with which we are equipped has a cultural type of structure superimposed upon it. During ontogeny, it is essential for the nervous structure to be stimulated by the system in order to begin

functioning. Only a particular system can do this, by constituting it intrinsically. Obviously it is not a matter of an abstract sort of functioning, but of the insertion of the structure in a social and existential situation.

9. Uniformity of the constitution of systems

Systems are adapted to specific modes of communication – language, science, music, bodily communication, mimicry, and many others. Each of these has various particular forms (the different languages, single scientific disciplines, etc.) which are adapted to the specific situations and things to be described and communicated as well as to the aims of the communication.

What is general about, and hence common to, all systems, and what model of a "System" can we propose? In a sense that is general about them is their particularity, their specific history – *i.e.* their interaction with things and individuals seen from the standpoint of what they have thus far accumulated. Hence there is no System in the shape of a rule underlying all systems, but genetic uniformity due to the fact that they serve a purpose. It follows from this that they are of a connective nature, and their connectivity in each particular condition must be adapted to its function.

In their diversity systems are uniform. They are equally connection-making machines constructed historically by operations of adaptation. This is only universal feature they possess.

We might add, here, that all systems share the common trait of being logical, since they are fitted to the situation that created them and hence not contradictory in their various articulations and communication functions examined in relation to the specific areas they are used in and to the modes they are used for.

This type of logic, obviously, is inherent in the operations of generalization. A syntactical construct is logical not in itself, nor even when compared with a single situation of connectivity, but insofar as it can be employed in all situations of that type. It is employable because it grew out of these.

In ordinary language, the proposition /and/ corresponds to the need for addition (and is adapted, in some way, to all the situations in which we must express addition). It expresses linguistically the operation of reviewing and adding, without further specification: it covers adding sequentially or adding quantitatively or considering two parts statically (in which case it means "to be made up of"), etc. At the ordinary linguistic level its operative function is extremely ample, but it remains logical and non-contradictory in relation to the language as a whole and the things the language expresses. If there is

a cerebral function that enables us to conceive of addition, it is not detached from /and/ but is the very function that makes us say /and/.

The concept "one" and "one thing" derives from the "this thing here" linked to addition and analogical operations in which we can put "that thing there" – *i.e.* "any" thing – in the place of "this thing here". These examples could be multiplied and analysed further, but they will suffice to show how the internal logic of discourse arises, rendering this continually attuned to the situations that have given rise to it and transform it.

Clearly, if we need to specify the concept of addition further than in the ordinary scheme of language, we will have to enter into another scheme that is more precise, but that still has the same logic, though with narrower conditions. When I replace "one" or "any" by "*a*" or "*x*", I specify what I mean by addition, and set out on a mathematical discourse, or else I examine /and/ meta-linguistically in its linguistic contexts and try to define linguistic laws. The system is mobile for this reason too: at a certain point it has to hand over to another system more adequate for given operations but not, however, more logical than the previous one. If the first, which is apparently less logical, reveals contradictions, this is because it is being examined in the context of a system with different and bigger claims to coherence. Yet this greater coherence is rendered necessary by the desire to adapt ourselves even more to reality.

The logic of rough and ready attunement as expressed in ordinary language is as complete as formal language examined in its context. Formalization can be examined not as a change of logic but as the introduction of ever more precise conditions into the concept of logic – in other words into the exploration of the referent. This exploration is never, at any stage, promoted to "Logic", but remains a product of the things of the structure and is always translated into a discourse.

The system can obviously be used badly and illogically: in given circumstances it may be ambiguous because contextual elements capable of conferring meaning are lacking, or it may be inadequate in a new, more developed context. But is neither illogical nor inadequate with respect to its origin and its use. It cannot be "wrong". The way the individual uses it and the conclusions he reaches may be wrong, but the system functions and gives him what is asked of it, translating everything that has been put into it during history. This does not mean there is a "truth of the system"; it is neither true nor false, and does not confer any prestige on the things it communicates.

The previous remarks might seem to suggest that since all discourses are logical and self-compatible, they are all equivalent, and that the choice

of one or another is a matter of convention. This is not the case. Discourses are adequate in relation to their contexts. We cannot choose an approximate discourse for a scientific context. In this sense we may speak of a march forward of discourse under the influence of scientific research, where the object of investigation imposes its choices. The logic that gives conformity to discourse through coherence with the object also requires that these be chosen according to the demands of the exchange (both as regards the people spoken to and the things spoken about).

But here too we must reflect on the logic of the system: it is not a device for "picking up" and manipulating things (such that if it picks the right ones it arrives at true results and if it picks the wrong ones it obtains false results). The way it takes up things is in itself linguistic. We interpret the world through signs, and a system of signs is necessary from the outset for defining things. This means that we conceive things as they are presented to us by the culture we live in. Only things immediately physical and in themselves incommunicable (pain, hunger, fear, anguish) receive an internal, non-linguistic identification, but even these can circulate only by virtue of culture. Thus truth or falsity are determined as the coherence of a view mediated by a discourse, and are in fact coherence or incoherence within the discourse itself. We can take entirely mythical objects and make a logical discourse, just as we can take real objects and make an incoherent discourse. It is the linguistic attunement to reality that makes it necessary to fit language to the referent taken as object. This is how science is born. It is not born because a higher aspiration at some point turns into a language, but because there is a necessity for greater coherence both in the identification of the referent and in its communication.

10. The composition of systems: culture

If the organization of communication – the system – were a perfect machine, an *a priori* whole, it would be difficult to imagine relations between different systems, since each would be a monad. The system, however, is only an *a priori* if compared to the individual. As regards the genesis and succession of the collectivity it is an *a posteriori*. The system, then is an Id in which the Ego is largely submerged – just as the hand and the eye are an Id. Given that the individual inherits both cultural and physical things, the Ego's claims to being a intentional force acting through consciousness are puerile. Consciousness, which grows upon a vast humus of objective presences not directly perceivable, presupposes a texture of non-consciousness, of

impersonality (in the sense of "beyond my individual range"). The Ego is built on the Id, not opposed to it. If we want to look deeper into the Ego and see it not as an ineffable intuition but as something with a real origin, we must penetrate zones where consciousness cannot help us, where we must reconstruct objective relations, where the Ego can be seen as part of an Id that upholds it, in the current that goes back without interruption to the origins.

Every system, then, is deeply rooted in the predominant impersonality of things, and is a system because it is the means of translating this impersonality into a certain degree of exploitability and familiarity. Knowledge, in fact, is the rediscovery of our connaturality with things. It follows that the idea of a system-monad as a kind of network of circuits capable of handling any entity inserted in it, is false. Its logic originates long before logical formalization, which is merely a consequence of impersonal logic, though this would be more appropriately termed "collectively originated" or "historico-social" logic.

If this is how things stand, the real problem of the relations between the various systems in action is not that of a "System of Systems", but that of their interdependence, since each system is moulded by reality and this reality includes the reality of the other systems. There will thus be no absolute point of view but the coexistence and mutual attunement of all the communication systems. Even if there is no single, final-resultant (or "composition" or sum), their utilization will be unitary, since all the systems have the same point of departure and arrival – namely, the things to which they are adapted – and the same dynamic, *i.e.* the history that has produced them and the single individuals that use them.

This "unitary character" of the use and compatibility of systems is culture. Culture grows out of single contributions and is thus dependent both on the historical period and the geographical area. There is no such thing as the "Civilization" or the "Culture". What exists is a culture conquered by ancestors and utilized by descendants. It is made up not only of objective conditions but also of the efforts and commitment of individuals. It is important to note, in fact, that what enters culture has to be produced. The fact that we see culture as largely impersonal in no way diminishes the responsible, active role of its members. As well as receiving it they promote it.

Culture is always a set of modes of exchange, that is, of communication. There is no such thing as non-linguistic knowledge, and this is valid for culture too. Systems are forms of adaptation, and so is culture. It has adapted itself as a whole to things in the course of its development. Thus culture is a system of coherence linking the terms of the communication process,

similarly to the communication system itself. But it includes the communication systems, and these cannot be considered as a *primum* with respect to culture as we have hitherto done for convenience's sake. Just as the system comes before the sign, so culture comes before the system. In both cases, however, the two are strictly interdependent.

All cultures are thus equal in that they form conditions of compatibility between the systems of communication. There is no such thing as a better or a worse culture; at most there is a degree of evolution. This of course does not mean that cultures are not different. There is no doubt that the particular blend of the various languages affects their formation. The position of science – the language specifically concerned with the problems of the critique of attunement – is particularly pertinent in this respect. In fact the various languages may behave "spontaneously" and cumulatively, but non-intentionally, or they may combine in a systematic, conscious manner, thereby influencing all the other systems, given the interconnections that exist. And since an adapted system is also one that manipulates reality, the scientific system, which aims at a systematization of attunement and hence of transformation, can modify the whole of the surroundings and of coexistence, assuming a sort of leadership and profoundly influencing the culture. It is worth stressing, however, that science is not opposed to the other systems. In the long term it is able to achieve homogeneity even with systems held to be extraneous. Science, then, introduces the possibility of a more extensive use of communication and culture, whilst remaining an integral part of these.

Culture is bound up with problems of translation, whether of one type of language into another in the same area, or of the same types of language in two different areas – *i.e.* between different cultures. Translation within an area is the process that defines concept itself of culture. Translatability of an ordinary language into a scientific one, of family and social relationships into emotive and normative terms, of linguistic situations into esthetic codes, etc. And alongside the systems, there are the documents of the systems – the comparative literature of systems.

Culture is a dynamic of "translatability". Translation, as we have repeatedly remarked, is a process, and not an indifferent convention. There is no such things as a reality that can be expressed indifferently in different languages. Systems have zones of competence. In each translation, the objective *x* is considered from a different standpoint and is a reality with many cultural facets. Thus the same "state of affairs" – a type of social relationship, for example – can be reported in ordinary language as a reality, studied and criticized in a scientific language against a background of objective

considerations, inserted into moral codes or collective normalization, or recognized in emotive or esthetic terms, these two forming self-compatible systems.

There are also processes of translation between different expressions of the same type of system – the various languages, for instance. As we shall see later, translation, outside of well-defined denotative areas, is a complex process that involves retracing the genetic development of the system. The translation of the connotations of a poetic text is not a direct transfer from one language to the other; it demands the consultation of the historical heritage of each. Languages of the same type reveal a high degree of particularity in two different cultures. This is a point that needs taking into careful consideration if we are to avoid misunderstandings – such as assuming that certain languages are universal and do not require translation; for example, music. But music is not built of pure sounds or of the notation that makes these reproducible. This is merely the phonology of musical language. This music has been constructed by the accumulation of deposit of meaning in the course of history.

One language, however, is immediately shared from the outset: the language of science, of which we will speak later. The birth of science as a language that does not require translation between areas is another reason for its powerful capacity to influence the world.

11. Language and science

What we have previously maintained about the general physiology of communication must be tested on concrete systems. The two languages we will examine here in this light are ordinary language and science. Of course there are other languages, but these two undoubtedly cove the major part of the area of human communication. To examine these, then, is not simply to *exemplify* a general situation – especially as they are not separate, or parallel systems but form part of a series. The language of science presupposes ordinary language just as scientific knowledge presupposes ordinary knowledge. Scientific language is a specialization of ordinary language. Language transforms itself into science for the purposes of a more precise exchange concerning a referent defined by standardized operations, but it continues to use the same basic means of inter-subjective contact and of testing against object reality.

The range of application is extended but not changed. As we have repeatedly remarked, translation from one language to another makes it

possible to widen the area in which things can be manipulated. It is never simply a matter of manipulating the same area from equivalent and indifferent standpoints. Each translation functions and has a particular purpose vis-à-vis the referent. When scientific language perfects and specializes ordinary language it brings about an expansion of the exploitability of the referent, going beyond what can be grasped by direct intuition, or common sense beyond the macroscopic scale to which we are geared. The area expands. Both the adaptation and the coherence of the description are augmented, and with these the inter-subjective objectivity of the framework via which we look at the world. This does not mean we will ever arrive at a super-language: there is never any qualitative leap forward. What takes place is a translation inherent in the physiology of communication whereby our adaptation to our genetic area is improved.

12. Language. Logic in the construction of language. Invariants

As we have frequently remarked, the logic of a system is a state of affairs the key to which lies in the system's genesis and its adequacy to the context from which it arises. The application of this concept to language leads us to the much-debated question of the relationship between logic and language and subsequently to that of the "function" of language in the representation of the world.

Since the context is anything but arbitrary and conventional, the logic of language will not simply be a matter of internal coherence or non-contradictoriness. It will also take the form of an invariant state of affairs – invariant in the specific sense of equivalent in all possible languages to the extent that they express the same situations. The problem of logic and linguistic invariants is thus basically an existential collocation seen in its genetic development up to the situation of the specific collocation of the single individual in his particular context.

What are the invariants of the setting which require us to postulate linguistic invariants in order to cope with them? Which are the constant existential situations whence the logic of language arises? In the first place, they include the things we speak about. Whilst we agree that cultures are diverse, we totally disagree with those who see this diversity as being radical. Men are more or less alike as regards their basic make-up, and cultural diversifications do nothing more than organize these basic facts. Languages are different in so far as their basic material is the same. Man is always subject to

death. All men age, and this, fundamentally, is what gives rise to the reaction of fear which, in its turn, is balanced by reactions of hope. Human desires are basically identical: being born of a mother, and having children are facts that are not in the least affected by any kind of conventionalism. The basic need for food and rest, and the tendency to avoid suffering are universal. These are the constants about which we constantly speak. Even structural situations with a certain degree of variability (the family, kinship relations, various types of interpersonal relations) have a unitary matrix, since they simply give different arrangement to terms from an identical horizon. Language as a differentiating phenomenon has its roots well within the horizon. The things about which linguistic exchanges are made are those we actually do wish to exchange in reality, as well as being those which have phylogenetically determined possibility itself of exchange (including linguistic exchange).

This is less obvious than it might seem at first sight, if we recall those idealistic intellectual constructions according to which language recreates reality, which thus becomes a sort of simulacrum shored up by words. Things, however, are very definitely present inside words, in whatever way we interpret the mutual relation between the two. At every level of linguistic expression we refer to the genetic context of the language, and this context is the same as that of the things named. If we speak of death in terms of a denotative observation (as an obvious event), or in emotive terms (an event that affects us), or in poetic terms, we use different linguistic modes but what we are talking about remains death, and our language simply expresses, case by case, the different guises in which death appears to us. All this squares with the referentiality of language upon which we have insisted on various occasions. Of course, the way in which language is organized are always social, and this means that a high degree of variability derives from the constants: whence the various cultures, the different lines of development and the diverse heritages. Hence also the different languages and the possibility of comparing them. Nevertheless, it would be quite impossible to compare them if it were not for the fact that behind their diversification lies the preponderant presence of the basic constants and the existential invariants.

Next comes another set of invariables: what we might call the "technical-inter-subjective" aspect of language. However much situations differ one thing cannot vary – namely, the fact that the individual speaker must characterize himself and construct a subject that speaks to another about others.

The invariable nature of the "particularity" of communication also has its operative equivalent in language. We have emphasized that the logic of communication is general, not universal – in other words, it sets up conditions whereby the particularity of a construct can be expressed in an

indefinite series of situations. Clearly, the existence of a particular subject is a general situation that finds expression in language as a "subject" whose characteristics are univocally defined.

