

Beyond the Skin

Beyond the Skin:
The Boundaries between Bodies
and Technologies in an Unequal World

By

Bianca Maria Pirani

**CAMBRIDGE
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P U B L I S H I N G

Beyond the Skin:
The Boundaries between Bodies and Technologies in an Unequal World,
by Bianca Maria Pirani

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Dedicated to the Memory of Wilde Bettini

Exploring the archaic is the key to inventing the new

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PREFACE

ISHWAR MODI

BEYOND THE SKIN: The Boundaries between Bodies and Technologies in an Unequal World by one of the most eminent sociologists on Body, Bianca Maria Pirani, the founder President of the Research Committee on The Body in the Social Sciences of the International Sociological Association (ISA RC 54) is an exceptionally brilliant disposition and examination of the body and its reflections in social behaviour particularly in the context of new emerging technologies.

What this book highlights is the advance transformation of persons into spectators. But this is only one side of the story. The other side of the story is that the *Homo sapiens* have always been and still remain performers besides being spectators. In their role both as performers and the spectators there is lot of emphasis on the skin as well, skin which has to be shining and glittering to make the body as attractive as possible. This is precisely what the modern mass media: films, TV and the internet, and the print world, is churning out and performing day in and day out. The predominant focus of the huge advertising industry is centralized on the concept of beautifying the body. More than anything else, body has become the ultimate focus of attention, more so in the Western world.

What is happening in the West is being emulated all over the world almost irrespective of the levels of development of the various societies and countries. It is another matter that to what extent body is considered central in the thought and action of these societies. It is also reflected in the fact that while there had been so much of discussion and debate on body in its various forms and ramifications in the Western intellectual tradition, body has not received much focus and attention in the oriental intellectual and religious traditions. As against body, it is the soul that has found precedence in quite a few intellectual and religious traditions. Hinduism is the most prominent example of this thinking and thought. It is not body but the soul that matters most for a Hindu. Body for them is only a medium of performing their ordained duties of *Dharma* (righteousness), *Artha* (prosperity), *Kāma* (desire), and *Moksha* (spiritual liberation). It is Moksha or the salvation of soul which is the ultimate objective.

However, the scenario has drastically changed practically everywhere in the contemporary world. Body seems to have gained precedence over soul in spite of a large number of people still thinking that it is not possible to conceive of a soul without its body, and that of a body without its soul. Going much further and beyond these considerations, this book hypothesizes that the body is a spatial-temporal *vector of socially distributed processes which permit the acquisition, storage and manipulation of information through bonds with humans and non-humans, structured in social networks*. As such it is no exaggeration when the author points out that in fact, the 20th century has theoretically invented the body. Body has been theorized in different ways depending on disciplines, ideologies, experiences. The author has rightly pointed out that “thinking about the body implies thinking about who we are, what we are doing and how we are acting”.

This book focuses on the boundary between bodies and technology, whose social-technical construction, starting from the *perspectiva artificialis* of the Renaissance, has created the body/mind dualism that characterizes the history of modern culture. In focusing on this variable boundary the author has highlighted the differences that distinguish modern society from pre-modern society, and at the same time investigate the destiny of emotion, memory and unpredictability, which are the constituent values of intelligence. It can hardly be overemphasized that the intelligent infrastructure constitute the next horizon of computer technology.

Bianca Maria Pirani has very competently and brilliantly dealt and unraveled the most crucial unresolved questions within the contemporary mobile transformation through the notion of *the body in action in context: the sensory inscribed body* within the spatial interaction mediated through new socially oriented applications. The author has highlighted the concept of bodies acting in context as the main empirical field which allows sociological investigation to test *in loco* the most important neuroscientific discovery of the last two decades—the existence of mirror neurons. She has rightly pointed out that there is a great need to revise and enlarge our visions of the human condition, to be closer to reality, not only for others, but above all for ourselves. The pericorporeal space revealed by current mobile spaces and experimentally demonstrated by the discovery of mirror neurons, invites cultural forces, and sociology in particular, to a reconsideration of the function of the body in the sphere of its own temporal and spatial systems.

