Systemics
Voices and paths within complexity[1]

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Introduction[2]

Ludwig Wittgenstein observed in his *Philosophical Investigations* (1953, no. 18) that language "*can be seen as an ancient city: a maze of little streets and squares, of old and new houses, and of houses with additions from various periods; and this surrounded by a multitude of new boroughs with straight, regular streets and uniform houses.*" In our view, this analogy also captures the evolution of the various forms of knowledge (collective, individual, family, cultural, aesthetic, religious, etc.) and scientific knowledge in particular, with its "constructions", interaction with other styles, and landscape. The metaphor of the city thus enables us to imagine the coexistence of new and old buildings, "historical" neighbourhoods inhabited by peaceful, long-established paradigms and busy crossroads where the foundations are being laid for the construction of new edifices, new viewpoints, new ways of understanding the city itself, new ideas. And ideas are born and ripen like fruit on trees. The convergence of different ways of looking at the world leads to the emergence of ideas that are very similar even when they regard distant spheres. These similar ideas multiply, one new metaphor gives birth to others, new ideas are "invented" or simply "picked up" by those capable of recognising and appreciating them. The same ideas are sometimes translated into theories by authors who do not even know one another, are concerned with different subjects and have not travelled the same paths, but are in some way visiting the same city and the same district. Because science is not an independent variable and does not describe trajectories that are defined, consequential and "natural". It is rather an unorganised set of possible pathways, an open system, dependent on the context, the economic, cultural and artistic matrix, the moods and the landscapes that fill the gaze of scientists, providing constraints and new possibilities. Science is an open system closely connected with the events in its context,

[1] This long introduction is the first part of a book which came out in Italy in 2003 by Bollati Boringhieri (*Sistemica, voci e percorsi nella complessità*), a very well known publisher. The book is built as a hypertext and collects 150 words which are core constructs of the complexity and systemic frame. Each word/concept is described by more than one author in order to give information of difference. This project was closely supervised by Heinz von Foerster who is also interviewed in these pages.

[2] Translation by Paul McCalffe. I thank Michele F., good friend and subtle linguist who has checked the translation with attention and care.

influenced by the world outside and responsive to the cultural changes underway and the ideas in circulation. It can be described as a complex social activity, just like the appraisal of knowledge.

If it is true, as Kuhn (1962) argues, that science changes and evolves in terms of paradigms, it is equally true that the ways of knowing nature and mankind are not subject to wholesale replacement. A new city of knowledge is not founded every time there is a revolution. There is rather a change in location, in the relations between the centre and the outskirts, the places that attract visitors and those now deserted, the fashionable haunts and the backwaters. In every city, as in every cultural panorama, there is thus always something new and something old, elements that coexist, coming into contact and collision to generate new configurations and ideas.

It becomes difficult to describe the evolution of ideas and impossible to do full justice to tradition, innovation and the crucial role of chance, just as it is hard to describe the shifting of perspectives or the joy and hope for projects that may now look like attempts or illusions (to describe the birth of the universe or history, to reproduce the processes of the mind, to "create" the mind, to foresee the future evolution of the world or science). For this reason, we shall attempt no more than an outline of what can still be observed in the older neighbourhoods, where the foundations of the buildings – the intentions, assumptions, and models of construction – are now exposed, and then go on to compare them with the new projects, models, and theories. This juxtaposition – the possibility of referring to what has gone before, an understanding of how the "town planning scheme" has evolved – is in fact very important if we are to appreciate the more modern structures, distinguish the innovations, and enjoy their forms.

Our intention here is to address what Foucault described as "mutations" in knowledge, where minimal differences are magnified and amplified, giving rise to ideas and metaphors that bring out aspects of reality built up through the very choice of the metaphors employed and lead to revolutions, not least in the type of question that science asks.

The story presented is not one of constant, linear progression. We shall thus offer various descriptions of the same historical period: one that unfolds diachronically in step with the scientific dialogue and highlights some important phases in its development; one that identifies the different models that have served the scientific community as points for aggregation and the exchange of ideas; and one that puts forward a possible attitude towards knowledge in line with the ideas of Heinz von Foerster. The keywords that we will underline emerge precisely from the pathways mapped out in this introduction.