In short, the constants are the things talked about and the terms of the exchange. We thus have a nominal, or identifying, logic, and a syntactical, or orientating, logic. These two aspects are clearly inseparable in discourse, because we always talk about something, and we always talk to one another. Nominal logic has been constructed syntactically – *i.e.* according to a certain perspective – and syntax has been filled up with the concreteness of nominal logic.

With the term "nominal logic" we refer to the situation of correspondence and adaptation between words and context. We have already discusses the associated genetic processes when dealing with the general logic of communication systems. What we have, however, is not a system of fixed, conventional correspondences whereby the name is nothing but a reproduction in miniature of its corresponding object. Rather, the name, as we have seen, is the very process of identification and segmentation. The name sums up for me all the operations that I carry out in order to indicate the referent. These operations are the same as the ones used to take discursive cognition of the referent by those from whom I have inherited language. In this sense, since I can identify, know, and name it, the referent has become meaningful for me, and joins the complex of referents that makes up the setting both of my life and of my knowledge and discourse. There can be little doubt about the fact that words continue to carry with them all the processes out of which they have arisen, and that this is what forms their constant meaning in discourse.

All names, then, correspond to series of identifying operations. They may refer to similar, partially-overlapping operations and thus generate various kind of synonymy. Or they may refer to operations not susceptible detained specification, and hence remain imprecise or ambiguous. They may also be overloaded with references, worn out by use, or so complex as to become unserviceable. I think I have already sufficiently demonstrated why it is illogical to assume that a genetic-referential theory implies that names are somehow precise equivalents of objective things. Identification by means of names is an operation involving the system.

As "discursive exploration of things", names can refer to things or operations, and thus be nouns or verbs, or represent processes of further definition of things and operations, and thus be attributes or adverbs. They can also express generalizations of unspecified range, and so on. This is how the grammar of language comes into being; its structure of invariance undoubtedly lies in the identification of things, states and actions in the

world. It is beyond question that every language, in one way or another, expresses movement toward, movement away from, the act of speaking, the sun, the mother… and that all these elements come to represent the bulk of every single language, the rest – what is peculiar to a given language – deriving from these. If actual grammatical structures are in practice different one from another, this only goes to confirm the fact that languages as a whole have to achieve the same goal of identification – in other words accomplish a process that I must be able to communicate and account for. If, for example, it is necessary to indicate a plurality of a significant datum, one language may choose a single noun preceded by a prefix marking its plurality, another may prefer a suffix, etc. But there is not a single language that fails to express this general logic through its own particular grammar.

The series of constants that a language must in any case account for is extremely vast and to exemplify it would be an almost interminable enterprise leading to a banal affirmation – namely that a language is so constructed as to account for the position of things and the operations relating to them.

But, of course, if names are processes of identification, they are at the same time the result of the exploration of things and the use of names – in other words of a process that leads to their definition and use and is itself a discursive process, a link or relationship between names. This, then, is nominal logic. During the development of a language a name identifies a plurality of objects which I can "singularize" at will but which is general because is linguistic.

By providing general identifications, a language also provides logical processes of intersection of classes whereby we can pass from the generality of all nominal constructs to the singularity of their use in a given situation. Any sentence can be examined as an operation of classes with which we pursue the identification of things in the existential process where we use the language. The generality built on the genesis of the language is a generality attuned to the particular, and the operations that lead us back to the particular are as logical as those that have formed the general. They are the same operations of segmentation, rearrangement, and intersection.

Thus we must once more reject the fallacy of an abstract, purely formal logic that *directs* the operations – whether of the language, of mathematics, or of any other expression of thought. Logic arises together with the operations, transfers itself into language, directs this in so far as it is directed by it, and is the state of affairs in which interactions stabilize themselves.

Discursive relations are necessarily a logical structure of compatibility which is operative and defined by use. It is thus not correct to try and set

up a formal logic which directs language, or to see the logic of classes as the principle of language, or to maintain that language can be purified by analysis into mathematics. Logic is inside language itself, and if there is such a thing as purification, this comes from the use of language inside language. Mathematics and formal logic are not external principles for removing the incoherence of language. They are principles internal to the genesis of language and evolve alongside language as it sharpens its focus on things and on itself. Thus formal logic is not the purifying principle of language but a consequence of language. Mathematics, then, is the daughter of language.

It remains to be clarified that a dynamic interpretation of this kind rules out the possibility of distinguishing qualitatively between a series of linguistic structures for handling indication – *i.e.* nouns – and another series for handling operations on nouns – *i.e.* predicates, as if there were two distinct levels of linguistic approach. Everything is operative, in the sense that the noun includes the operations for identifying it (Man's subjective operations) and can be predicated of anything on account of its open nature – in other words it can be investigated further and identified further. Moreover the noun does not define a closed situation and is not a definitive label, since it is always open to further attributes and operations. It constitutes a segmentation that expresses the direction in which the observation is orientated. Clearly it is defined to the extent that it is distinguished from all the other simultaneous operations that define the horizon for us.

This logic is what determines "grammatical forms". Subject and direct object, dative, vocative etc., as well as attributes, transitive and intransitive verbs are logically determined by the context of inter-subjectivity. The particular ways in which this "logical necessity" finds phonological and graphical expression are certainly various, but they remain secondary compared with the logical framework that gives rise to a deep structure in every specific language. And it is this complex of invariants that renders one language at least partially translatable into another. If we analyse the genetic development of my language, what we find is not the evolution of phonology according to general rules (as if these existed before the language), but the development of general logic through the particular phonology.

The logical constants are the phylogenetic *a priori* for handling reality and are at the same time linguistic *a priori*.

We must now explicitly discuss a number of views on the relationship between language and thought, word and concept.

According with some scholars, language is the original, authentic mode of exchange, and thought is simply a consequence of this. In this sense, logic is particular as language is particular. A person who reasons simply

interprets the world through linguistic parameters. Peirce wrote: "the analysis of sentence in subject and predicate is certainly the manner in which we Arians think, but it is not the unique one".

This view is then extended from logic to the reality of the world, which ends up as a purely linguistic reality. We believe we are establishing something objective – in the sense of "independent of the way it is communicated" – whereas we are merely creating an optical illusion: what we are handling is neither things nor concepts, but simply words. If we change these – by changing languages – we will change everything we are communicating.

It is clear that what we have said so far goes against a concept of this kind. Language is not a *primum*; it reflects the concrete circumstances out of which it has arisen. These circumstances are to a large extent constant, and all languages in one way or another are informed by them. The world described remains the same, at the level of linguistic expression that speakers have reached. There is no point in continuing to repeat this. However, the simultaneity and interdependence of language and logic does not mean they are identical. We are prepared to admit that a thought is such in so far as it is expressible and communicable, and thus that it is necessarily a thought in a language. We have sufficiently emphasized the logico-operative structure, or thought-structure, of language. However this interdependence does not mean that one term is entirely identifiable with the other. The relationship in question can be reconstructed by analysing the beginnings of discourse in a child: psychogenetics has shown that the child starts thinking in distinctly pre-linguistic operative modes, yet these are clearly modes of connection and communication.

The logic of operations, then, is born before language and constructs language, of which it remains permanently the inner texture, the deep structure, the operative justification. It is true, of course, that when language arises, it defines itself in its inter-subjective terms and nothing can ignore it. Nevertheless, even at this stage, it is going too far to identify thought with language, since thought is undoubtedly more embracing than language and anterior to it. There is a tendency, moreover, to extend the meaning of (ordinary) language to cover the whole area of language. No matter how vast it is, however, it is only one mode. To say that we necessarily think through a particular language is extremely limiting. It would be more correct to say that we communicate by a series of languages and that all linguistic communications are pervaded in the same way by that logic of contact and operation we call thought – where the term thought has a broader meaning than

usual, signifying all exploratory activities (even those going beyond rational operations) and includes the sensation of one's own collocation in the world, even if purely existential, affective or instinctual.

13. Formal logic and operative logic in language: syntax and semantic

We have seen how formal logic defines states of non-contradiction, and that these are expressed linguistically because operative logic translate into language. Formal logic is thus not a game or a convention, but is bound up with the phylogenetic operations that have formed it out of the operations proper to the "logic of things".

We must now see what traces of this origin are to be found in language. $\supset \cdot \mathrm{V} \sim$ are clearly present in all languages. They are linguistic constants, in fact, and not feature of any particular language. Their symbolic, formal definition is the result of an operation on the language objectively in use. All that has been done is aim at the degree of precision (*i.e.* a type of use) not found in ordinary language. But everything, even formalization, is already contained in the operations of language and above all in the genesis of language. We have already stressed that scientific knowledge is not different from ordinary knowledge but simply a deeper stratum within the latter. The same holds for formal logic in relation to language. This term needs stripping of the connotations of arbitrariness usually attributed to it. It is not formal logic that becomes labile and nuanced when transferred into discourse, but discourse that defines itself in its real structure with the precision and inelasticity of formal logic. The sign · or the particle /and/ both indicate the act of reviewing: formal logic, language and operative logic are mutually interdependent in application, and are interdependent with the world too. If I review and am in a world of things that I can review, it is I myself who am capable of doing so because I am homogeneous with the operation and generated by it. Thus I must be able in one way or another to express this fact or operation, and in so doing I recognize my collocation. I can do this because I have eyes, memory, and above all the possibility of segmentation: it is /and/ which defines the segmentation for me, indicating the presence of one thing next to another. The operation is mediated; it does not refer to eyes or hands, but to a type of cerebral and mental development which is in itself linguistic and at the same time physical and thus non-contradictory vis-à-vis the things which have produced it.

Inclusion and exclusion are based on the same operative procedures with which we identify the meaning of terms in language. The type of cerebral development itself implied is modelled on including and excluding, on comparing with a reference that which is being reviewed case by case. The word, then, is determined in the same way as a class is determined. Operations on words (*i.e.* language) are, as we have said, operations on classes.

However, it is worth repeating here that the type of operation carried out is, in principle, the same as that performed by the enzyme when it reviews the outside world to find its substrate: all molecules it can bind with in succession "comparing" them to its specific site, constitute "the class" for the enzyme, just as the world, in the long chain od mediations that have taken place, constitutes the class for Man. Each of these are essentially operations of a structure face to face with the environment.

Linguistically, these are operations occurring within a structure that at time *t* possesses *n* data about experience of the same kind. These data are obviously not indifferent in the process of comparison and reviewing, for even the data of experience are words and the confrontation with things is also a confrontation with discourse.

In other words, if we call the linguistic relation between word and thing "semantic", this cannot be divorced from syntax – *i.e.* the operational and discursive logic that enables me to identify the thing. Syntax and semantics cannot be separated, according to Morris's tradition. In this kind of approach, there are certain correspondences based on rules of meaning and subsequently – as in chess – logic intervenes with its various syntactical combinations. Semantic meaning, on the contrary, is the set of syntactical combinations. The same mistake is made by those – like Ajdukiewicz and Russell – who see designation as a separate problem from identification. For them, too, designation is totally semantic and precedes syntax or logical operations. But logic is not brought to bear on pre-existent language: it is logic itself which identifies meaning and designates.

In short, f we analyse a logical proposition of the type "if no A is B, then no B is A", its linguistic truth coincides with its logical truth for the simple reason that As and B are not empty, even if they can be filled with anything. A and B are real, and the sentence is true because it corresponds operatively to the reality of As and Bs. The very structure of thought has been formed phylogenetically in this way by the As and Bs.

14. Invariants and the historical dynamics

The fact that language is based on constant patterns (the constants of the horizon and inter-subjectivity) needs squaring with the equally evident fact that there exists a plurality of languages and of their historical dynamics. The last two aspects are interdependent. The historical dynamics is a source of differentiation and thus generates plurality. We can take it that in history many languages are totally extraneous one to another with no cross-communication –in other words, closed words of contact with reality. Each develops in its own way and gives different accounts of reality. But how different? If there is a "mechanics" of languages (if they serve a purpose), then even in historically and geographically diverse situations each will organize itself according to a common model, reproducing a basic pattern. Each will then act on the variables (for in our scheme all contacts, including linguistic ones, act on and within the particular) to make them serve the basic purpose of exchange.

The constants, as we have already said, are:
(A) some common basic things;
(B) the sound element and related structures – *i.e.* the physical modes and the mental modes behind these;
(C) inter-subjectivity, or the perspective in which the exchange is constructed – an "I" that speaks to another by things.

The variables are:
(A) some particular things; clearly, in Man's horizon alongside birth and death and other typical constants, there is also a high degree of variability in environment; deserts, forests or mountains must have played essential roles in all communication;
(B) the specific individual shape of the sound element, in other words the different phonology.

If we combine the constants and the variables – each of which operates within an isolated system roughly identifiable with the group in which a given language arises – two concrete facts emerge.

(1) The uniqueness of the "assembly" of the components – in other words the individual languages. This is not due to a mingling of logic and actual states of affairs, but is the way in which the need to communicate develops in a particular situation. Logic and actual states of affairs are the same thing,

and languages resemble each other to the extent that the protagonists are similar, and differ to the extent that the latter differ. Nevertheless the divergences are extremely small compared with the resemblances. Who would deny that somehow a language must produce the interrogative as a request for data, or hypothetical clauses or similar structures to express supposition, or reported speech, and that all these follow from the need to have a subject, a direct object and so on?

These are intrinsic necessities of communication in any language. Each language in its process of linking individuals elaborates its phonological materials and syntactical constructions to achieve the results of communication requested. These results are obviously particular, but common to a large extent to all situations: they express information, influence, commands, persuasion, etc. From the grammatical and syntactical point of view all this is accomplished by different methods. We thus find languages with profoundly dissimilar structures. In spite of this, however, they can be translated. If we could introduce the situational variable (those inherent both in the particular environmental world and in the particular culture), we could even argue that languages are fully translatable.

(2) The type and the phase of cultural development in which we consider a language.

We have repeatedly observed that the composition of the elements forming a language is brought about by its being used in a given circumstances. In other words its logical development is also a historical development. It follows from its internal logic – which is a logic of the particular – that a language differentiates itself along the lines of least resistance that it finds in a single situation – *i.e.* in the single group in contact with a single environment. Linguistic development is cultural development, it consists of differentiation and singleness. Hence language takes on the meanings conferred on it by the operations of those who have used it and modified it by use. Each linguistic structure alludes to the choice that have gone to making it, though it is important to note that this particular feature in no way implies arbitrariness or the impossibility of translation.

A language is the logical product of the group in which it has taken shape. It reflects the life of the group and sums up its culture. Some of its aspects, as we have seen, are general, others particular, specific of the group and linked to the transmission of variables or "internal constants" of the group. This is the sense in which culture is tied to language. A language is not variable because the phonological, grammatical, syntactical structure of the constants is different from case to case: if this were so, its translatability

would be immediately perfect, with our needing to introduce any promise to the rules of transformation. It is diverse because, in part, it communicates different things specific to the group. A language, then, sums up what is culturally specific. The differentiation of a language takes place throughout the history of the group and represents the whole of its anthropological, literary, religious, historico-politic, economic, and subsequently, philosophical and scientific evolution. Each of these aspects is, as it were, immobilized in the language so that if we want to understand the culturally specific character of the language we cannot make a horizontal, mechanical translation, but must tempt a vertical, historical one, retracing its linguistic evolution and discovering the cultural conditions that have led to its diversity, exactly as we do in a phylogenetic study. It may not always be possible to do this in practice for lack of the necessary documents, but this does entitle us to speak of "incommunicability". In fact, when we try to penetrate an "anthropological black box" – a hermetic, mysterious civilization – we do so in the first place through the language, which explains its specific origins to us.