The concluding part of her book: What Homo sapiens teaches the mobile society of the 21st century, is the most original contribution of the

author which will motivate many other scholars interested in the field of social sciences / sociology of The Body to undertake researches in this important area of contemporary importance since in her own words “Despite a growing number of reflections about the body, there currently exists no complete works based on the sense and associative function of corporeality as an “entity” located within space and time, particularly in the dominion of social sciences, and more specifically in the field of sociology.”

Prof. Ishwar Modi

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FOREWORD

ROBERTO CIPRIANI

Bianca Maria Pirani, founder of Research Committee 54 (“The Body in the Social Sciences”) of the International Sociological Association and for many years its president, attempts to offer the sociological community a sort of *summa* of scientific knowledge about the body and its reflections on social behaviour. This is indeed a remarkable undertaking, the result of long years of study on the subject and hermeneutic experiences of the nature and influence of the somatic in the daily behaviours of social actors. The approach taken by this vast study is multidisciplinary. Here, sociology continually goes beyond its academic boundaries to pit itself, as equal, against the so-called hard sciences so frequently present in the author’s reflections. She has chosen a four-fold development, almost an echo of the “four noble virtues” of Buddhism (pain, its origin, its extinction and the way to its extinction), a philosophy and religion that has made the body its *raison-d’être*. These are: the origins of *Homo sapiens*; the rhythmic dimensions of the body; the theories of body in the social sciences; and the dynamics of the body from Renaissance Italy to what is emblematically defined as “electronic autism”, indicating a human social reality increasingly accompanied by constant but at the same time continually changing “prostheses” (from the mobile phone to the smartphone, from the lap-top to the tablet, and so on into the future, which will certainly not fail to find other solutions, all having, however, substantial synergy with our bodily potentials).

This is a work that digs deep, often revealing what lies under the skin of the topic under investigation. In it, Bianca Maria Pirani offers lucid readings of reality. Far from being vague pronouncements, what is presented here represents conclusions reached only after long reflection and continual modification on the author’s part.

The keystone of the first part of the development is what holds together the first two parts, where, starting from the profile of *Homo sapiens*, the Working Memory is gradually delineated. Nor is it by chance that the very real metaphor of the dance embodies – and there couldn’t be a word more apt – the features of a “rhythmic body” that is both a form of self-

expression free from social trammels and limitations and an exercise of memory, of respect for times, of convergence between gesture and sound (real or only imagined), as we admire in the famous age-old Addaura Cave, in Sicily, which has often moved and impressed the author, inspiring suggestions for future analyses. The symbiosis between mask and dance reconfirms what has already been said, and leads the author to move between reality and so-called, more or less theatrical, fiction. (And is it not true that theatre is part of life? And that our own agency is the producer of plays already given and/or promised?)

In a context of such detailed and at times inextricable development, Bianca Maria offers a thread that guides the reader through the labyrinth of theoretical formulations and empirical findings to find the path of final explanation-interpretation. To this end, the third part gives full treatment to the importance held by the theme of body in all the social sciences. And once again, at the point of arrival, we find the “rhythmic body”.

Probably the most original contribution is found in the concluding section, the fourth, where input of various natures and origins comes together. This input derives from “modern culture” and includes reference to the very recent concept of mirror neurons, a further proof of the necessary, and therefore undivided and undividable, interface between body and social environment, individual and society.

Finally, the author attempts to offer a look forward to the future, with *Homo sapiens* becoming Working Memory to teach coming generations the paths of action.

INTRODUCTION

“We are our bodies”. “We have our bodies”. “We make our bodies”.¹ This “three headed” axiom has turned the body into the “parasite” of modern culture. This is the image that the Canadian director Cronenberg skilfully used in the film *Shivers* to illustrate the body as the site of the most unsettling transformations and intense effects. This “biological horror” – exemplified by bodily illnesses, mutations, strange creatures, violent telepathy, video hallucinations, drug addiction and perverse sexuality, the focus of Cronenberg’s film – testifies to the status of the body, in the literary and cultured western world, as a “space sanctioned for the expression of internal conflicts” (Lemma, 2001: 28). A space that unwinds, mockingly, “beyond the skin” of human beings, animals, things, and emerges as a sort of multimedia icon, in “synthetic worlds”, currently presented in every possible format by the so-called “convergence culture” (Jenkins, 2007).