The greatest problem for any description, be it artistic or scientific, is to set boundaries, to define a beginning, a before and after, a temporal axis. Our description begins arbitrarily with the discontinuity

or watershed of the 20th century born out of a desire to move beyond the previous mechanistic view of knowledge.

As pointed out by the anthropologist and father of complexity Gregory Bateson (1991), there are numerous mechanistic viewpoints, understood as those deriving from the science of Newton and Locke, which became the industrial revolution and then science. While the 19th century can be described summarily as a period dominated by mechanicism and the search for and "discovery" of the laws of nature, it should also be recalled that some inventions and thinkers did not share this view and paved the way for a shift in perspective.

Mechanistic Assumptions

- There is a privileged point of observation that scientists must take as theirs.
- A view of discovery is adopted whereby the laws of nature are to be sought out and identified like mushrooms in a wood.
- The search focuses on laws and regularities as a sort of very large and comprehensive umbrella beneath which to organise knowledge, which is required to offer order and certainties of a timeless and ahistorical character.
- The observer is detached from the process of observation (self-reference being absolutely prohibited.)
- Neutrality is assumed on the part of the observer making observations from a privileged vantage point.
- Knowing is considered an objective process and the same for everyone. The aim is to attain the clarity and generality of a unified perspective.
- Chance is banished and regarded as wastage, thus giving rise to the idea that disorder indicates a high proportion of ignorance and order a process of developing knowledge in greater depth.
- The knowledge process itself is seen as one of accumulation, building up gradually from a state of ignorance to one of certainty. Knowledge is the accumulation of pieces, like the erection of a wall that keeps growing higher.
- The task of science is to describe, explain and predict phenomena by means of inductive operations.
- A rift opens up between the sciences of man and the sciences of nature. Dichotomies and divisions are created between inside and outside, organism and environment.
- A substantial difference is suggested between the physical world and the world of ideas: every law becomes a sort of idealisation. For example, the law of the "pure" motion of a particle or a wave packet becomes a useful abstract model which excludes the world, possible collisions, challenges and peculiarities.
- Attention is focused not on the interaction between parts but on individual isolated trajectories.
- All phenomena are reduced to a single level of explanation, namely the microscopic dimension identified by physics in the basic structure of matter.
- The concept of "truth" is consistent with the mechanistic epistemology and connected with the process of simplification and synthesis.
- The goal is to attain homogeneity rather than plurality. The focus is on order, invariance, stability, uniformity and equilibrium.
- Logical tools are employed and aspects of a personal, subjective and emotional nature are outlawed.

- The experimental method is based on reduction, separation, quantification and repeatability. The laws of the dynamics of trajectories – the basis of positivist science – are reversible, deterministic and conservative.
- Reproducibility, understood as the possibility that the same results can be obtained in a experiment also by other scientists in other laboratories given the necessary coordinates, is regarded as a key element of scientific status. (This postulate was to survive the epistemological revolution intact.)
- Verificationism is regarded as the way to establish the guarantee of a scientific certainty, the truth of a theory.
- Time is regarded as reversible. The movement of a particle from point A to point B is perfectly reversible. The stimulus for movement must come from outside. There are no systems capable of determining their evolution from the inside.
- Time and space are often regarded as eternal and immovable.

The 20th century was an age of great transformations and the evolution of contemporary knowledge is also characterised by multiple changes. Authentic scientific revolutions took place and necessitate the constant revision of traditional disciplines, including those which are most consolidated.

Among the various "innovative" theories, mention can be made of **thermodynamics**[3] (1824), which regards entropy as the yardstick of disorder and challenges the inherent absence of time within the mechanistic view of the universe. Thermodynamics attaches new importance to time and suggests that the universe, understood as a machine, will not be able to function forever but is indeed already running down. Thermodynamics is in any case concerned with systems in or close to equilibrium within an irreversible evolutionary process. It also introduces a macroscopic vision in that entire populations of particles are taken into consideration. (It is no coincidence that the Austrian physicist **L. Boltzmann**, 1844–1906, interpreted an increase in entropy as an increase in disorganisation in addressing the problem of reversibility.)