The logic remains the same. A language must be used by individuals to talk about individual things, so it is necessarily non-universal. The physiology of a universal language would be incomprehensible and unnatural. Actual languages talk about particular things common to everyone: this is why they speak in a general and translatable way. The translatability of a language is an aspect of the inter-subjectivity of communication. We can translate what we can understand and share with others, in other words, what is basically common to mankind.

The problem emerges with particular clarity in connection with the connotative aspect of words and syntactical structures touched on elsewhere. Connotation, however, is not some kind of mystical aura. Like denotation, it is a historical, logical and functional product. It is a deformation and extension of sense, or a combination of meanings, or a creation of connections – in other words, a linguistic exploitation of a previously-constructed language that makes use of the latter's material according to the overall logic of its make-up. Connotation is not built on different (deep) rules from those of language in general. We have already remarked that connotation always "denotes" something, even if it is complex, cultural and not "horizontally" translatable. Connotation is utilizable for meaning exactly like denotation. It is possible to carry out entire operations of a connotative nature – combining the "historical" auras of words – and to subject the results to control. This is the problem of poetry. But even here, must we consider connotation as a kind of "special reserve" of language? What sense could connotation have without the support of the structure that has generated it? In the

last analysis, the whole of language evolves via a dynamic relation between denotation and connotation. Meanings which are mobile and linked to new circumstances of use – what we might term experimental ones – are subsequently established inter-subjectively as denotations and serve, in their turn, for connotative experimentation in connection with other denotations of the language.

15. Experimental and attuned uses of language

Everything we have said so far confirms the hypothesis that a spoken language is not a translation of something previously existing into code but a part of the exploitation of the world. Every time we speak we confirm the instrumental and operative function of language. The basic feature of spoken communication is the possibility of using a limited number of constructs to communicate an indefinite number of situations. What governs use is the particular circumstance. It imposes choices, makes us select from the repertoire what is adapted to the circumstances. The repertoire itself is formed by the various circumstances, hence repertoire and single circumstances are on the same plane. This leads to a fundamental conclusion, namely that speaking consists of a continual testing of the validity of the linguistic instrument and its interdependence with the horizon whence it has arisen, in the new circumstances that occur and have to be communicated. The relationship between speaker and language is governed by a continual attunement to things. In what other way could we conceive of the unlimited expressive possibilities of languages? Human language of all types has grown out of the hypothetical activity – that is, out of the possibility of setting up verifiable analogues of reality. These form a sort of memory of the future which remains empty until it is compared with the reality of things. This activity is by no means limited to science, but is an extremely generalized kind of cognitive operation and one that is used even at very short range. Speaking is at all times a process of attunement to reality through the reality of experience and the availability of linguistic instruments (the latter, too, depending on experimentation). In a new situation, the first place I choose words to communicate with, and in so doing I link up with the whole network of correspondences that has taken shape in the course of history. Thus, in my inter-subjective aspect, I attune myself to things by using instruments that I share with others and that others have supplied me with. I "anticipate" the situation with words and then check to see if my forecast is correct. Thus the linguistic validity of the description is verified after its

attunement, and confirms whether the mechanism set up during history works.

It is interesting to note how the opinion of those for whom the sentence is a mechanical decoding process – a sort of complicated reflex manifested by linguistic behaviour – coincides with that of those who conceive of language as a fixed structure in which meaning derives from some prior non-historical and non-linguistic property whose origin lies in a supposed absolute specificity of man. The extremes meet: if the linguistic response is that of a robot, it is necessary to set up the rules of the robot.

Language actually is a particular interpretation performed by means of a highly complex, even if rapid, hypothetical-experimental sequence. Since this is characteristic of all knowledge, it follows that knowledge in itself is made up of linguistic behaviours. Knowledge as an attempt to test the scope of our attuned constructions cannot be make use of our inter-subjective equipment, and hence, chiefly, of language. What comes later – scientific knowledge – is simply a further differentiation of this linguistic characteristic.

16. Precision and logic

When we talk about language, the terms precision and logic are usually intuitively associated and considered as near-synonyms. If this is logical, it is also precise, univocal and unambiguous. If, as it is easy to show, language – at least in its ordinary form – continually produces ambiguities then it is denied logical status. In order to purify it, we must resort to logical principles, which are thus necessarily held to be external to language and not historically determined. Only if we draw on these can a language become precise and be used without ambiguity.

This cultural attitude is built on a fallacy. Language has the degree of precision that corresponds to its use. Imprecision may be one of its functional elements. In ordinary communication, there are imprecisions that amount to blurring compared with the univocalness of denotation but which are functional because they give prominence to other aspects of the construct. There are other situations in which a high degree of precision is not needed. Language has been selected by use in actual circumstances. We must therefore assume that certain terms we might otherwise define as imprecise are not so at all in relation to given circumstances. Logic and precision do not coincide. We are continually mislead by a fallacy of formal "logicism" which today has become the ally of a certain kind of cybernetic mechanicism. For

the majority, logical means perfectly adapted to pre-constituted connections, a sort of ideal structural-formal correspondence in perfectly established framework.

Actually, however, this framework issues from a history of reciprocal adaptations and an evolution that can only be judged in terms of its development. Only if precision is necessary will a language be made precise. And this obviously depends not only on the circumstances but also on the degree of cultural history – *i.e.* on the quantity of the heritage already stored in the language. This brings us back once more to the problem of scientific knowledge, which is a refinement of ordinary knowledge and presupposes the latter entirely. Likewise, scientific language is a refinement – though partial, for particular uses – of ordinary language and presupposes it entirely. The link between the two is homogeneous, evolutionary, progressive, whereas common opinion sees them as opposite poles, as if scientific language has developed only thanks to the introduction of a heterogeneous principle (logic, or that *quid* named "scientific method") into ordinary language.

This "principle", however, is homogeneous with ordinary language – that is, with the life of contacts with the world, and with common knowledge. It is the same logic that develops in contact with needs that arise, within the framework of what has been so far accumulated. This latter point should not be overlooked. When we speak of "accumulation" we intend to refer to the fact that every increase in precision takes place in a theoretical framework that guarantees the continuity and compatibility of what we find and what we produce – a continuity and interdependence with the immanent framework that no "logicism" succeeds in preserving. Thus a way of proceeding that might be defined as empirical (in the negative sense of the term) actually emphasizes everything that is theoretical, namely the network previously acquired through which we look at the world. This outlook is not arbitrary, nor does it depend on one language rather than another. It has grown up through language in an objective manner, in contact with the world the language represents and manipulates. Language is thus a complex tool that has formed itself in contact with the world, and it is language itself that, in this process of accumulation, constantly forms the *theoretical framework* of our knowledge of the world. If this knowledge is scientific, the theoretical framework will be the complex of scientific language at a given stage in science. Language, then, is what constitutes our framework of interpretation, ensures our collocation in the world and provides us with our scaffolding of categories. We need not insist further on the fact that it is rooted in our interaction with the world and logical – adapted to our structure, that is.

It is interesting to observe how the imprecision – the supposed inadequacy – of language is emphasized with equal energy by two opposite schools of thought. By the formal logicians, who aspire to a fixed super-language and super-universe, and by the idealists and subjectivists who rule out the possibility not only that the framework can be uniform but also that it can be translated; in this latter view the world is seen through the arbitrary eyes of single words, and even thought is a reflection of the phonological system. Fundamentally, the two attitudes are the same: they exclude any logical-evolutionary development of language and any contact with or knowledge of the horizon. Yet it is only these aspects that are capable, in our view, of explaining the interdependence of thought and language, communication and the logic of communication.

The argument that linguistic imprecision is such because it causes misunderstandings, can easily be parried by observing that all kinds of knowledge, given that it is mediated and indirect, are subject to uncertainties, and that in any case a fact has to be verified inter-subjectively. Imprecision in this sense is a necessary feature of a language in a state of development. And those who insist on misunderstandings, citing the historical damage caused by the ambiguity of words (*e.g.* analysing the words/symbols that Man has used for all kinds of controversies), commit a glaring error, for in this case the ambiguity does not lie in the words as they have been generated historically, but in the historical operations (operations of power, economic interests, ideologies) that deformed them when their meaning in relation to their use had already been defined. Here the interpretative key is no longer the word and its historical setting, but the subsequent historical setting, where it does not undergo any further development for the purposes of communication but is used with a completely different logic. It would be quite misleading to claim that the analysis of the ambiguities of the word "democracy" can be performed within the realm of linguistics. Even if there existed a word expressing the concept in a much more detailed fashion and susceptible of precise formalization, it would still be used in the same way and exploited by the same groups for their own, contrasting ends. To argue that the greater precision of words would have caused less damage to humanity is naïve. The precision of words is an outcome of human events and bears witness to these. It is hard to see how this historical dynamic could be replaced by the legislation of some kind of Royal Society bent on purifying the language of imprecision.

It is true, of course, that connotation often masks social deceptions. This shows that there are social forces that exploit the margin of imprecision of words for their own purposes. It is an issue that certainly merits investigation

in order to discover how language lends itself to deception and how it is capable of being "ideologically deceptive". However, all this confirms that language is a part of the whole system of human knowledge. If the word "negro" has a pejorative sense, in other words, if it carries a negative emotive connotation above and beyond its denotative function, this means that a sector of humanity uses it in this way. The negative association will disappear only when this sector has made other steps forward in knowledge, and these will certainly not be related to the mere utilization of the word in question. The evolution of man moulds words, and the evolution of language is a manifestation of the evolution of culture as a whole.

17. Language and the transformation of the world

Knowing, at the first instance, means to transform oneself and others, in the immediate sense of interacting; the higher, ethical or philosophical, concept of knowledge is not the primary one. Language and knowledge overlap to a great extent, since historical knowledge is "accumulated" in the world and necessarily translated into a linguistic form that expresses "that" particular knowledge of the world. Because this constitutes the theoretical scaffolding for specific interpretations and hence action, it also becomes the tool for transformation. This does not mean we must rashly assent to those various mystical outlooks which view the word as an autonomous creative force, rehashing the old concept "In the beginning was the Word". It is enough if we claim an active role for language in the process of transformation, and reject the widely held view of language as a passively reflecting, immobile entity – speech opposed to action. If knowledge is inter-subjective, its immediate expression is language. Up to now we have emphasized, in a general manner, how the process of human communication is attuned to reality, but the most important reality is other human beings, as well as the communication processes themselves. Language to a great extent speaks about itself: one way or another, precisely because it is inter-subjective, it attunes itself to previous language which represents the sum of accumulated facts and the overall framework of interpretation of reality shared by the group. The work of interpretation-transformation that language-and-knowledge perform can be seen as the advance along a broad front of a collective nature. The strength of words (whereby they are instruments, though not in the emotive sense that alludes to their powers of persuasion or to rhetorical techniques) lies in the fact that they are inter-subjective points of convergence. If they are capable of modifying the environment, this is because they have accumulated in

themselves all the operations of analysis and penetration of the environment from which they have arisen. Each modification of the surroundings is necessarily a collective achievement brought about through language. Moreover it is language which makes possible the insertion of the individual, the new datum, the specific modification of a particular situation, and active intervention.

The collective origin of linguistic operations on reality in no way diminishes the individual's role and responsibility in applying them. To say that there are no such things as individual instruments (constructed by a single self) is not in contrast with the fact that they are employed in single situations. On the contrary, it is the individual who is responsible for using a common heritage to transform the world.

This amounts to saying that language is the most direct evidence of the *fitness* of the human structure in relation to the environment. In the face of theories which emphasize the importance of language as a *primum* that somehow constructs reality (in an idealistic view of the assignment of meaning), the material existence of a concrete and exchangeable phonic object like language – which connects the various pieces of reality by means of its action and interpretation – testifies the degree to which it is an integral part of the world and how it derives from the world of things and others and is moulded and adapted by use. It is precisely the materiality of this exchange and inter-subjective-objective connection which reveals the continuity between nature and culture. Functionally, human language as a tool for action and transformation cannot be explained without a prior evolution: its homogeneity was established at the very outset long before human languages) between reading machines and the things interpreted. On the other hand, it is the phylogenetic sedimentation of the modes that gradually build up a language which confirms how language use is never a random reflex response (even a complex one) but an integrated interpretation, a theory of the world whose concrete application lies in the hypothetical activity. In other words, language is an object and an instrument of connection, but this basic characteristic cannot be explained simply by the evidence of its use in single situations. Rather, we must recognize its function as a theory of general framework. The demands of this unitary outlook cannot be met by idealistic conceptions (*i.e.* the *a priori* unity of linguistic structure). What is required is the reconstruction of the historical background of this unity arising from the interdependence of world and interpretation. It is this background that has built such highly complex exchange systems as language – the most important, common, flexible and serviceable of all.

Thus two characteristics coexist in language, and the investigator must take both into account: the languages receptivity towards the environment to which it is attuned; and the internal compatibility of the linguistic instrument as a whole – its theoretical or structured nature. Normally it seems to be assumed that these are mutually exclusive, a position which explains the birth of the structuralistic approach whereby each element is opposed to others and everything derived from a dialectic enacted in the intrinsic, magical coherence of language. The result is that the things acted upon, the objective information exchanged, and the world modified by words, are reduced to vague shadows in the background. Of what use are words then? Simply to talk about things that are indifferent. The only reasonable way to consider "structure" (seen simply as an actual arrangement of the various parts of the instrument) is as the organized mode whereby we can understand the "openness" of language – its availability for use and its capacity for connection and transformation.

In a structural investigation the key lies not in the structure itself (for it is just this which has to be demonstrated) but in the function. A functional approach cannot avoid examining the genetic relationship between language and material context. Thus language is the cognitive mode uniting the various experiences in which man and the world (subjects and objects) have come into contact. It is the exchangeable, verbal knowledge of the world.

By way of a footnote, it must be added that the physiology of language is made up of a great deal more than its use in behaviour related to circumstances in the here and now. It is not simply description, or information, or a command, an exhortation or a request. It is not even simply the refinement of description *sub specie scientifica*, an aspect we shall explore later. It is, above and beyond all these, a means of independent enquiry, in the same sense that if – as we have argued – each word carries with it the entire history which has gone into its making, then by acting on words (*i.e.* merely by combing them) we can make the roots of human, cultural-existential experiences from which words have arisen clash, mingle, melt together in a way that goes far beyond the merely operative use of words in immediate circumstances. In other words, language is the material of poetic experiment and the instrument of political expression: these powers, too, derive from language's collective genesis. A more specific discussion of this aspect is to be found in my book "*La scienza, il potere, la critica*" mentioned earlier on.

18. Scientific language

It is not our aim here to carry out an analysis of scientific language but simply to pick up out those aspects relevant to the general problem of language as presented in the preceding chapters. In particular, we wish to remain faithful to our assumption that scientific language is a particular type of ordinary language subjected to a number of rules related to a "rigorous" verification of reality. All languages are adapted to reality and depend on the degree of historical development of contacts with reality. Thus scientific language corresponds both to a certain kind of methodological area and to a certain phase in the development of a language – in the precise sense that, as we have remarked, there is no discontinuity, but on the contrary a logical evolution from ordinary to scientific knowledge.