What our bodies do to us is just as critical as what we do to our bodies: our bodies age us, and eventually kill us. Bodies are strange, not only in their plurality and the elusiveness of their meanings and interpretations, but also because we theorize the body in different ways depending on our disciplines, ideologies, experiences, and also on our own bodies. Thinking about the body implies thinking about who we are, what we do and how we act.

Despite the growing amount of reflection about the body, there currently exists—particularly in the dominion of the social sciences, and more specifically in the field of sociology—no comprehensive work based on the sense and associative function of corporeality as an “entity” located within space and time. It is not a question of reconstructing the history of

¹ Within this axiom the body is presented by the diverse sociologies of the body as “subject”, “object” and “project”. Or, using different terminologies, as “self”, “other” and “action”. The first assumption, “body as subject”, mainly refers to the theories of Sartre and Goffman; the second, which considers the body as “object-machine”, refers to Descartes’ formulation and to its fundamental function in biomedicine; the third, “body as project”, specifically refers to the intersection of the body with gender, race, social class, and in a different way is also present in the works of Giddens, Bourdieu, Bromberg, Foucault and Butler.

the body and its conceptualization, nor of revisiting the paradigms that have been used to think about the body. Instead, it is a question of focusing on current paradigms for identifying corporeality as the total of sensorimotor abilities that permit the body to interact successfully with the environment that surrounds it. The determination of the boundary between the social *sensorium*² and today's technology is the fundamental and as yet unsolved methodological problem emerging from the current "*spatial turn*"³, a development coming out of the reorientation of the classic digital paradigm (a concept that is centred on the opposite idea of the disappearance of space, the end of geography, the reduction of mobility, and the annulment of embodiment in digital communication on the web). In the evolution of contemporary mobile communications, the concepts of space/code (integrated with the communicative and social revolution of the amplification and portability of social networks) represent the foundation of the prospects for new mobility paradigms which technological developments, and more specifically the ecologies of wireless communications, are producing and articulating in post-PC society.

The impact of physical mobility on the logics of contemporary culture is such that sociological research is reorienting its analytic paradigms to make mobility the fundamental paradigm of our daily lives. However, this return to the relevance of spatiality, in both the physical and the offline worlds, is not a return to space in the sense we have understood up to now—a mere container of individuals, objects and events. As Dourish and Bell (2011) have shown, in light of the processes of digitalization of the omnipresent web, the re-emergence of spatiality in diverse disciplinary dominions (geography, sociology, architecture, economy, art, and urban informatics, to name some), is configured as "transduced space"⁴, or in other words as space constructed and activated continuously and socially by the networks and new digital realities emerging at the intersection of mobility, geo-sociality and augmented reality. Within this *scenario in*

² In English, the term "*sensorium*" signifies the whole of the sensory functions that in a given moment

connect the human body to the context in which it moves and acts. (see Ragazzini, G. (2005), *Dizionario il Ragazzini*, Bologna: Zanichelli: 972).

³ "*Spatial Turn*", in the words of Warf, Arias (2009).

⁴ The theory of *transduced space* is taken from Dodge, Kittchin (2011) in an essay in which the authors refer to their previous works as well as to the work of A. Mackenzie (2002, 2006) on the social dimensions of software and programming codes.

movement there emerges the concrete problem of delimiting the space of action as an *elementaryintegrated unit*, defined by the interaction between the sensorimotor activity of the experience of the body in a given situation and the mobile connection produced by a specific technology.

This book uses the Freudian concept of “drives”⁵ and the insight of Lévi-Strauss, who holds that the most important and effective of the inherited instincts in our biological patrimony consists of a “mass of unconscious rules”⁶. It considers the somatic dimension as the biological basis of any performance situation that does not require conscious attention to be brought to mind, generally in the form of habits, perceptive strategies and abilities acquired through experience. Based also on some of the more recent acquisitions in neurosciences (Damasio, 2003; Kandel, 2005; Gazzaniga, 2008; Goldberg, 2009), we propose the somatic dimension as the foundation of the physical bond that connects the body to the surrounding context, anchoring its associative pathways to the places where we live.