Let us recall the ideas of **Charles Darwin** (1809–1882), who made use of numerous reductionist assumptions but took the opposite approach as a biologist for species, suggesting that systems change and the forms of complex life originating in simple systems become increasingly organised. As a geologist and palaeontologist, **Teilhard de Chardin** (1881–1955) also had a vision of the world that anticipated systems theory, describing evolution as progress towards greater complexity and growth of consciousness, understood as a specific effect of organised complexity.

We could begin to speak about a ***new science***, about ***new ways of thinking*** that alter the representation of the relations between nature and the human being (what the philosopher Martin Buber (1958) called

[3] This is a discipline that we regard as a precursor of the science of complexity. The 1st law of thermodynamics postulates the conservation of energy. The 2nd law, formulated by Clausius around 1850, states that any isolated system moves towards ever-greater disorder and a state of equilibrium.

the "*human becoming*" so as to highlight its unstoppable evolution) and present a different view of the relationship between the subject and knowledge. We could discuss the hypothesis of a new and non-predictable world capable of expanding innovation, of creation as destruction. But let us try to proceed in order.

Dialogue of Ideas

It was on 14 December 1900, during his study of entropy, that **Max Planck** (1858–1947) formulated the hypothesis that marked the beginning of modern quantum physics, namely that energy is made up of indivisible elements (the elementary quanta of action). In conflict with classical mechanics, his discovery obliged him to address the epistemological problem of the relationship between observer and observed, thus introducing a different view of the world. Planck in this way undermined various cornerstones of positivism, including the independence of the physical world from our knowledge of it and the causal determinism upon which the formulation of the laws of physics rests.

Another important figure is the French mathematician and epistemologist **Henri Poincaré** (1854–1912), who anticipated Einstein's results with respect to special relativity,[4] arguing that we can predict simple facts, or at least those that seem to be such. He suggested the dependency of electrical and optical phenomena on the observer as early as 1901 and put forward the concept of "convenient and inconvenient" (the capacity to permit greater simplicity in organising the relationship between phenomena) to replace that of the "truth" of the conceptual framework of a theory. He suggested in 1895 that the signals received from the senses are not by themselves a sufficient foundation for our ideas of space, objects and forms: sensations are necessary but not sufficient for perception.[5] The necessary element is movement, i.e. the possibility of altering one's sensations by moving one's body and connecting these new sensations with the voluntary movements (a theory then taken up by various psychologists, including Piaget and von Foerster). His reflections on the possibility that even simple physical systems of a deterministic character can display complex, chaotic and irregular behaviour, like aleatory systems that elude all prediction and control, entitle him to be regarded as a precursor of the concept of organisational closure as well as the father of deterministic chaos. The latter was, however, only to be taken up by scientists some 70 years later, probably due to the adverse influence of the reigning epistemology, understood as the predominant view of nature and science.

[4] Certain authors draw also upon this historical episode to argue that Einstein's theory and quantum mechanics marked no real break and that substantial continuity was maintained with the theories of classical physics.

Attention must also be drawn to the work of **Louis de Broglie**, professor of theoretical physics at the University of Paris and winner of the Nobel Prize in 1929, who was one of the first to introduce Niels Bohr's concepts of quantum mechanics, which he applied to the study of x-ray spectra. He laid the foundations of the new wave mechanics with his view of matter as both particle and wave.

Albert Einstein (1879–1955, winner of the Nobel Prize in 1921) published three articles in the *Annalen der Physik* on photons and the electrodynamics of bodies in motion in 1905. These can be regarded as the manifesto of special relativity, which dispenses with the categories of time and space as absolute containers. Time and space depend on the motion of the observer and his system of reference. Einstein challenged the geometric configuration of the world and introduced the observer into the process of observation: the view of the universe differs in relation to the position from which it is observed. He also challenged pure rationality by suggesting in his correspondence with Maurice Solovine that that the scientist must have an attitude of "empathy" with respect to nature as a basis for development of the axioms on which the logical, mathematical and experimental categories rest. He introduced imaginative and emotive qualities "*that are interesting for the spaces they can generate, the type of physical legality to which they can give rise*". The outcome was an epistemological clarification of the consequences of this dethronement of Euclideanism (1921): "*As far as the propositions of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality.*" The very concept of truth began to totter.