By way of premise, it must be stressed that when we speak of "refinement" and "further development" we do not intend this to carry any hierarchical implications and wish to steer clear of such empty controversies as whether science is positive or negative, or whether it represents the peak or the depths of culture. It is certainly a phase that cannot come before certain others and presupposes results achieved in a previous stage. This is all we need to assume here.

Our discussion will take the form of a brief investigation of a number of key aspects.

A. Standardization

The feature that gives rise to the differentiation of scientific language from ordinary language is inter-subjective standardization. The cooperation between subjects purely for the purposes of ordinary operations no longer suffices. For an exchangeable and efficacious knowledge of the object it is necessary to reduce the area of uncertainty inherent in transmission and its instruments to the minimum. What was valid and suitable at one level reveals itself immediately as inadequate at another. This is a general linguistic necessity when we have to deal with problems of reproducibility. If we want others to repeat an operation of any kind (and this holds outside the domain of science too), the instructions must be such as to rule out individual oscillations. The prescriptive-normative function of language is one aspect of the process of standardization.

It follows, then, that scientific language arises outside the science, since the latter has not yet taken shape. It arises out of ordinary operations where

the need for reproduction and precision occurs. Science, in fact, is the offspring of calendars and the measurement of fields – in other words, of practical, ordinary, concrete operations for which it was necessary to achieve regularity. It is usually maintained that its technological origin demonstrates the economic, productive nature of scientific activity, which thereby is presented as linked from the outset to the world of production and technology. Actually, it merely shows that science arises together with all the other aspects of culture, as we would expect. What from a methodological point of view distinguishes the calculation of the area flooded by the Nile or the measurement of time of the Assyro-Babylonians from any other operation is precisely the emphasis places initially on measurement – *i.e.* the standardizing of the operations. Not, of course, that this is absent earlier: we have insisted continually on the fact that scientific knowledge is simply ordinary knowledge refined. In fact, standardization is present in the construction of any instrument as well as in the regulation of all aspects of the life of primitive communities. But refinement arises in order to render standardization more cautious and regulated.

The terms of standardization are obviously operative in nature, and this point should not be overlooked. It is not possible to conceive of any operation of inter-subjective attunement to reality outside of those operations in which standardization manifests itself. This means that, as it develops, the language that sets up this kind of standardization (scientific language) rigidly conserves the historical and adapted features peculiar to every kind of language, and thus remains firmly rooted in ordinary language. Scientific language, too, from its outsets, includes the history of all the operations that have gone to form it and change it.

Standardization arises from a basic cognitive situation. Each act of cognition of the object is performed subjectively, through the subject's entry sections as established by evolution. These are shared by others, both in the sense that all possess the same entry sections and in the sense that cognitive description is linguistic, that is, cultural and inter-subjective. The two modes are clearly closely related, since it is not possible to know independently of the structure that knows and of the culturally developed language.

Standardization, then, is an operation consisting of the subjective identification of features of the object in such a way as to make it possible to communicate the identification inter-subjective and to eliminate purely individual oscillations. Standardization is thus based on the existence of the object, and on the objective general framework upon which we have insisted in the first part of this book. Obviously it does not arise from a single need or situation but from a theoretical framework in which the presuppositions of

"objectification" and of the permanence of the object are firmly established, and already present in the language in operation.

Scientific knowledge is born, therefore, in opposition to a vision of the world as continually unstable, subjective, exploitable at will, subject to the constructive and destructive caprices of the myth.

The problems of seeming and being, the fallacies of perception, the entire question of truth, which at times leads to scepticism and solipsism, are the philosophical basis of scientific interpretation. In the first place, we must obviate the fallacies of the senses and of thought.

The first fallacy is obvious, but hard to eliminate: perceptive evaluations differ from subject to subject and are tied to particular environmental circumstances, although they share a basic uniformity that makes communication possible. We all know what length means because we continually perform ordinary operations that refer to this concept and define it. It forms part of our environmental relations of operative interpretation of the world. I can say that a given length A-B is five hundred paces if I want to give a rough idea, but if I want to measure the length of a field or the shadow of a pole I must say something more – namely how long a pace is. Thus an operation which I want to fit the thing with precision automatically implies an operation of reference which is inter-subjective and conventional.

The kind of standardization simply amounts to subjecting subjective operations of interaction with the world to definite and communicable criteria. This is essential feature of all measurement operations. Any scientific procedure, no matter how complex, is based on a series of standardizations of this type. Logically, however, all operations, if they are to be communicable and inter-subjective, must be linguistic. The expression in which the measurement is manifested includes the operations of standardization on which it is based, though in an extremely synthetic form.

Measurement is at the same time also the standardization of a sign. The spoken and written expression takes on the same degree of rigidity as the operations from which it has arisen; it includes these in itself in just the same way as ordinary words include the operations from which they originate. The words of the ordinary language are elastic and imprecise from a certain standpoint, since they derive from "rough" attunements. The problems of constancy are not felt as primary. Scientific expressions, on the other hand, include operations in which problems of constancy, reproducibility and precision are primary.

It should be noted that, although its most salient aspect is of a quantitative type and involves measurement in the proper sense of the term (the unit of measurement, the instrument), what we have been discussing has a

broader compass. Measurement, in fact, is but one aspect – and not the most important – of inter-subjective attunement. There are attunements which cannot be translated into measurement operations and yet equally syntonize the object of observation with the category of its observers. This is why we do not feel that there is a real difference between the science of nature and the science of man. There are many cases in which it is impossible to transfer data into numerical terms and yet which form a legitimate part of scientific discourse.

The second fallacy is not merely perceptive. It is illustrated by the example of the stick that looks as if it is broken if dipped in water. Here it is not merely a matter of seeking a shared mediation but of setting up a framework that will explain the fallacy. The second presupposition of scientific discourse is thus that reality may be very different of indirect reconstructions based on standardized operations that "reconstruct" the object in a way that at times is beyond the powers of perception. This, in turn, postulates the homogeneity of the horizon. Even this reconstruction, however, though outside the range of ordinary, direct observation, remains discursive and linguistic because it respects the fundamental presupposition of language that consists in carrying with it the operations out of which it has arisen. Thus if a scientific statement is, as we expect, expressed in terms of scientific language, this will be the operative definition of the process. It will not be a kind of summa of protocols, because scientific language (like ordinary language) develops out of the linguistic tissue thus far woven – in other words out of the general theoretical context whence the operations derive.

The third fallacy is inherent in the logical structure of language. We have established that all types of languages are constructed logically, in the sense that they correspond to the reality from which they have arisen and which they serve to connect. But here too, real logical attunement, in ordinary use, serves only up to a certain point. In spite of its origin, language can afford to be used to some extent illogically, imprecisely. As we have seen, the operations that give rise to syntax account for certain basic situations of approximate attunement of reality. We have posited that the instrument works rigidly, *i.e.* absolutely logically, in the sense specified for the phylogenetic origin of a structure capable of language. Nevertheless, the use of the instrument is logical only to the extent that is necessary for the operations requested, without any waste of energy.

A greater degree of rigidity, in other words a more conscious and precise syntax, is required in the realm of reproducible observations of the object. Scientific language has the same syntax or logical connection as ordinary language because the operations from which both derive are the same and

equally logical. Its formulation, however, is less equivocal, for reasons of coherence, representability and reproducibility. Both ordinary and scientific language give an account of the world, and there is no question of there being two different worlds. It is the angle of vision that determines the language, and this angle of vision is, in the last analysis, a level of use of interpretation. Take, for example, the scientific-syntactical concept of implication. Ordinary language expresses it in any number of ways, fairly rough and ready but more than adequate for its purposes. There is no need to specify it any further than in the spoken or written expressions that display it with the meaning conferred by its use in the world and known to everyone. But if we want to render this concept in scientific language, we have to specify it, and in so doing we realize – precisely because we must refer to all the operations and circumstances with great precision – that the concept in itself dissolves, or rather, is reconstructed through the operations as a state of constant correspondence. Thus it is that I become aware (thereby solving a glaring logical fallacy) that what I consider basic and definitively accepted in ordinary language (as if it were a category that organized the whole for me) can only be defined exactly by conditions and circumstances, and is logical in so far as it is fitted to these.

Thus formalization simply involves a particular rigid use of this kind of syntax, which is to be found equally in things and in knowledge. I can if I wish specify implication with a sign in formal logic, but this only reveals even more how it depends on the logic of use and on the operation I am performing. As I try to investigate the logic I need for accurate observation and transmission, I discover the nature of language, ordinary language included: it is not a vision of the world through a coherent structure situated on a different plane, but a description-interaction carried out with the aid of an operative structure. Thus, as I gradually clarify the scientific conditions of analysis, the structure of the context emerges ever more clearly.

Even in this case, however, the context is explored linguistically. I refer to what I can see by means of the language I possess and which forms my theoretical framework. Thus the theoretical framework of the world (*i.e.* my overall representation, within which my actions and single contacts take place) is my own language when what is involved is the overall representation necessary for my contacts with my group; whereas it is the sum of scientific language at time *t* (the theoretical framework at time *t*) when what is involved is a scientific representation. In either case, the general framework is no different from that supplied by language.

An important problem of standardization concerns the object. It is not enough to say that we attune to the object. What does this mean if the

operations are subjective and inter-subjective? What point is there in talking of an object in this case? Actually it is precisely in this phase that the object reveals itself as something quite "outside" us, and anything but a shadow created by our minds. It is the site of the operations of inter-subjective standardization – a point of convergence that exists and is external in that it syntonizes us univocally. The concreteness of the object, above and beyond the operations we carry out on it, is revealed by the fact that it directs these operations for the purposes of an orderly communication. Once it has been standardized and admitted to scientific language, the object thus described can be used as an element of any scientific sentence that needs it. This is exactly what happens in ordinary language, where conventionality is the opposite of arbitrariness for the simple reason that what is conventional serves in practice to convey an unlimited number of new circumstances and situations. In the same way, an element introduced through standardization into scientific language is correct (or corresponds to an objective situation, or is satisfactory, or is true – however one cares to put it) because it expands throughout the whole language and can be employed in specific situations, confirmed, and linked with other elements.

Everything, then, in scientific procedure turns out to be linguistic, in the sense that it is shown to be objective through the mediation of discourse.

To sum up: scientific interpretation is intrinsically linguistic because it consists of inter-subjective standardization. As a language it is neither arbitrary nor idealistic: it is the demonstration of the contextuality between interpretation and its object.

B. Historicity

No scientific statement makes sense outside its theoretical scheme of reference, in other words outside scientific language at a given stage in its development. Not only does it fall into the scheme, but it is also foreseen by the scheme, since the language orientates experimentation and causes the framework to evolve. New things and new research lead to the introduction of new linguistic operations. There is thus a profound dynamic interplay between the coherent set of linguistic-operational expressions known as scientific language and the explorations based upon these; the outcome is that the language comes to form the mode of seeing things, these being real in so far as they modify the language retroactively. Each new datum is searched for with the aid of working hypotheses, and these are made on the basis of existing concepts. It is obvious that the operational activity that makes up science is not a random undertaking. It would not make sense to

imagine a sort of disordered activity upon which the context-environment of science acts simply by means of selection. The peculiarity of science cannot be accounted for by any model based on the concept of mutation. Working hypotheses are obviously directed towards the unknown, but they are built on known directives belonging to the linguistic corpus of science. Subsequently they return for comparison with what is already known, and will enter into one of a number of possible relations with the language being used: they may be incoherent and completely unacceptable, or perfectly coherent, or coherent with some aspects and not with others. In the first case they are rejected because radically non-homogeneous – reality fails to correspond to the hypothetical schemes. In the second case they are accepted and do not modify the language in use; if anything, they reinforce and extend it. In the third case, they must be accepted because the operations carried out lead to a degree of compatibility and hence appear adequate, but at the same time necessitate a rearrangement of the language to test whether the partial incompatibilities are eliminated by a different linguistic context.

This latter point is extremely important. Under the pressure both of facts and of pre-existing linguistic structure that must be adapted, scientific language is compelled to evolve. In this kind of framework, of course, experimentation is much more than a localized operation aiming to clarify a single aspect of the object. It is also far more than merely a strip of discourse added to those already produced within a fixed, definitive language. The single datum makes it necessary to carry out readjustments in very distant fields, and often the revision is far more laborious and pregnant with consequences than the experiment in itself. The retroaction of experimentation is constant. Scientific theory and scientific practice are a single whole, and there is no difference between these two aspects of science, which is an ensemble of theory and practice, interpretation and technique.

It is increasingly clear that we cannot do without the general framework even in the most restricted fields of experimentation. There are no such things, in fact, as crucial experiments – *i.e.* operative situations capable in themselves of answering with a yes or a no. A datum is linked up with other, pre-existing data and tests the coherence of these; it is inseparable from these even when it forces us to rearrange them. It is approved by the state of the language as a whole and, if necessary, proposes the readjustment of the language as a whole. Even the apparently revolutionary vents occurring in science share this feature of internal re-systematization and compatibility. The objects of the pre-existing language are rearranged, not discarded. If they were valid previously, they will be valid later, with the difference that the overall structure has changed. I have devoted a more detailed analysis to

this revolutionary-conservative aspect of science elsewhere.[2] What I would like to stress here is the historical resultant of scientific interpretation and at the same time its objective orientation toward the world. In fact, discourse is permanently being re-systematized, and our yardsticks are constantly being modified: they have already changed radically on more than one occasion since the beginnings of science. Nevertheless discourse is orientated – that is, it moves coherently in a certain direction, a direction undoubtedly laid down by things. It is things themselves which, when seen through the scheme in use, force changes upon it and refuse to fit into the interpretative pigeon-hole assigned to them. As we have maintained for all kind of discourse, it is things themselves that make themselves heard by creative language. And as many things cannot be seen with the eyes or heard with the ears and do not belong to the world of normal language (though this does not mean they belong to the world of phantasms or myths), the discourse they enforce on us is made up of a series of indirect proofs and apparently abstract theoretical constructs. In order to understand the historicity and evolutionary character of science, it is essential to observe how it gradually penetrates the area lying outside the domain of Man, entering the world of objects not directly recognizable and verifiable by means of the senses (from the meson of the unconscious).

Linguistic evolution is thus also an extension of our domain, and brings concreteness to regions where formerly there were only indeterminacy and the unknown. When language penetrates these areas, the objects found there are visited, used, made to interact, demonstrated to be concrete presences in our horizon, which is thereby enlarged. Thus historical evolution means material expansion and operational refinement. It bears no resemblance to the idea held by those who see the historical outlook and the objective outlook as contraries. The fact that science during its historical evolution has penetrated and continues to penetrate regions outside Man's domain (the nucleus of the atom, for instance, or the nucleus of the cell) is extremely instructive in this respect.

Obviously, given our present approach, we exclude from this concept of the expansion of science any overtones extraneous to the observation of facts and events as they actually occur.

---

[2] *La scienza, il potere, la critica*, cit; *La scienza, la storia e le n culture*, Il Mulino, *240*, 583, 1975; *Per un discorso sull'uguaglianza*, Il Mulino *236*, 910, 1974; *La biologia nell'attuale pensiero scientifico*, Il Mulino, *225*, 58, 1973.