The somatic-sensitive areas of the brain (Damasio, 2004: 314) construct the dynamic maps that the boundaries of the body configure with the environment through pathways of neural activity coordinated over time. Without this mechanism, we would not be able to localize our interactions with the environment, nor would we be able to use the wealth of knowledge acquired by the body when touching an object, looking at a panorama, or moving through space along a trajectory that it describes through its movement. Most interactions between the body and the environment take place within a *spatial and temporal limit* generated by the combination of the boundaries of the body and the practices of our culture, whichever of our senses is used (the sense of touch or any other). This combination is a fundamental ability for our mental world. Without this skill, every object and problem would be an *ex novo* encounter, and we would not be able to use any of our previous experiences to deal with them. As the works of Herbert Simon (1996) have demonstrated, the recognition mechanism is the main one used for problem solving in present experience. This mechanism is morphologically identifiable as the

⁵ Freud (1915: 17) had identified in the concept of “drives” the “*boundary* between the psychic and the somatic” (cursive added).

⁶ In a text for UNESCO published in the 1980s, Lévi-Strauss (1984:42) strongly supported the idea that “between the instincts inherited by our biological patrimony and the rules inspired by reason, the mass of unconscious rules remains the most important and most effective, from the moment when reason itself, as understood by Durkheim and Mauss, is a product rather than a cause of cultural evolution”.

working memory, which organizes behaviour with respect to the temporal dimension and controls the execution of the operations the body enacts to achieve its objective in the environment.

The capacity to recognize is not exclusive to the human race. It is shared by every other species with the capacity to learn. What differentiates human beings is their capacity to transmit inventories of recognition from individual to individual and from generation to generation through cultural practices. Indeed, the architecture of the organism is neither innate nor acquired, but is instead the result of continuous interaction between endogenous genetic factors and exogenous environmental factors. The construction of this architecture distinguishes animal existence from human existence. The transformational evolution from animal to human existence entails a radical change in the nature of transactions between the body and its environment: animals always build the same dens, and as far as we know they have always built them this way (Ingold, 2001: 1116), while human beings build different types of houses. Although these types have existed for a long time, it is a historical fact that they have undergone significant changes over the course of time.

Based on these considerations, now fully acquired by neuroscience, this book hypothesizes that the body is a *spatial-temporal vector of socially distributed processes which permit the acquisition, storage and manipulation of information through bonds with humans and non-humans, structured in social networks*. Every process of human formation regards a specific individual who relates to contextual variability *with and through* his or her body, which acts within a *determined spatial reality* characterized by a specific symbolic system of reference (contents, beliefs, culture and language). The comparative analysis of the characteristics of corporeal-kinetic intelligence sheds light on its capacity to shape itself in close relation to spatial intelligence, which centres on individuals' ability to transform objects in a specific environment and orient themselves in a world of objects in space. It is this capacity to orient ourselves in space that allows us to establish our position in the environment, to estimate the distance between external stimuli, and to move. It is this very complexity that has up to now prevented a systematic analysis of the fundamental dynamic relationship between corporeity and the surrounding space, especially as regards the processes of abstraction and emptying out that the intellectualization of experience has caused in modern culture.

The 20th century invented the body theoretically. This invention came out of psychoanalysis, when Freud, observing the exhibition of bodies displayed by Charcot at the Salpêtrière Hospital, identified conversion hysteria and understood that this would be the starting point in the

development of his studies: the unconscious speaks through the body. That first step was decisive, because it led to the idea of somatisation and the consideration of body image in the formation of the individual—what was to become the “skin self”⁷. The next step, made by Husserl, was to focus on the body as the “cradle” of all meaning. Husserl’s influence was particularly felt in France, where it led to Merleau-Ponty’s conception of the body (1945: 97) as “embodied consciousness” and “cornerstone of the world”. The third step in this discovery of the body was the result of Marcel Mauss’s surprise when he noticed that the British infantry in World War I marched to a different step from the French. This notion of “body technique” has profoundly influenced all historical, anthropological and sociological reflection on the question of the body.