Max Born (1882–1970) was awarded the Nobel Prize in 1954 "for his fundamental work in quantum mechanics". In addressing the problem of the relationship between the object observed and the instruments of observation, he suggested that we cannot know what an object is like but only the effects of our observation. Quantum theory marked the end of the Galileian object and emphasised the importance of the observation process and of the measures employed. It also introduced a microscopic world governed by laws of a non-univocal character.

The German physicist **Werner Heisenberg** (1901–1976), who also won the Nobel Prize (1932), put forward the principle of indeterminacy, which states that it is impossible to measure the position and the speed of a particle at the same time and maintain a high degree of accuracy. Every physical measurement disturbs the system to be measured and, as he put it, the changes brought about on the object observed by the instruments of observation must be taken into account in atomic physics. Heisenberg radically challenged the idea of a deterministic natural order independent of the human

[5] This idea was taken up from the writings of Charles Bell (1774–1842) and Johannes Peter Müller (1801–1858). The latter formulated the law of specific nerve energies, stating that sensor nerves transmit no information about external objects.

being and rejected the classical principle of causality, which asserts among other things that given exact knowledge of the present state of an isolated system, it is possible to predict its future state.

Over the same period, in fields apparently far removed from physics, new developments took place of equal importance to the experiments of Planck, Heisenberg and Bohr, incorporating human aspects such as consciousness, intentionality and the subjectivity in their theoretical frameworks and causing the definitive collapse of objectivity and determinism through the introduction of the subject into analysis of the world.

The invention of psychoanalysis and the concept of the unconscious marked an important stage in undermining the predominance of rationality and the necessity/possibility of control over human knowledge. The unconscious, defined as "psychic reality", could not be interpreted by means of the conscious rationality of the western culture of the time. The "deep" motivations of human action do not respond to the logic of conscious reconstructions of events but to the "energetic" logic of drives. Freud thus proposed a broadening of the concept of rationality and a revolution with respect to the dominant culture. The spreading and popularisation of the ideas of Marx (1818–1883) and Nietzsche (1844–1900) on a huge scale was accompanied by what Gianni Vattimo terms the "*school of suspicion*", which posits a further (and ultimate) reality lying beyond consciousness, class relations and scientific and philosophical knowledge.

This period saw interesting changes (connected with the spread of scientific and psychoanalytical theories) also in the field of the arts. Figurative art rejected realism and embarked on attempts to move beyond objective representation of the world. Futurism (with Marinetti), Surrealism (a term coined by Apollinaire), abstract art, Cubism and the Metaphysical painting of De Chirico all developed in quick succession. The novel adopted the "stream of consciousness" as an attempt to reproduce the mental processes theorised by the great psychologist William James, abandoning a rational and external view of the world to focus primarily on subjective experience and the connotative aspects of knowledge. The world became increasingly elusive. It was no longer possible to know the future by knowing the present in that knowing the present was itself considered impossible.

It was in 1931 that the logician **Kurt Gödel** (1906–1978), a pupil of Bertrand Russell, developed a critique of Russell and Whitehead's *Principia Mathematica*, hitherto a point of reference for logic and science, and reduced mathematics entirely to logic. Gödel presented algorithms that made

recursiveness[6] inevitable in science and organised mathematical logic as a computational theory, again emphasising its recursive character. The foundations were thus laid for inductive thinking to take its place alongside the practice of deduction. The pursuit of certainty was abandoned in favour of the challenge of many uncertainties, with the observer fully established as part of the observation process.[7]
Meteorologists, agronomists, anthropologists operatively exemplify the changes in paradigm developed by physicists and mathematicians in that the impossibility of focusing on one variable at a time appears evident in their work. The elements they address are correlated in such a dynamic way that their complexity cannot be avoided.
While science developed primarily in Europe at the beginning of the 20th century, Nazism and World War II caused a shift to the United States, where psychologists, anthropologists, sociologists and economists were involved together with physicists and biologists in the planning and management of the country's human resources. The social sciences grew both in importance and in concrete substance, abandoning the theoretical sphere of the universities for the field of practical application, as necessitated by war and national reconstruction. This permitted and fostered communication between people working in very different fields and made interdisciplinarity possible if not indeed necessary.
The ten **Macy Conferences**[8] held over the seven-year period from 1946 to 1953 constitute a noteworthy event in this connection by virtue of their interdisciplinary character and the opportunities provided for dialogue between figures and fields previously kept at a distance. Funded by the Macy Foundation as a contribution to science and organised by **Frank Fremont-Smith**, its medical director, the conferences involved a number of leading scholars in different areas of the world of science, including Fremont-Smith himself, the neurophysiologist and neuropsychiatrist **Warren McCulloch**, who chaired all the meetings, the mathematicians **Norbert Wiener** and **John von Neumann**, who were involved in designing the computers of the future, the engineers **Julian Bigelow** and **Claude Shannon**, the neurobiologists **Lorente de Nò** and **Arturo Rosenblueth**, the logician **Walter Pitts**, the anthropologists **Gregory Bateson** and **Margaret Mead**, the physicist **Heinz von Foerster** and the economist **Oscar Morgenstern**. While these figures constituted the "core group", other scholars were