C. Connectivity and meaning

Scientific language is the set of coherent and self-compatible statements which is possible to make about reality at a given stage of scientific development. These statements, as we have seen, are at once empirical and theoretical in that they derive both from facts and from the pre-existing language. The scientific representation of reality is nothing other than the attunement of language to reality through experimentation. It involves as a retroaction the modification of language, *i.e.* of the theoretical framework, and this then proposes further experimental possibilities which, in their turn, will bring about linguistic changes.

Here we wish to draw attention to the "connectivity" of the process, which might at first sight seem to be a kind of self-regulating mechanism from which physical reality is at some distance. In reality, at the heart of all scientific processes lies the referent, the object of discourse. We have already insisted on the physical, external origin of the process of meaning, and gone so far as to postulate that interpreting machines are simply the products of things, which become signs of creating *ad hoc* the machines capable of revealing their nature as signs.

The sequence of mediations may be so long as to make it easier to ignore the basic connections between referent and interpretation, and see the process of meaning as a unilateral assignment of sense. Nevertheless, in spite of material impossibility and mental laziness, we prefer to believe that the chain exists and that it is made up of real, active referent-signs connected in series and in parallel. Doubtless, language is born in a stage of humanity where self-awareness is limited. Its mechanism is perfectly logical if examined on the basis of objective observation, but the awareness of this does not exist. Moreover, it is used logically as long as it is interdependent with necessary operations (those actually responsible for creating language) and becomes aleatory and ambiguous if applied to the aleatoriness and ambiguity that characterize the earliest phase of culture. Here too, as we have seen, it is not the language of myth, but myth itself which is imprecise. Language has to adapt itself like a servant to the world of things to be communicated, and these things are imprecise. And since it is continually involved with things and attuned to them, it ends up by representing the ambiguities of culture – in other words, it represents with its logical precision an a-logical or pre-logical cultural state of affairs. Thus a communication system that derives phylogenetically from the logic of material exchanges that are inescapable and create an inescapable logic (*i.e.* the syntax and grammar that allude to things and to the operations carried out by the reader on the world), has

to adapt itself to transmitting the most various and unverified imaginary objects with the same logic. It will thus speak of demons or punishment, authority or fears, forlorn hopes and joys to come. None of these "things" is haphazard: they all express cultural situations and are really symptoms rather than things. Language simply acknowledges them. Its connective relation with these is merely a matter of appearance: the speaker believes he is reporting situations and things, whereas he is actually reporting a biography – his own and that of his predecessors. It is in this sense that language is enriched by cultural experiences; it includes them and continues in its historical evolution whilst at the same time fulfilling its obligations of material representation. The use of language, which is born of the referent, is not confined to precise and uncontaminated referents in a relationship in which the whole body of language is designed for the description of the world. At every moment, the referent is inevitably overlaid with cultural usage, history, the habits of the group, and the partiality of references.

Language thus reflects a world in which reality, the interested exploitation of reality and phantasms are inextricably entangled. It is worth noting, however, that the connection set up is always satisfactory, in the sense that it is performed by the language in its entirely, since it connects an anthropological reality with cultural situations. We must never fall into the trap of considering myths as inexistent, given that they have been created, have affected the collectivity, are transmittable and are producers of history and social actions.

However, it is precisely in the realm of culture that the need for objectifying sooner or later makes itself felt. It is necessary, in other words, to raise the problem of the referent above and beyond the usury to which it has been subjected, or the creations of fantasy with which individuals or groups have overlaid it for their own particular purposes. It is during the development of culture that knowledge specifically poses the problem of the constancy and objectivity of the world, together with that of its description, its modification, and hence the freeing of knowledge from all interested interferences. Obviously this act of awareness has two inseparable aspects:

(a) it discovers that the objective situation seen by a reader is necessarily subjective-inter-subjective: it implies, that is, a methodology and correlated problems of standardization;
(b) it discovers that there is a connection between things identified in their objectivity (rediscovered in their autonomous nature, unviolated by Man) and linguistic situations; studying things objectively through language, we find that it is precisely the logic of material operations which has been transferred to language.

The birth of science coincides, methodologically, with a clarification about ordinary language, or language (and this is the sense in which, in real terms, scientific language derives from ordinary language). Ordinary language becomes aware of the fact that it is historical and springs from the world. It is thanks to these two features that it is able to represent the world. Thus science is initially a reflection of language upon itself motivated by projections toward the external world.

Science, then, comes into being as an emphasis into the problems of relations with the referent. The scientist seeks to identify a linguistic referent. That need to connect with reality which is expressed almost involuntarily by language (whose immediate task lies in other types of link – chiefly anthropological and utilitarian) is here taken up as a primary aim and extended to the whole of natural and ontologico-objective reality.

An important aspect of this is that science, as it proceeds with a certain degree of methodological rigour, rediscovers in ordinary language to that necessary succession or series out of which language hs arisen – the processes of communication of things and of selection of structures.

We can thus distinguish two dimensions of scientific language:

(1) a methodological dimension based on experimental and logical operations, in continual, orientated evolution as the overall corpus of language. In other words, a dimension of communication directed toward the referent;
(2) an ontological dimension based on the fact that what it describes – the referent – belongs to the framework and is not extraneous to the birth of the linguistic capacities that express it.

We can talk about things because they have created us and we can act on them because we are on the same physical-inter-subjective plane. There is a genetic interdependence between discourse and the things we talk about.

In the last analysis, the process of meaning is a rediscovery of relationships, a deciphering of sins and referents that can never be exhausted, but is necessarily oriented toward things.

19. Language and criticism: negative thought and other inventions

The formative power of language with respect to the individual is enormous when we consider that the single being is born in a cultural system and set in motion by this. He is built within the schemes of language. From one point of view, this formative capacity can also be seen as a sort of conditioning or sclerosis. If use is not constantly accompanied by the refurbishing of the instruments employed and by the testing of the things explored, it becomes mere repetition, false certitude, an a-critical attitude. It is possible, in fact, to construct a sort of ideological semiotics in which all the conditions appearing at a cultural level are viewed as simple interpretative schemata standardized by history and allotted to the individual for the definition of his horizon.

Clearly, the view of a cognitive structure as having a linguistic scaffolding and the objects explored as its only poles of reference, is somewhat illuministic. There are certainly many historical diaphragms between the two, and those which are most interesting to study are doubtless the deforming lenses of ideologies, which in themselves are authentic historico-linguistic apparatuses. We do not intend to pursue this problem here, since it would require an extremely detailed semiotic treatment. What we would like to do is to draw attention to another issue: faced with the structuring power of the codes in use, many thinkers argue that it is necessary to work for their disintegration and undertake a thorough-going "semioclastic" activity (to use a Barthesian term). The capacity of imagination or fantasy is proposed as the individual's only defence against the uniformity and predictability of the codes in use, and against the entire social-productive apparatus bound up with the dominant semiotic structures. This kind of outlook creates a bipolarity between an organized and inevitably opaque social world of which the codes are a manifestation both as an historical product and as the capacity for social conditioning (conservation, repetition, acceptance of the existing, insertion in a repressive society), on the one hand, and the individual who has become regimented and petrified in the sea of codes and must thus take up arms against them in order to overthrow them, on the other.

It is a point of considerable importance. It is here that we find the source of all contemporary irrationalism and all present-day protest movements. It forms the theoretical basis of a vast area of culture modelled yet again on patterns of contraries: the individual versus society, the individual use of codes versus the structure of codes. What is proposed is thus the original

use of codes, and hence the individual fact of language or action, and experimentation as a means of disintegrating the established language. This is the attitude of those who feel that in order to define something specifically human it is necessary at all costs to keep some kind of dialectic combat alive, or more precisely, some kind of epic of combat. It matters little if the description of the battle is so complicate and remote as to suggest a war of puppets. In the struggle to lay the foundation of base "outside" objects (*i.e.* to make it possible to escape from the horizontality and linearity of interactions) any purely verbal-philosophical artifice will do.

Adorno talks about the destructuring of alienated reality by means of negative thought. The only obvious product of the system of codes is the alienation of the individual from his cultural setting. He is either devoured (in other words he no longer realizes he is in opposition and becomes part of the system's intestine), or he invents some kind of engine capable of undermining the great monument. This engine may take the form of negative thought. Although it is clearly quite impossible for anyone to list the characteristics of this entity, the name suffices. It is the platform that enables us to keep one foot outside the system in use and to feel, even in moments of blackest pessimism, somewhat "celestial".

Barthes prefers to talk about the epistemological destructuring of the accumulated codes that keep social knowledge prisoner. Behind both Barthes and the Frankfurt School lies a strident sociological philosophy which succeeded in holding the stage in 1968. However, it does not seem to have been sufficiently recognized that the thinkers whose chief intellectual mission seems to be to save the individual from standardization and thus make possible a non-alienated reconstruction of society, take as their starting point an extremely petrified and reductive sociological outlook. What they imply is that the individual stands in the same relation to his historical context as the bee to its bee-hive. He is programmed to the last detail. Nor is there any alternative to the bee-hive, which is "built by others" and felt to be alienating and unalterable. In the precise, time-honoured Manicheism underlying these contemporary theories, the bee-hive has replaced the devil. Nobody is prepared to admit that we (the collectivity, nature, culture) have built it ourselves. There is no way out: all that remains is a dialectic of contraries between bee and bee-hive; the only hope lies in challenging the destiny of the ant and hence the constructor of the ant-hill. All this suggests that the entire philosophical ideology has its roots far more in the unconscious than in the critical level, and that it is woven on the loom of a myth – that of non-immanence. The unknown creator of the bee-hive is the enemy. If necessary he can be impersonated by a short-term scapegoat-constructor

born a few centuries ago: capitalism, for instance, or feudal society. This kind of dialectic revives the need to postulate something radically "other" and to found everything upon what does not exist, upon absence – not as an empty thing among full ones but as a category of the spirit. This, in fact, is the mythical basis of dialectic systems. Their strength lies in their capacity for creating enemies that suit their own requirements. When they consider scientific investigation, they have a tilt at quantitative positivism and the philistines who want to measure and classify everything that exists. When they consider the need to rebuilt society, they have a tilt at capitalistic modes of production. If one thing is certain, however, it is that neither positivism nor capitalistic production are devils that we find before us fully-grown; if anything they are devils we ourselves have created and kept alive.

The problem is to decide where to turn in order to exorcise them: to the investigation of the way nature has fabricated demons, or to holy water? If religion is the opiate of the people, then many dialectical materialists are heavily drugged.

What we must decide is how to choose our own judges. Do we want to choose judges who teach us how we must see the things of the world, in which tiny pigeon-hole (compared with the preponderance of God or the Dialectical System) we must place our meagre knowledge, and were salvation lies? Or, do we want to choose knowledge itself, and be judged both by this and the world it reveals to us? Do we want to build a fetish-structure where everything is organized and worship it, or do we prefer a succession of operations – open both towards the past (towards our genesis) and the future (towards interaction, transformation, and the unknown)?

Undoubtedly, if there is one thing of which the advocates of serial investigation and real immanence (those who are something called positivists, sometimes neo-positivists, sometimes neo-illuminists) it is that we must criticise the existent and not conceive of anything as "self-explanatory" or as "structuring in its own right". Where, then, does Opposition come from? Whence Revision, Resolution, the Struggle of the Individual, the New Society? Do they come from a partisan activity, from the snipers who, in the name of liberty, shoot at the great Repressive Code and at the Juggernaut of historical determinism?

From what we have argued throughout this volume, it will be clear that this position is mythical, and largely theatrical. There is no such thing as a position from which snipers can fire, for the simple reason that all snipers are inside.

Opposition and criticism come into being during the succession of semiotic procedures and are contained by the semiotic process. Their

use includes revision and re-systematization which, as we have seen, are necessarily non-harmonious and lacerating. One of the most widely-used commonplaces today is the revolution-evolution dichotomy (unfortunately the most repressive and conditioning activity of codes is that exercised today by the liberators of the individual and the destroyers of repression in the name of imagination with their depressingly-stereotyped language). Yet it is enough to look just a little further than the words in order to see there is no such thing as an evolution which is not a permanent revolution, and that no revolutionary process can begin other than from precise theoretical constructs and precise judgment on reality.

This dichotomy only too clearly leads to non-commitment. It is easy to take the negative side because this simply means sprinkling the world with holy water and praying for its destruction and resurrection.

On the other hand, those who see criticism as immanent, an operation remaining within the bounds of cognitive processes, cannot shun responsibility for constructing cultural systems. These systems are collective, and though they constitutes an Id compared with the individual, they are not "given" or "impersonal". Culturally they represent everything we put into them in our efforts towards analysis, adaptation and change. They also represent the fatigue of living. Criticism, therefore, should not be sought in semioclastic activity or negative thought as an anti-code, but in the development of codes, in positive interaction and in the sequential processes of transformation.

The capacity to develop language and transform the world with it forms part of the physiology of semiosis and always has done. The cultural revolution forms part of knowledge in itself. The field is undefined, schemes are temporary, certitude is an illusion, and one of the greatest illusions is the dogmatic certitude of negative thought. The only way to escape from the existent is to penetrate more deeply into it. The only way we can break out is by constructing broader and more coherent interpretations and interactions, continually pushing beyond short-range ideological-anthropomorphic interpretations.

For ultimately there is no contrast between a structured world and a serial world. Structure, in so far as it is actually structured and serve a purpose, is a product of the succession of operations. The history of a structure is the history of the series of processes that have caused it to evolve. Structures are created and continually moulded by the succession of trials and collisions. They are thus the culturally dependent situations which mediate relations with the world. In this active and socially responsible sense, language, social forms and science are structures. Structures are thus open onto the world.

Giorgio Prodi

The formation of meaning in phylogenesis

2nd Congress of the International Association for Semiotic Studies (IASS), Vienna – July 2–6, 1979

[This conference paper was previously not published (see Foreword). Footnotes in italic are the handwritten remarks added by Giorgio Prodi to the typed text, either in Italian or in English.]

In this paper I would like to make a number of remarks on the formation of meaning in phylogenesis.

1) The elementary semiotic situation consists of two material objects, A and B, linked by a situation whereby, on coming together, they form a complex A–B. Object A moves randomly and collides with an indefinite number of objects without establishing any link with them. Only when it meets B does it react in a specific manner. This is testified by the formation of a complex.*

We shall say that:
a) A and B are complementary.
b) A reads its environment and finds object B significant (and vice-versa).
c) B is a sign for A (and vice-versa). Sign and referent coincide in this elementary situation.
d) Object A is significant given that in nature there exists an object B capable of reading it: it is significant only for the latter.
e) A's reading consists therefore in "scanning the environment" and finding B. Meaning is a situation testified by a material process – the formation of the complex A–B.
f) The reader is always inside the environment, and reads it in so far as it constitutes a material hindrance among others, and finds what is significant around it.
g) The environment consists of a number of things, some of which are significant for some others. The environment is always greater than the readers and includes the readers.
h) Reading is a particular process, because A reacts only with B; however, it is also a general process because it can react with all B's. The capacity to react with reader A is what defines the class of B's.
i) A is a reader in so far as there exists a B to which it is adapted. A reader is always to be taken as a reader of definite things in a definite environment; it can read these in so far as it belongs to the environment.

---

* *Peirce dice che la azione dinamica tra due non è semiotica. Specificare che si intende una fase che ai semiologi appare presemiotica (specificare l'uso che si fa nel libro). Spiegare che vantaggio a questo livello significa solo "maggiore durata", non vantaggio di sopravvivenza.*

j) Reading is always governed by parameters and is always subjective. A reads its environment from the viewpoint of its own structure, which is what enables it to react with B. The specific link of A with B can be conceived as a historically determined correlation, in a situation of the tenon-mortise, key-keyhole type.