However, despite Mauss’s enlightening intuition, more often plundered than sufficiently understood, the body was relegated to the subconscious, stowed away inside the “subject” and included as the “own body” among the social icons of culture. It was as if knowing, in the most general sense, actually signified “representing”, according to the philosophical view that contrasts the immediate data of consciousness to the principal elements of representation, a view that sees culture as a social substitute for instinctual automatism. The crucial turning point of modern European history is found just here: only after the transformation of the world into a series of limited but open models (in that they continually refer to something that is *absent* because it is *external*), does the *space for representation* guaranteed by paper become possible. To quote Lefebvre (1974: 59), space is that which “the imagination attempts to modify and occupy”. While in pre-modern society space constituted the *anchor of time*, in modern society space flattens time by standardizing social organization. According to Giddens (1990b), this change coincides with the expansion of modernity.

Thus, this book focuses on the *boundary between bodies and technology*, whose social-technical construction, starting from the *perspectiva artificialis* of the Renaissance, has created the body/mind dualism that characterizes the history of modern culture. In focusing on this variable boundary we highlight the differences that distinguish modern society from pre-modern society, and at the same time investigate the destiny of emotion, memory and unpredictability, which are the constituent values of intelligence.

⁷ Cf. Anzieu D. (1985), *Le Moi-Peau* (1985), Paris, Dunod; Bick E., “The Experience of the Skin in Early Object Relations”, *International Journal of Psychoanalysis*, 1968, 49: 558–566.

Contemporary information technologies come to grips with this dimension through the production of *lightweight, high-density materials* (Maldonado, 1992: 80). The physiological, sensorial and cognitive mechanisms that are activated in the relational context through current information technologies are the same ones found in pre-modern relations between man and technology. The Swedish neuroscientist Torkel Klingberg (2008: 10-11) has proved that today's brain capacity is identical to that of the oldest anatomically modern *Homo sapiens*. What has changed in *Homo sapiens* over the long course of time from the invention of the first stone tools to today's information technologies?, What is dramatically clear, starting from the perspective of the Renaissance, is the exclusion of *biological, material and corporeal "situativity"* in the construction of sensorial experience that humans create in the environment. From the chipped flint stones of the Upper Paleolithic to nuclear power plants, the technical resources of human ingenuity have responded to the primary biological need to dominate the environment, which is inseparable from human nature. While the biological history of living forms has always been determined by ecological interactions with the environment, humans have created their symbolic and cultural universes of meaning, using them as a *diaphragm* between themselves and nature, and imposing them on themselves and on nature as a model. In the experiment of worldwide significance that technology has started to perform on humanity, our innermost root is coming to light: the "body in action in context", the foundation which the *rational animal* has always stood upon, and which in our depths unites the possibility of reason with the animal nature of the living thing. Intelligent infrastructures make up the next horizon of computer technology.

We are entering the phase of microelectronic technology in which computers will interact in a totally new way with the physical world. Today we have to discover that, even though the world may be restricted in terms of physical access, its horizons continue to expand through the contextual assemblages that create mobile boundaries between sensory experience and technologies. The technological environment that surrounds the body profoundly influences its ways of being, doing, and bonding with the surrounding bodies of living beings, things and places. In considering technology as the matrix of the agent/context relationship, the theme of corporeity is considered from a bio-dynamic perspective, aimed at investigating the adaptive individual/environment relationships as an inseparable mind/body whole, encountering contextual variability. Today we know that the motor system, far from being a mere muscle- control system or simple executor of encoded commands, is able to perform

cognitive functions that for a long time were erroneously considered to be the prerogative of psychological processes and neural mechanisms of a purely associative kind. For neuroscientists it is now a confirmed fact that human beings automatically and unconsciously organize bodily experience in spatial units, whose boundaries are established and determined by changes in place and time and by the interactive elements that determine this experience. These processes constitute the *implicit* or *procedural memory*, a form of memory that is not recalled at a conscious level. Already conceptualized in French philosophy (Maine de Biran, Ravaissou, Bergson), this memory governs not only simple perceptual and motor abilities but also Margot Fonteyn's pirouettes and Wynton Marsalis' trumpet technique, as well as cyclists' leg movements. Descartes himself observed that the lute player has hand memory when playing his instrument. Procedural memory constitutes the biological foundation of all performative situations. It is often automatic and is directly accessed through execution, without any conscious effort or awareness of reliance upon memory. In its contextualized *performances*, implicit memory guides us through consolidated routines, abilities and habits acquired through experience. If explicit knowledge can be communicated through language with a high degree of awareness, implicit conscience has a character that pertains fundamentally to the somatic, emotional and behavioural dimension, referring to the "here and now" of the "present" (Stern: 2004).