The interpretation that A gives of reality is its capacity to react to B. This is the "subjectivity" of A, a particular instance of the sum of objective reactions between A, B, and the n undefined, indifferent objects of which the environment is composed. The environment is greater that the A's and the B's. Reading is an internal, particular phenomenon.*

2) In this elementary model, the two terms are semiotically equivalent: each is at once sign and referent, and together they lead to the formation of the complex A–B.

Situations can be imagined in which one of the two terms, or the complex, has reading advantages in the environment.

For example, A finds B significant and destroys it to its own advantage: A's stability may thereby be increased. In this case A is a preferential reader: its reading outlasts its discovery of B's significance, and can be repeated with an indefinite number of B's, which are selected and destroyed one after another.† A has a reading advantage in an environment in which its complementary term B is present.

Another possibility is that the discovery of the complementary term B gives the complex reading advantages over the environment, if the complex A–B is able to read a third significant term capable of increasing the stability of the complex: this operation may be repeated sequentially.

Thus multi-term complexes may be formed, (AB)C, with increasingly marked reading advantages over their environment, in that they can read a large number of things, an ever-widening section of the environment. The reading of the significant object endows the reader with stability: in this way it demonstrates its advantage, its "prevalence" over things read.

At the same time, the state of complementarity of the various terms A, B, C ... which make up the complex is definable as internal significance, *i.e.* as a specific aggregation of the terms of the complex, each complementary to the others. The various A's, B's and C's ... that form the complex are mutually

* *Spiegare la differenza tra lettura e semplice stato: ad esempio i cristalli.*

† *Enzimi.*

adapted. In this way, reader-aggregates are formed which are capable of a vast range of external readings because they are characterized by complex systems of internal complementarity.*

Adaptation towards the exterior (*i.e.* the capacity to read the things present in the environment) and adaptation towards the interior (*i.e.* the stability of the various complementary terms that make up the complex) are two aspects of the reading advantages of a reader of the world.

In nature, the reader which acquires reading advantages over its own environment is the individual in the biological sense of the term. From microbe to man, it can be interpreted as an aggregate capable of identifying as significant a given sum of things to which it is adapted in its environment. The significant area differs widely for the different individuals. They have acquired reading advantages in directions which differ markedly with regard to complication and areas interpreted.

Reading advantages can be exemplified in terms of molecular biology and biological aggregations, both as regards internal signaling and significance and as regards the reading of the environment.

The reading of the environment is always centralized, *i.e.* unitary, and at the same time subjective: each reader explores a section of the world and explores it with its own parameters. On the other hand, the various kinds of complementarity of which it is made up, form a situation of compatibility, that is to say a unitary reading.

3) Given that an object is significant when, in nature, another object is capable of reading it (*i.e.* when it has a complementary reader) and given that complex readers with reading advantages have a high degree of complementarity with the things of the environment, the problem of the genesis of adaptation arises: namely, that of the correspondence of an individual, and the relation of its reading capacity to the many aspects of the environment which are "significant to it".†

We may assume that the increasing complementarity and reading advantages postulated in the above-mentioned models have actually occurred in nature. This constitutes phylogenesis, which can be taken as a process of development from the first stages of equivalence between the various signs-referents (of which there is no longer any trace) to the appearance of fully-fledged, progressively more complex individuals.

---

* *Interno ed esterno. Distinguere esteriore ed interiore.*

† *Describe how this condition can be explained.*

Significant aggregation is to be seen in every case as correlated to the situations of interpretation of environing objects, and is thus a function of the reading and the advantages which this confers upon the reader. It follows that complication is governed by the reading of the environment: the individual develops its complexity via the things it reads; in other words, it moulds itself upon the environment with the result that it is always adapted to it. In the last analysis, things are transformed into "things which are significant for a reader", that is, into signs, precisely by constructing an appropriate reader for themselves, in a continuous contextual relationship between signs and readers. It is the things which construct the reader and have themselves read.*

In phylogenetic terms, the construction and complication of the reader (in its various ramifications known as species) takes place via the encounter of a large number of copies and generations of the readers with the environment, so that adaptation amounts to selection.† What comes into contact with the environment is always an individual which has already achieved a certain degree of adaptation. This implies, in addition to the notion of complex situations of complementarity, the notion of the encoding and transmission of order. These processes are bound up with the mechanism of transmission and stability as well as with accidental variations and environmental selection.‡

4) Significance is realized in a process which links reader and signs, and has its starting point in the elementary model A–B. The chains of the linking process can be of varying lenght, and are extremely long in the case of the reading carried out by man. In every case, the process that links reader and referent and which is a reading, or a language operation that deciphers (finds out) what is significant, is a translation chain. Translation is used here to mean a series of operations which links two structures, each of which, by the fact of being translated, signifies the other. Translation is carried out by creating structural analogues, *i.e.* structures that "stand for" each other.

An analogue is never an indifferent equivalent: it extends the area of meaning; in other words, it is a process of reading a reality, and in some way modifies the reality. It expresses an order by reference to something else. Order is always "an order in relation to". Thus translation implies active constructional processes.

---

* *Referent creates sign. Sottolineare creates.*

† *Darwin.*

‡ *Darwin. Mutazioni.*

At the macromolecular level, this can be illustrated by the analogical translation of DNA into RNA and proteins. These are analogues of each other, in that they are constructed on the basis of a sequential reading which reproduces the order, but they are different molecules, with different functional meanings, as well as being processes differentiated by their phylogenetic development.*

If the reader is an organism with a very high reading advantage (and thus a complex federation of situations of internal complementarity), its interpretation of the environment will involve a long series of translation chains which identify situations of complementarity – *i.e.* which locate the area "that have proved significant during phylogenesis".

This reading machine can, once it attains a certain degree of complexity, reconvert the semiotic contact with things into traces: in other words, it is capable of memorizing.

In a subsequent stage, it can employ these traces to produce internal material states, which are taken as translational reactions with things: these are hypotheses.

In a complex reader we may postulate that the levels of reading are organized serially, a lower level offering its structural states as a referent to a higher level, which reads them by setting up a translation chain and ensuring continuity between internal and external readings. The translation sequence, which constitutes "knowledge", makes it possible to interpret-identify-manipulate traces, which are, in their turn, translations of semiotic events relating to the external referent.

5) Each reading situation, whatever its level of complexity, maintains the characteristics of interpreting a section of the world – the one which is significant to it. This is the section of the world which has produced the reader itself and its reading characteristics, *i.e.* it is its genetic area. Thus each act of "knowledge" is the recognition or rediscovery of the genetic area of the reader. This holds for man too. Human knowledge leads to the rediscovery of man's connaturality with his material terms. His signs are in a relation of solidarity with the referential world.

The structure of knowledge is "categorial" in the sense that the parametric sections by which man understands (*i.e.* the translational-semiotic chains that characterize his knowledge structurally) form the "*a priori*" of knowledge, which is determined evolutionarily by the things that have proved significant – significant precisely because they have determined the

* *To be analog means to be linked to something by a translation.*

categorial parameters appropriate for having themselves known by structuring the specific modes of human knowledge.

This holds for all degrees of knowledge, from its most elementary form right up to human knowledge. The phylogenesis of knowledge is a linear-sequential-selective complication of modes of interpretation of areas of meaning. Things become significant by determining the reader, and the area of things which become significant expands, determining the phylogenetic complication of the reader.

The reader is always shaped by what is outside it, and in this sense is impersonal, even if it cannot act other than from the standpoint of its subjective parameters and of its unitary and centralized modality of interpretation. This is true for man too, whose knowledge is linked to an extremely vast Id.

Human knowledge, in spite of idealistic interpretation of it, is a rediscovery of a genetic territory, of already-given relations which, in the course of phylogenesis, have created the human reading machine which succeeds its forerunners.

6) When a reader reaches the point when it can carry out interpretations of meaning which imply both memorization (*i.e.* the synchronic presence of many data) and the production of hypotheses (*i.e.* the internal manipulation of memorized data as pure internal referents or material states of the structure that can be compared with the external referent) what we get is the inversion of the sign-code relation. Whereas at the level of simple reading systems the code is given by the compatibility and sequentiality of signic-referential readings, at the human level the referent is interpreted with the mediation of a complex code; in other words, it is inserted in a linguistic system which confers sense upon the single reading event. Human knowledge is necessarily linguistic-systematic. It is also cumulative and social, being socially acquired. Sociality itself is at once the cause and consequence of linguistic communication, since language has acted as a natural object or a selective hindrance in causing structures capable of language to evolve. At this point, in a specifically human sphere, purely linguistic, semiotic relations are set up, in the sense in which they are normally understood in semiology. These distinctions nevertheless derive in a linear manner from conditions in which the signic relationship is (albeit via long translation chains) a directly referential relationship that picks out an object-sign in nature, *i.e.* a genetically significant thing. Hence, I believe that the study of human signs – semiology and linguistic – should be based on the study of the prehistory of the sign, in other words, on the natural history of the sign before the appearance of the human sign.

The foregoing observations are a sort of synopsis of a book of mine entitled *Le basi materiali della significazione* (*The Material Bases of Meaning*) published by Bompiani (Milan) in 1977. They derive from a series of reflections presented in *La scienza, il potere, la critica*, published in 1974 by Il Mulino (Bologna) and in a number of articles which have appeared in such journals as *Versus*, *Lingua e Stile*, *Il Mulino*, etc.

I have explored the connection with human language and its aesthetic content in a book which is shortly to appear: *L'uso estetico del linguaggio* (*The Aesthetic Use of Language*).

Afterword

Anna Gasperi-Campani

Born in Scandiano, a small town near Reggio Emilia (Italy) in 1928, Giorgio Prodi was third in a family of nine brothers and sisters. His adolescence was marked by restrictions imposed by the Second World War. On the other hand, his strictly Catholic family environment placed great importance upon ethical commitment and learning. In this period he developed a strong, visceral interest in literature and music that would accompany him for all his life, until his death in December 1987, at the age of 59. He used to say that his need to have a personal private space at home, where to retire to think and write while listening to classical music or simply to be by himself for a while, was a direct consequence of the inescapable noise that had surrounded him in his parents' house during his childhood and adolescence. A second interest soon became evident and proceeded side by side with that in literature and music: an enthusiasm for scientific research, which led him to the intellectual focus of his life, namely academic research, carried out in the field of chemical carcinogenesis, and personal constant research in that of the philosophy of knowledge. Paying great attention to keeping them apart, he attended to these three fields (oncology, epistemology, literature) separately, in total reciprocal autonomy, convinced as he was that it is possible to specialize in more than one subject. He wanted to be judged by specialized audiences in each field of study separately, and not be considered as an oncologist who writes, or a writer who leads a scientific institution, and so on. During a memorial conference on Giorgio Prodi's work in the field of semiotics and philosophy, Umberto Eco said, "It is extraordinary how a man had the capacity to cultivate different fields of knowledge without looking like an amateur in any of them".[1]

Giorgio Prodi graduated from a high school specializing in classical studies in 1946, winning the Leoni Prize "for the best examination of the District in 1946". Two years later he won the "Unpublished Poets Prize" in Reggio Emilia for his first collection of poems. After the *summa cum*

[1] *Saecularia Nona* 2, 46–49, 1989.

laude degree in Medicine obtained at the University of Bologna in 1952, he embarked on an academic career which took him to the Chair in Oncology (the first in Italy) in 1968, at the University of Bologna. Years later he took a second degree, this time in chemistry, with full marks. In 1973 he founded the Institute of Cancerology and in 1984, together with clinician colleagues, the Interdepartmental Centre for the Research on Cancer, and remained the director of both until his death.

The main areas of his scientific interest, evidenced by more than 300 publications, were the mechanisms of the action of environmental carcinogens on cells, and the role of immune response in tumours and in their metastatic capacity, followed in his last years by a pioneering study on the hormonal dependence of some human tumours. His scientific books include such noticeable works as *Trattato di patologia generale* (eds. Giovanni Favilli and Giorgio Prodi, Milano: Casa editrice Ambrosiana, 1982, 1986), *La biologia dei tumori* (Bologna: Esculapio, 1970, 1973, 1977), *Oncologia sperimentale* (Bologna: Esculapio, 1977), *Orizzonti della Genetica* (Milano: Espresso Strumenti, 1979), *Oncologia generale* (Bologna: Esculapio, 1985).

As regards literature, he published six books, together with several short articles. In 2009, a collection of his literary works appeared under the title *L'opera letteraria di Giorgio Prodi* (Reggio Emilia: Diabasis): *Il neutrone borghese* (Milano: Bompiani, 1980), *Lazzaro: Il romanzo di un naturalista del '700* (Brescia: Camunia, 1985), *Il cane di Pavlov* (Brescia: Camunia, 1987), *Il profeta* (Brescia: Camunia, 1992[2]), *Le quattro fasi del giorno* (Ferrara: La Bautta, 1988), *Dopo il mar rosso* (with drawings by Cécile Muhlstein, Ferrara: La Bautta 1990). Among the short stories were "L'untore e i mostri" (in *Ragione e mostri* – Boni 1977), "L'evoluzione degli animali a penna" (in *Ragione e mostri* – Boni 1977) and "La tensione e la quiete" (in *Ragione e mostri* – Boni 1978), "Ricerca di casa" (in *Dossier* – Maggioli 1981). In this field, three books and several short or long stories written by Giorgio Prodi are still unpublished. A collection of Giorgio Prodi's poems was published as "Cielo" (in *Il Belpaese* 5, 1987[3]), while a very large number of poems still remain unpublished.

Asked by Carlo Donati in an interview in 1985 (*Il Resto del Carlino*, Nov 6, 1985; *ibidem* Dec 6, 1988) on how much time he could dedicate to writing narrative fiction, his answer was that he used to write on the train (between Bologna and Rome, between Bologna and Milan), on the plane, in airport

[2] Written in 1986–1987.

[3] *Il Belpaese* is a book series of 'Culture and current Literary Events', edited by Raffaele Crovi and published by Camunia. See also [41].

lounges and the like. "Consider," he said to Carlo, "that there is something similar between writing a novel or a story and scientific research: there must be the same close investigation, the same necessity of communication, the same circulation, even the same solitude, either to write a novel or to accomplish a scientific research." And on the occasion of the publication of *Lazzaro* (*La Gazzetta di Reggio*, Oct 25, 1985), he said to Piergiorgio Paterlini, "writing means for me something largely inward, ascetic. Following a character, I follow myself, I unify fragments. I am turned outward, or rather not outward, but inward. Somehow, writing takes the place of spiritual exercises."

The main field of his philosophical research regarded the problem of meaning, assumed as the central one, and developed in terms of natural situations of significance from the points of view of semiotics, philosophy of language, and formal logic. Eight books by him were published, together with a long list of reviews and articles, most of which were in Italian. The books were *La scienza, il potere, la critica* (1974), *Le basi materiali della significazione* (1977), *La storia naturale della logica* (1982), *L'uso estetico del linguaggio* (1983), *Alla radice del comportamento morale* (1987), *Gli artifici della ragione* (1987), *L'individuo e la sua firma: Biologia e cambiamento antropologico* (1989), *Teoria e metodo in biologia e medicina* (1989) [1–8].

As regards *Le basi materiali della significazione* [2], which is the specific matter of this afterword, several reviews appeared after its publication in 1977. The biophysicist Massimo Piattelli-Palmarini[4] wrote,

> "the reference mark of this book has an international extension and a remarkable historic value. Umberto Eco presented it to me as "a biological construction of the world". It is a very original ingenious work, written with the aim of telling something new and not of commenting something written by others. Gilbert Ryle wrote that a great philosopher is not someone who gives new solutions to traditional problems, but one that disarranges all the problems concerned with knowledge, reorganizes them in an original way and tries to find solutions. In this sense, Giorgio Prodi is a great philosopher. He succeeded where Wittgenstein failed".[5]

A similar concept was noted by Giuseppe Mazzei who wrote:

> "Giorgio Prodi's book is a clear demonstration that to do philosophy is still possible. He does not seek patrons or tutelary deities, he takes his own

[4] Centre for Cognitive Science, MIT, Harvard University, USA, and Director of the Centre Royaumont.

[5] *Corriere della Sera*, Aug 8, 1977.

> responsibility, referring when necessary to a previous book of his own. When you finish reading this book, you want to begin it again and not because it is an easy reading, but because it is a reading which is at the same time thought".[6]

The first article by Giorgio Prodi on semiotics was "La preistoria del segno" (The prehistory of sign), published in *Lingua e Stile* in 1974 [11].

Figure 1. Giorgio Prodi (right) making a presentation "Filosofia della conoscenza e biologia" (Philosophy of knowledge and biology). Moderator Prof. Sergio Sarti (University of Udine, 1983).

To the presentation of the second volume of the *Enciclopedia Einaudi*[7] Prodi was invited in the capacity of an "epistemologist" with a lecture on "Il passaggio dal non-vivente al vivente" (From non-living to living) in a roundtable with Ilya Prigogine and René Thom. Thereafter he attended the second Congress of the International Association for Semiotic Studies (IASS) in Vienna on July 2–6, 1979, with a talk on "The origin of meaning in phylogenesis" as part of a roundtable "Levels of semiotic integration: isomorphism between biological structures and specialisation of functions" organized

6 *La Voce Repubblicana*, Oct 14, 1977.

7 The meeting was organized by the *Enciclopedia Einaudi* in the Italian Institute of Culture, Paris, February 20–22, 1978, and was attended by Giulio Einaudi, Italo Calvino, Massimo Piattelli-Palmarini, Renè Thom, Ilya Prigogine, Carlo Brumat, Pierre Delattre, Ludwig Arnold, Adriano Buzzati-Traverso and others.

by Thure von Uexküll and Harley C. Shands, in the presence of Thomas Sebeok, Umberto Eco, Roland Posner and several others. This presentation is published for the first time in this volume.

After that, Giorgio Prodi continued to publish short and long papers on semiotics together with books (see Bibliography below), so that he began to be considered as a co-founder of the field of biosemiotics. He was invited to participate in several meetings, among which were the XXVII National Meeting of Philosophy, Lecce (Italy) on April 24–27, 1980, where he gave a talk "Il problema della libertà individuale di fronte alle acquisizioni della biologia" (The problem of individual freedom in front of the acquisitions of biology) [21] and the Schiapparelli Lectures, Venice (Italy) on October 28, 1980, with a talk "Sui nuovi rapporti tra filosofia e scienza" (The new relations between philosophy and science) [22]; see also *Fig. 1*. Thomas Sebeok invited him to contribute to the *Dictionary of Semiotics*. In 1981 Giorgio Prodi wrote "Phylogeny of codes" and "Ontogeny of codes", later published as "Development of semiosic competence" in *The Encyclopedic Dictionary of Semiotics* [39].

Prodi's work was highly valued by semioticians like Thure von Uexküll, Walter Koch, Umberto Eco, Thomas Sebeok and others. Thure von Uexküll, Giorgio Prodi and Thomas Sebeok spent a week together in Freiburg in 1979, discussing the subject that was close to their hearts, biosemiotics. This was followed by new meetings of the three semioticians when they attended the III Congress of the International Association for Semiotic Studies in Palermo, June 1984, talking in the roundtable "Semiotics and the science of nature". Giorgio Prodi and Thure von Uexküll met again for the last time on the occasion of the meeting organized by Eli E. Sercarz on "The semiotics of cellular communication in the immune system" in Lucca (Italy), on September 9–12, 1986 [45]. Walter A. Koch invited Prodi to give a talk during the meeting organized by him in Bochum on October 7–11, 1986, on "The nature of culture". Prodi's talk bore the title "Culture as natural hermeneutics" [44]. In 1992 Thomas Sebeok dedicated the first volume titled *Biosemiotics*[8] to Giorgio Prodi, with the inscription "*In memoriam:* Giorgio Prodi (1928–1987): bold trailblazer of contemporary biosemiotics". In more recent years, Donald Favareau included Giorgio Prodi into his list of 24 essential authors of biosemiotics.[9]

[8] Sebeok, Thomas A.; Umiker-Sebeok, Jean (eds.) 1992. *Biosemiotics: The Semiotic Web 1991*. (Approaches to Semiotics 106.) Berlin: Mouton de Gruyter.

[9] Favareau, Donald 2010. Introduction and commentary: Giorgio Prodi (1928–1987). In: Favareau, Donald (ed.), *Essential Readings in Biosemiotics: Anthology and Commentary*. (Biosemiotics 3.) Berlin: Springer, 323–327.

Giorgio Prodi and Umberto Eco became acquainted in 1973 and since then they remained in touch, meeting at academic events and in philosophical and semiotic meetings, or in Bologna or Milano just to share opinions and have a coffee together. Umberto was an editor for Bompiani for several years and had a leading role in the publication of Giorgio's books *Il neutrone borghese* and *Le basi materiali della significazione*. In July 1979 they both attended the IASS congress in Vienna.

After Giorgio Prodi's death, his wife Anna Gasperi-Campani asked some friends, among them Umberto Eco, to participate with personal memories in a remembrance day, held in the historic Archiginnasio Library of the University of Bologna in the presence of the Rector Fabio Roversi-Monaco.

Several memories and articles have been written on Prodi's work.

(1) About him as a medical scientist: by Luigi Chieco Bianchi (Giorgio Prodi oncologo, *Belfagor* 66(395): 609–612, 2011), Felice Gavosto (Quel multiforme ingegno, *Fondamentale*, AIRC, 16(2), 1988), and others.

(2) About him as a philosopher: by Giorgio Ruffolo (*Micromega* 39(4), 1987), Umberto Eco (Una sfida al mito delle due culture, *Saecularia Nona* 2: 166–168, 1989], Renzo Tomatis (*Saecularia Nona* 2: 169–171, 1989), Gino Mazzoli and Silvano Zucal (editors, *Giorgio Prodi e l'avventura del pensare poliedrico*, special issue of *Il Margine*, 7/8, 1989), Cosimo Caputo (Biologia vs semiologia: La proposta di Giorgio Prodi, *Idee: Genesi del senso* 5(13/15): 183–188, 1990), Felice Cimatti (*Nel segno del cerchio: L'ontologia semiotica di Giorgio Prodi*, Roma, 2000; *A Biosemiotic Ontology: The philosophy of Giorgio Prodi*, Springer, 2018). In a short obituary in *Fondamentale* (16(2), 1988), Umberto Eco wrote:

> "Giorgio Prodi represented a challenge to the negative myth of the two cultures. He was one of the country's leading research oncologists, while being a highly original contributor to semiotics, philosophy of language and formal logic on the one hand, and a noteworthy literary figure on the other. When Giorgio told me he used to listen classical music when working at home, I felt angry somehow: why did he have a day of forty eight hours and I one of only twenty four? Anyway, not one of the pages written by him is banal. The most debatable ones are clearly styled and full of sense. The best ones invite us to continue to work in his direction".

(3) About him as a literary writer: Raffaele Crovi (Giorgio Prodi narratore, *Il Belpaese* 7: 164–165, 1989), Ermanno Paccagnini (I racconti di Giorgio Prodi, *Il Belpaese* 9: 335–346, 1993), Elvio Guagnini (Letteratura come

ipotesi e sperimentazione della realtà: Itinerario narrativo di Giorgio Prodi; introduction to *L'opera narrativa* of Giorgio Prodi, Reggio Emilia: *Diabasis*, 7–17, 2009), Giuseppe Longo (Presentazione dell'*Opera narrativa* di Giorgio Prodi, *Intersezioni* 3: 459–472, 2011).

In 1985 Sebeok asked Prodi to prepare a short version of *Le basi materiali della significazione* in English, to be published in *Semiotica* and to be followed by the translation of the whole book. The translation of the entire book had been prepared by William N. Dodd, Professor of English Literature at the University of Bologna, in 1984/85 (see his signed Note in *Figure 2*). The translation was checked personally by Giorgio Prodi (see an example of Giorgio Prodi's calligraphy in *Figure 3*) with help of Anna Gasperi-Campani (for the biomedical terminology). The short version appeared in *Semiotica* in 1988 [46]. William Dodd consulted Giorgio Prodi frequently so as to ensure he understood and translated the professional terminology used in the original Italian text correctly. Meanwhile, Giorgio Prodi and Anna Gasperi-Campani revised the Italian text to detect repetitions and excessive length of some descriptions, considering the differences of the English language characteristics in respect to the Italian ones. In the end, Giorgio Prodi revised the translation personally, as testified by the changes he made in the typescript by his own hand (see *Figure 4*) in order to remove repetitions and check once more that all his special terminology had been correctly rendered in English. In 2020, Anna Gasperi-Campani transferred the typescript into a computer file.

Selected publications by Giorgio Prodi

Books (philosophy and semiotics)

1. *La scienza, il potere, la critica*. Bologna: Il Mulino, 1974.
2. *Le basi materiali della significazione*. Milano: Bompiani, 1977.
3. *La storia naturale della logica*. Milano: Bompiani, 1982.
4. *L'uso estetico del linguaggio*. Bologna: Il Mulino, 1983.
5. *Alla radice del comportamento morale*. Genova: Marietti, 1987.
6. *Gli artifici della ragione*. Milano: Edizioni del Sole 24 Ore, 1987.
7. *L'individuo e la sua firma: Biologia e cambiamento antropologico*. Bologna: Il Mulino, 1989. [Portuguese translation: *O indivíduo e sua marca: Biologia e transformação antropológica*. (Lorencini, Álvaro, trans.) São Paulo: Unesp Editora, 1993.]
8. *Teoria e metodo in biologia e medicina*. Bologna: CLUEB, 1989.

Articles and reviews

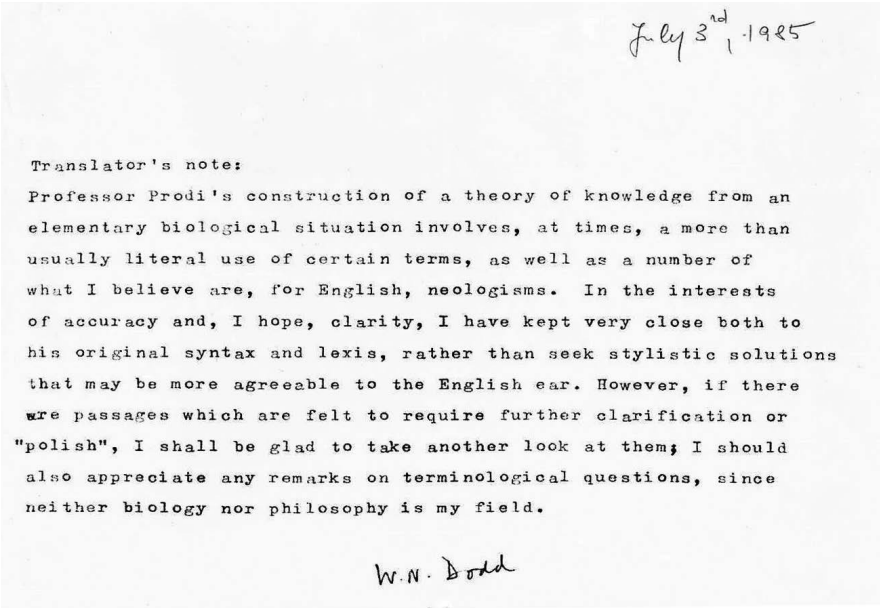
9. Scienze e potere. *Il Mulino* 222(4): 655–679, 1972.
10. La biologia nell'attuale pensiero scientifico. *Il Mulino* 225(1): 58–98, 1973.
11. La preistoria del segno. *Lingua e Stile* 9(1): 117–145, 1974.
12. Per un discorso sull'uguaglianza. *Il Mulino* 236(6): 910–929, 1974.
13. La storia, le scienze e le *n* culture. *Il Mulino* 240(4): 583–605, 1975.
14. La linea e il quadrato: note storico-critiche sulla attività tabulatoria. *Il Verri*[10] 12(December): 59–68, 1975.
15. Scienza – Ideologia – Società. Tavola rotonda con Giorgio Prodi, Sabino Acquaviva, Massimo Aloisi, Silvano Tagliagambe. *La civiltà delle macchine*[11] 24(1/2): 31–33, 1976.
16. Le basi materiali della significazione. *Versus* 13: 69–93, 1976.
17. Il corpo: in principio o alla fine. *Il Mulino* 253(5): 713–730, 1977.
18. The formation of meaning in phylogenesis. Talk at the II International Congress of Semiotics, Wien, July 2–6, 1979. Published in the current volume.
19. Economia del significato e significato dell'economia. In: *Studi in onore di Paolo Fortunati*. Bologna: CLUEB, 438–464, 1980.
20. Cannibali e medici. *Il Mulino* 273(3): 501–505, 1980.
21. Il problema della libertà individuale di fronte alle acquisizioni della biologia. In: *Atti del XXVII Congresso Nazionale di Filosofia (Lecce, 24–27 aprile 1980)*. Roma: Società Filosofica Italiana, 33–63, 1980.
22. Sui nuovi rapporti tra filosofia e scienza. *Il Mulino* 274(2): 298–309, 1981. [Also in the series of Schiaparelli Lectures: *Letture Schiaparelli*. Venezia, 24–30, 1980.]
23. Cambiamenti e direzione nell'epistemologia. In: Montalenti, Giuseppe; Rossi, Paolo (eds.), *Lazzaro Spallanzani e la biologia del settecento: Teorie, esperimenti, istituzioni scientifiche*. Firenze: Leo S: Olschki editore, 465–499, 1982.
24. Uomini o topi? *Il Sole 24 Ore* 95(April 26): 3, 1981.
25. Salute e malattia. *Enciclopedia Einaudi* 12: 394–427, 1981.
26. Sintomo e diagnosi. *Enciclopedia Einaudi* 12: 972–992, 1981.
27. Biologia ed Etica. Tavola rotonda: Giorgio Prodi, Evandro Agazzi, John Eccles, André Mercier. *Cattolica* (March 12 – April 27), 1982.
28. Ragione e miti oggi. *Il Mulino* 281(3): 432–446, 1982.

[10] A literature journal founded by Luciano Anceschi in 1956.

[11] Bimonthly journal of comtemporary culture, directed by Francesco D'Arcais. Round Table held at "Il Mulino", Bologna, and published in the January–April issue, pages 32–56.