The "body in action in context" is the "procedural" lesson that primitive *Homo sapiens* has transmitted, in the findings documented by paleoethnology, archaeology and art history, to the embodied spaces of the digital era. The secret of memory is written in this humble and pragmatic lesson. The capacity of the contemporary brain is identical to that of anatomically modern *Homo sapiens*. What changes is the volume and complexity of the information that constitutes the "technological environment". Technology is the place of relation/mediation among actors, their social networks and their cultures. It is neither neutral nor inert. Throughout history, when a technology once conceived of as fixed became mobile, a cultural change has accompanied this transformation. When, for example, the technology of writing was transferred from stone inscriptions to writing on papyrus or paper, the world changed. A similar cultural shift also occurred at the moment in which computing technologies became mobile.

As Intel announced in the year 2000, "Computing, not the computer, will characterize the information era". This is the key point of the current cultural transformation: it consists of an *activity*, as opposed to a playful pact "on this side of politics and culture" (Susca, in Jenkins, 2007: 364),

within which the maps of popular culture are traced⁸. Castells (2009: 75) defines this unprecedented form of communication as “electronic autism”, with reference to the social spaces of simulated reality, which combine the sociability and desire to experiment of grassroots convergence with role games. “Electronic autism” is the concrete proof of the risk of wanting to investigate and manage new phenomena with cognitive tools and methodology inappropriate for the analytical challenges of our day and of the near future. In classical web analytics, the dimensions of mobility and spatiality have not been the object of particular attention or in-depth research in recent years. The examination of social networks is, in fact, all too often conducted without inserting the variables of space and time into the analysis, evaluating only the abstract topological dimensions of social graphs. In this framework, the growth of information asymmetry between data actor and data collector is directly proportional to the uncontrollable expansion of manifestations of “electronic autism”. To contribute to avoiding this risk, using the notion of *the body in action in context* this book proposes to treat one of the crucial, unresolved problems of contemporary mobile transformation: the sensory-inscribed body within the spatial interaction mediated through new socially oriented applications.

⁸ The English term “Popular Culture” indicates the scenario of the New Media as a set of cultural practices and features that portray how individuals and societies relate to means of communication. Today, the large majority of cultural products are not for the masses. In fact, we live in a world of infinite niches and sub-genres. (See Jenkins, H. (2006), *Convergence Culture*, New York, New York University Press; Ital. ed., Jenkins, H. (2011), *Cultura convergente*, Milano, Apogeo.)

PART I:

**THE HAND AND THE TOOL:
THE INVENTION OF TECHNOLOGY**

CHAPTER ONE

THE HAND AND THE TOOL: THE ‘EMERGENCE’ OF *HOMO SAPIENS*

1.1 The Heredity of the Social Intelligence of Animals

The emergence of *Homo sapiens* is the unexpected outcome of contingent adaptations. Since the evolution of the biped, the arrival of *Homo sapiens* with his modern modes of behaviour represents the advent of an unprecedented species. Arguments reducing the emergence of *Homo sapiens* to no more than an improvement of the species which preceded it are unsustainable. What is globally defined as ‘human faculties’ comes under the category of emerging properties that allow a new combination of elements to produce totally unexpected outcomes by chance¹.

The question of our origin lies in the reconstruction of historical, genetic and adaptive modalities that gave rise to the explosion of the human species. Such an ‘explosion’ was the result of a long, uninterrupted evolutionary process which generated *Homo sapiens* through speciation (the evolution of new species was a continual process): the unexpected outcome of contingent adaptations. To explain this result, a new approach to evolution is necessary. Ingold (2001: 78-79) observed that not only was there a need for an approach that enabled us to explore the variations in, and the selection of, transmitted characteristics from generation to generation, but there was also a need to investigate the dynamics of self-organisation and the potentiality of self-formation. It is the living body that provides the cognitive key which explains the processes and the remarkable combinations that connect the first hominids with the appearance of *Homo sapiens*. It is the living body which includes its relational matrix, the individual/environmental bond, the *incorporation of difference*.

¹ Water, the classic example of ‘emerging properties’ essential to life, possesses characteristics that cannot be separated from its components hydrogen and oxygen, considered as two separate elements.

Konrad Lorenz argued that life could be described as a “process of knowledge”. The biological adaptation of organisms is, in fact, analogous to the acquisition of information relative to the environment. After each experience, new information is stored in the nervous system, the organism interacts with its environment, and a more or less permanent behavioural adaptation - usually called ‘learning’ - is determined. Only animals behave, or rather are active, in order to carry out certain functions and achieve certain ends. The inanimate world has neither goals nor purpose. Function appears with the first living structures. No metabolism or physiology exists without organic structure, no matter how small or large it might be. Their conformation or assemblage is such that they appear as if they are meant to carry out a particular function. Even the simplest cells have a behavioural embryo: they are repelled by toxic substances and attracted to nutritional matter. Elementary responses to external environmental stimuli can be regarded as *functions*, functional units or behaviour. These multi-cellular organisms coordinate particular cell functions, and above all control body activity, *movement* or a series of coordinated movements known as *actions*. For this to occur there needs to be a nervous system that elaborates stimuli from the external environment. Whatever happens between these two events is called the *mind*. Today, there are a number of scientists involved in the study of the mind and the brain, observing animals of various species. According to Vallortigara (2007: 15):

they are convinced that the most fundamental principles concerning the function of the mind - all minds, including the human mind - can also be obtained from the study of organisms that are very different from our own.

The basis to an understanding of the processes that occur between the nervous system and receptor organs, between movement and the outside world, is the study of the animal world (Umwelt). ‘It is that part of the surrounding world which acts through receptive organs’ (von Uexkull, 1934). The sensorial abilities of our species, like all other species, are simply the consequence of natural selection.

Evolution means, above all, progressive differentiation. Living beings change over the course of time as new structures appear that can co-exist with the old for long periods which in turn might undergo further changes. Consider the remarkable variety of plant life, birds and dinosaurs which has been found over the last two hundred years. Evolution brings about a transformation and an increase in variety, added to which, although not always, there is an increase in complexity. Take, for example, the extraordinary refinement attained by organs such as the eye or the ear over

hundreds of millions of years. Or, another example, the development of the human body, now capable of activities unknown to our ancestors who millions of years ago were learning how to use fire and break the bones of animals to suck out the marrow for nutrition.

Neither natural selection nor chance, nor the wider-scale processes of selection, can affect physiological or ethological systems in isolation, whether they are of the same species or in the transitional phase from one species to another. Even if the gene constitutes a discrete unit, it cannot function in isolation, either separated from the entire genome or cut off from the immediate surroundings of the cell. The exclusive characteristic of life is that it can reproduce itself, if conditions are suitable, and it can assume an enormous variety of forms, as the world surrounding us testifies. Even a crystal can reproduce itself, each identical to the parent crystal. A bacterium, too, has an identical structure to its parent, but over the generations it can change, revealing a complexity that was not present in the crystal; it continues to reproduce, remaining almost identical to itself, while simultaneously evolving.

In his experiments on song birds, Marler discovered that they do not sing the tune of their own species – it is not innate – but rather, they have the innate ability to recognise their own tunes from those species they live with (Marler, 1970). These birds learn to sing selectively, discriminating and favouring the structures sung by their own species. If they are taught short tunes with some variations, it is possible to identify the features of the song that males of a given species will imitate; these attributes vary from one species to another.

Learning the tune constitutes a very clear example of the close interaction between the cultural transmission process of a melody and the innate predisposition of the other. These discoveries led Marler and Gould to speak of ‘learning instincts’ (1987).

The song bird is eager to learn to sing, adopting a particular vocal tradition. It would seem that it is also inclined to embellish what it has learned, improvising and inventing. Such a rich potential of behavioural malleability with a possible genetic basis is conditioned by an innate predisposition. No matter what the consequences of this interaction between genes and culture are, every species has its distinctive song domain. In every domain that constitutes a potential cultural space, the range of variation can be huge; the boundaries for the species define a coherent, possibly complex vocal unit, even though they might change over time within their own cultural space. The ‘song of the species’ is a behavioural umbrella that presents hundreds of variations on a theme. This repertoire of songs forms the nucleus of the system of vocal communication

that controls different types of interaction between sexual partners and territorial rivals. The 'learning instinct' concept suggests that one species can manage to use cultural diversity to its advantage, while simultaneously maintaining a given degree of cultural canalisation.