29. Tipologie e livelli della divulgazione scientifica. *Il Sapere* 858(8): 22–31, 1983.
30. La biologia e il diritto alla vita. *Rivista di Filosofia* 25/27: 186–203, 1983.
31. Linguistica e biologia. In: Segre, Cesare (ed.), *Intorno alla linguistica*. Milano: Feltrinelli, 172–202, 1983.
32. La biologia come semiotica naturale. *Il Protagora* 24(6): 85–104, 1984. [In a special issue of the journal: Bonfantini, Massimo A.; Ferraresi, Mauro (eds.), *La ragione abduttiva*.]
33. La biologia come semiotica naturale. In: Herzfeld, Michael; Melazzo, Lucio (eds.), *Semiotic Theory and Practice: Proceedings of the Third International Congress of the IASS Palermo, 1984*. Vol. 2. Berlin: Mouton de Gruyter, 929–951, 1988.
34. Biology as natural semiotics. In: Koch, Walter A. (ed.), *For a Semiotics of Emotion*. (Bochumer Beiträge zur Semiotik; BBS 4.) Bochum: Brockmeyer, 93–110, 1989. [Italian version: [32] and [33].]
35. L'inventiva è la norma. [Proceedings, National Meeting "La forma dell'inventiva", Milano, June 14–15, 1985.] In: Boeri, Renato; Bonfantini, Massimo; Ferraresi, Mauro (eds.), *La forma dell'inventiva*. Milano: Unicopli, 173–180, 1986.
36. L'ingegneria genetica tra biologia e filosofia. *Il Mulino* 299(3): 420–470, 1985.
37. La logica della finitezza. *Zeta* 1: 37–48, 1986.
38. Lineamenti di sociologia degli invisibili. *Micromega* 4: 221–240, 1986. [Three Prodi's articles from *MicroMega* – this one, [43], and [47] – were republished in *MicroMega* suppl. al n. 7, 2016.]
39. Semiosic competence, development of. In: Sebeok, Thomas A. (ed.), *Encyclopedic Dictionary of Semiotics. Vol 2, N–Z*. (Approaches to Semiotics 73.) Berlin: Mouton de Gruyter, 884–887, 1986.
40. L'uomo e l'ambiente. In: Tamburrino, Antonio (ed.), *L'era dei bilanci ambientali*. [Proceedings; held at The Accademia Nazionale dei Lincei, Rome, Nov. 1985.] Roma: Kappa, 249–255, 1988.
41. Scienza, linguaggio, letteratura. *Il Belpaese* 5: 1–11, 1987.
42. Confini della vita. *Il Mulino* 312(4): 594–600, 1987.
43. Fondamenti della teratologia. *Micromega* 1: 191–211, 1988.
44. La cultura come ermeneutica naturale. *Intersezioni: Rivista di storia delle idee* 8(1): 23–48, 1988. [English translation 1989: Culture as natural hermeneutics. In: Koch, Walter A. (ed.), *The Nature of Culture: Proceedings of the International and Interdisciplinary Symposium, October 7–11, 1986 in Bochum*. (Bochum Publications in Evolutionary Cultural Semiotics; BPX 12.) Bochum: Studienverlag Dr. Norbert Brockmeyer, 215–239.]

45. Signs and codes in immunology. In: Sercarz, Eli E.; Celada, Franco; Michison, N. Avrion; Tada, Tomio (eds.) 1988. *The Semiotics of Cellular Communication in the Immune System: Proceedings of the NATO Advanced Research Workshop on the Semiotics of Cellular Communication in the Immune System held at Il Ciocco, Lucca, Italy, September 9–12, 1986*. (Nato ASI Series 23.) Berlin: Springer, 53–64.
46. Material bases of signification. *Semiotica* 69(3/4): 191–241, 1988.
47. Homo hypotheticus. *Micromega* 2: 97–122, 1989.
48. Verso un'etica fondata sulla biologia. Toward a biologically grounded ethics. In: *Etica della conoscenza scientifica: The Ethics of Scientific Knowledge*. Istituto della Enciclopedia Italiana fondata da Giovanni Treccani, 53–73, 1989. [Presentation in the conference "Etica della conoscenza scientifica", Venezia, 1987. Also published in *Alma Mater Studiorum* 2(1): 53–73.]



July 3rd, 1985

Translator's note:
Professor Prodi's construction of a theory of knowledge from an elementary biological situation involves, at times, a more than usually literal use of certain terms, as well as a number of what I believe are, for English, neologisms. In the interests of accuracy and, I hope, clarity, I have kept very close both to his original syntax and lexis, rather than seek stylistic solutions that may be more agreeable to the English ear. However, if there are passages which are felt to require further clarification or "polish", I shall be glad to take another look at them; I should also appreciate any remarks on terminological questions, since neither biology nor philosophy is my field.

W.N. Dodd

Figure 2. A note from July 3, 1985, typewritten and signed by William Dodd, Adjunct Professor of English Literature, University of Bologna, in the occasion of the translation of the text "The material bases of signification".

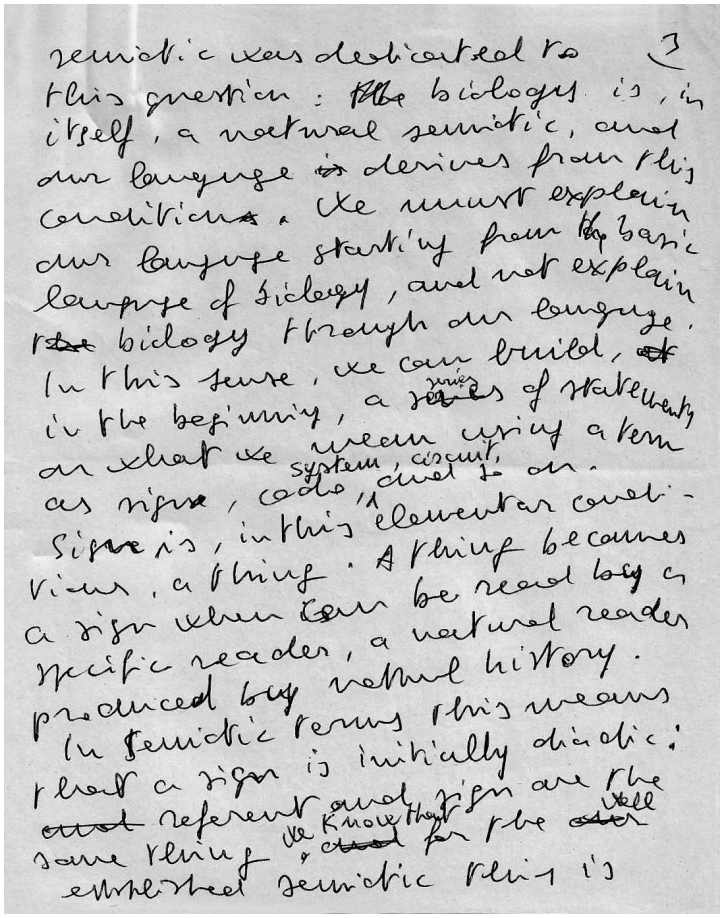
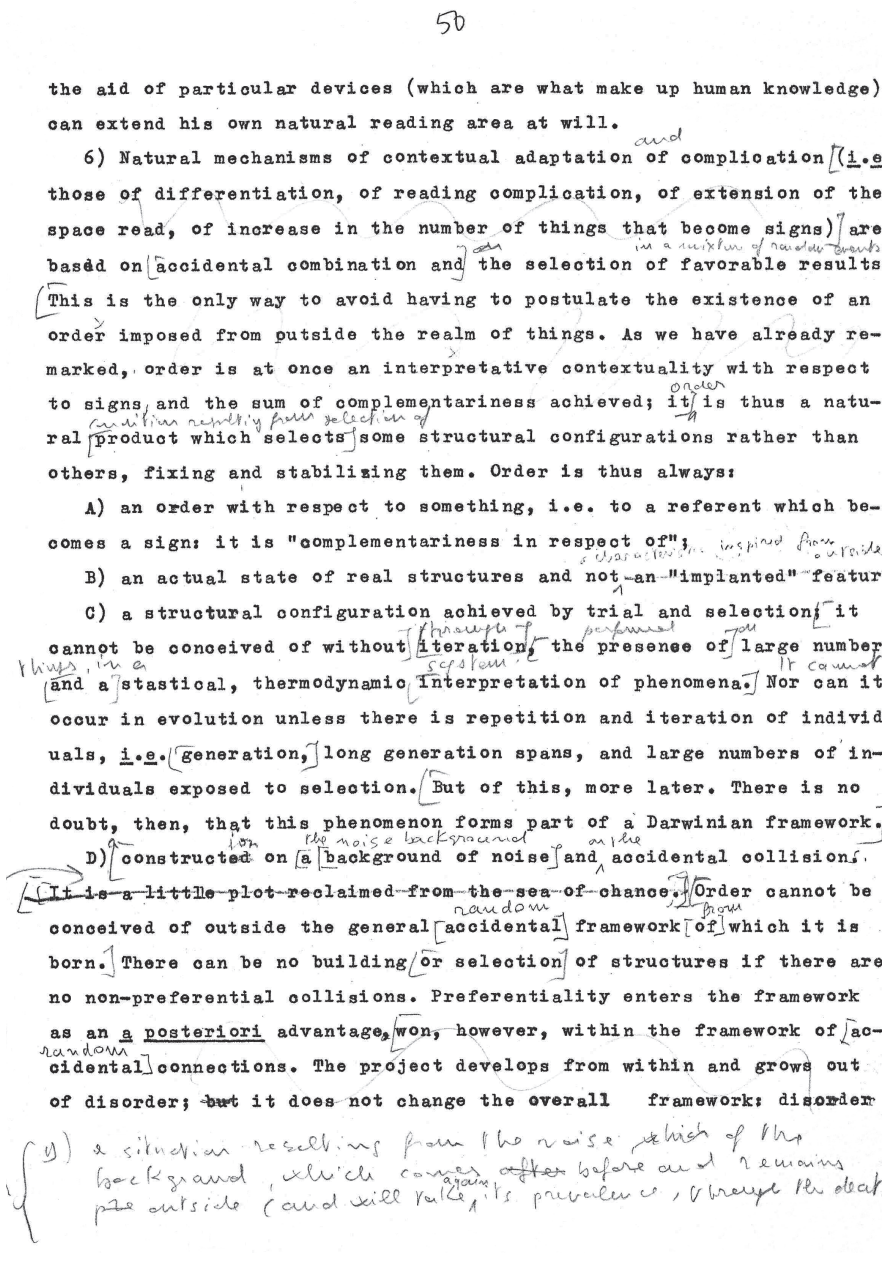


Figure 3. An example of Giorgio Prodi's calligraphy.



50

the aid of particular devices (which are what make up human knowledge) can extend his own natural reading area at will.

6) Natural mechanisms of contextual adaptation of complication (i.e those of differentiation, of reading complication, of extension of the space read, of increase in the number of things that become signs) are based on accidental combination and the selection of favorable results This is the only way to avoid having to postulate the existence of an order imposed from outside the realm of things. As we have already remarked, order is at once an interpretative contextuality with respect to signs and the sum of complementariness achieved; it is thus a natural product which selects some structural configurations rather than others, fixing and stabilizing them. Order is thus always:

A) an order with respect to something, i.e. to a referent which becomes a sign: it is "complementariness in respect of";

B) an actual state of real structures and not an "implanted" featur

C) a structural configuration achieved by trial and selection; it cannot be conceived of without iteration, the presence of large number and a stastical, thermodynamic interpretation of phenomena. Nor can it occur in evolution unless there is repetition and iteration of individuals, i.e. generation, long generation spans, and large numbers of individuals exposed to selection. But of this, more later. There is no doubt, then, that this phenomenon forms part of a Darwinian framework.

D) constructed on a background of noise and accidental collisions. ~~It is a little plot reclaimed from the sea of chance.~~ Order cannot be conceived of outside the general accidental framework of which it is born. There can be no building or selection of structures if there are no non-preferential collisions. Preferentiality enters the framework as an a posteriori advantage, won, however, within the framework of accidental connections. The project develops from within and grows out of disorder; ~~but~~ it does not change the overall framework: disorder

Figure 4. An example page of the typewritten "Basis" with Giorgio Prodi's notes.

Index of names

Giorgio Prodi's text

Foreword and Afterword

Tartu Semiotics Library

Book series editors: Kalevi Kull, Silvi Salupere, Peeter Torop

Vol. 1, 1998 V. V. Ivanov, J. M. Lotman, A. M. Pjatigorski, V. N. Toporov, B. A. Uspenskij
Theses on the Semiotic Study of Cultures

Vol. 2, 1999 J. Levchenko, S. Salupere (eds.)
Conceptual Dictionary of the Tartu-Moscow Semiotic School

Vol. 3, 2002 C. Emmeche, K. Kull, F. Stjernfelt
Reading Hoffmeyer, Rethinking Biology

Vol. 4, 2005 J. Deely
Basics of Semiotics *(4th edition, bilingual)*

Vol. 4.1, 2009 J. Deely
Semiootika alused *(K. Lindström, trans.)*

Vol. 4.2, 2009 J. Deely
Basics of Semiotics *(5th edition)*

Vol. 5, 2006 M. Grishakova
The Models of Space, Time and Vision in V. Nabokov's Fiction: Narrative Strategies and Cultural Frames

Vol. 6, 2008 P. Lepik
Universaalidest Juri Lotmani semiootika kontekstis

Vol. 7, 2008 P. Lepik
Universals in the Context of Juri Lotman's Semiotics

Vol. 8, 2009 C. N. El-Hani, J. Queiroz, C. Emmeche
Genes, Information, and Semiosis

Vol. 9, 2010 A. Randviir
Ruumisemiootika: Tähendusliku maailma kaardistamine (Semiotics of Space: Mapping the Meaningful World)

Vol. 10, 2012 D. Favareau, P. Cobley, K. Kull (eds.)
A More Developed Sign: Interpreting the Work of Jesper Hoffmeyer

Vol. 11, 2012 S. Rattasepp, T. Bennett (eds.)
Gatherings in Biosemiotics

Vol. 12, 2013 F. Merrell
Meaning Making: It's What We Do; It's Who We Are –
A Transdisciplinary Approach

Vol. 13, 2013 S. Salupere, P. Torop, K. Kull (eds.)
Beginnings of the Semiotics of Culture

Vol. 14, 2013 M. Danesi, M. Bockarova
Mathematics as a Modelling System

Vol. 15, 2015 D. L. Gorlée
From Translation to Transduction: The Glassy Essence of Intersemiosis

Vol. 16, 2016 C. J. Rodríguez Higuera, T. J. Bennett (eds.)
Concepts for Semiotics

Vol. 17, 2016 D. Robinson
Semiotranslating Peirce

Vol. 18, 2016 T. Maran, M. Tønnessen, K. Armstrong Oma, L. Kiiroja, R. Magnus, N. Mäekivi, S. Rattasepp, P. Thibault, K. Tüür
Animal Umwelten in a Changing World: Zoosemiotic Perspectives

Vol. 19, 2018 D. Favareau (ed.)
Co-operative Engagements in Intertwined Semiosis:
Essays in Honour of Charles Goodwin

Vol 20, 2020 Ľ. Lacková, C. J. Rodríguez H., K. Kull (eds.)
Gatherings in Biosemiotics XX

Vol. 21, 2021 M. Tymoczko
Neuroscience and Translation

Vol. 22, 2021 G. Prodi
The Material Bases of Meaning