Evolution means, above all, *developing the capacity to interact with the environment*. It is this which determines the success of a species or its extinction. As Hamilton (1964) argued, organisms develop through continuous interaction with the environment, from the embryonic stage to adulthood, whether self-generated or externally stimulated.

Environmental space is at one with *the tactile sensitivity of the living body* and its movement in context. Researchers have found that the cerebral cortex of superior mammals is generated by a network between functions of perception and motility made up of processes that join neural networks to receptive organs and *Umwelt*. Such a space (exclusively associated with interactive events that connect sensorial receptors to environmental elements) is structured by motility sensory integration which supports learning activities and the exploration of active contexts. Through its movements, the animal creates its own territory of action; the combination between the 'pericorporeal' space and the elements can at any given moment constitute its living environment. In this variable space, the animal lives in its own sensorial world and carries out its own territorial activities (Hall, E.T., 1988:15).

In animals we may observe direction, frequency and extension of behavioural changes that depend on the variation of space available. We could never hope to repeat similar experiments with humans. First of all it is possible to accelerate times with animals, since animal generations are relatively short. In forty years one scientist can observe four hundred and forty generations of mice while over the same period of time he or she will have seen only two generations of man. There is also the fact that since animals do not rationalise their own behaviour, they do not hide the regularity of the results: in their natural condition, they respond in a wonderfully coherent way, thus making the study of repeated and virtually identical actions possible. Limiting observations to the way in which animals use space, the observer can understand a quantity of translatable things in terms of human behaviour.

Territoriality can be defined as the characteristic behaviour with which an organism claims its rights to an area, defending it against his own species. The animal psychologist, Hedigher (1995), teaches us that territoriality guarantees the propagation of the species. It regulates its density, providing patterns in which actions are performed; it identifies strategic hiding places and suitable positions for learning or play; it co-

ordinates group activities and maintains unity; it establishes distances for animal communication regarding the whereabouts of food, or in the case of enemy threats, it raises the alarm. Carpenter, a pioneer in the study of monkeys in their natural habitat, listed thirty two functions of territorialism, among which are those that particularly pertained to the protection and evolution of the species (Carpenter, 1958). Territorialism is also a behavioural system related to spatial changes generated minute by minute by the tactile sensitivity of the body in movement.

Animals are born with not only the capacity to perceive and act, but also to learn and use experience gained in the past to improve behaviour in the present. Association and habit are two recognised forms of behaviour in the animal world, and as far as we know, two of the most diffuse. Learning is not automatically acquired, it is comprised of a series of specific mechanisms, the product of evolution. As we have noted above, the variation of the learning 'toolbox' available to living creatures is particularly evident. Song birds know how to learn: they can distinguish the differences between diverse learning mechanisms and diverse species.

There is less diversification between animal cultures than there is among humans. Although there are several differences between groups of animals (the baboons from the savannah, for example, tend to live in large groups, while those from the high plains congregate in smaller numbers), the complex effects on the life of each animal are more limited. In her research, Jane Goodall (1971), the primatologist, illustrated the complexity of the life of the chimpanzee, demonstrating that the construction of interactive events is central to the social intelligence of this species. She carried out an in-depth analysis of social life both in the family and the group, the communicative strategies within and outside the species, and the cognitive structure in finding solutions to problems. The principal contribution of her research into cognitiveethology and animal bioethics (two inseparably correlated disciplines) was the formulation of the concept of 'animal culture'. Animals, too, demonstrate the capacity to create new procedures that are not simply the outcome of a phylogenetic response of species-specific adaptation. On the contrary, such new procedures are the effect of a very real and singular innovation that emerges at an ontogenetic level. These procedures are later transmitted to the social complex, mediating learning mechanisms that enforce group identity. For example, some chimpanzees learned to use small twigs as a kind of hook to extract termites, a favourite food. Such results bear witness to the fact that chimpanzees are capable of constructing their own tools, hunting with complex team strategies and elaborating a very real local and transmittable culture. Small chimpanzees played amongst themselves with an infinite