[6] Born within mathematical logic, **recursiveness** is understood as the capacity of computation through reflection on the operations carried out. This constituted an introduction of the observer into the realm of observation, something ruled out by Russell e Whitehead as giving rise to paradoxes.
[7] Von Foerster maintains that the theory of logical types was disproved through the pioneering work of three men: the philosopher Gotthard Gunther, who developed a very interesting system of multivalued logic (differing from the logic of Tarsky, Quine and Turquette); the Swedish logician Lais Lofgren, who suggested the idea of "autology" (the application of concepts to themselves); Francisco Varela, who expanded Spencer Brown's "calculus of self reference".

invited to the different meetings in connection with the subjects to be discussed, including the psychoanalyst **L. Kubie**, the psychologist **K. Lewin**, the sociologist **P. Lazarsfeld** and the mathematician **L. Savage**. The proceedings of the last five conferences, the only ones to be published, were edited by Margaret Mead, Heinz von Foerster and Hans Lukas Teuber. Entitled *Feedback Mechanisms and Circular Causal Systems in Biology and the Social Sciences*, the first conference aimed at establishing dialogue between the "hard" sciences (engineering, biology and mathematics) and the behavioural sciences (psychology, psychiatry and the social sciences in general). It was on this occasion that **Wiener** presented his model of control and communication in man and machine, which the participants decided to call "**cybernetics**" (from the Greek Κυβερνήτης, meaning helmsman).

Even though the prevailing spirit of the conferences remained consistent with the mechanistic ideals and the pursuit of a pure scientific language, the interesting aspect of the event lay in the opportunity for scientists far removed in terms of discipline and interests to listen to one another and exchange ideas. Von Foerster described the conferences as the place where he came to understand by experience what interdisciplinarity actually meant.

These were interesting years for the revolution of knowledge, years in which cybernetics, general systems theory, game theory and communication theory made contributions of great importance. It proves difficult to establish which movement influenced which, to assign primacy and pinpoint relations between disciplines. What we are faced with is a revolution in all fields of knowledge brought about by the introduction of a "processual" vision of nature into the scientific world. The construction of a shared, transversal language and the pursuit of a new unity of the sciences began to take shape.

Meeting Points

In order to locate the concepts clearly in their places of origin, we shall draw attention to a number of contexts and groups of markedly interdisciplinary character that catalysed various ideas and stimulated interesting innovations.

- The **Jean Piaget Institute** in Lausanne, where the famous Swiss psychologist examined the forms of cognition in childhood. After numerous experimental studies, Piaget hypothesised a number of fundamental operations in the "construction" of concepts and the attainment of object permanence on the part of children and defined the universal and transcultural character of the construction of human

[8] The Josiah Macy, Jr. Foundation for the development of medical research invited a group of scholars who had already gathered at Princeton in 1944 and established the existence of a basis of common ideas and the need for a shared vocabulary.

knowledge. He described the (rigid) sequence of the evolution of cognitive processes, which follows a pre-established course from the sensorimotor stage (perceptions accompanied by patterns of action) to the formation of symbols and the use of forms of logical-abstract thinking. The theory thus formulated was one focusing on the acquisition of experience (developed by the subject in solitude in its active relationship with the world) rather than the ideas of exclusively symbolic abstract knowledge predominant at the time.

- The **Biological Computer Laboratory** of the University of Illinois at Urbana, operative from 1956 to 1976 and described by its creator and director von Foerster in 1992 as an international centre for research into the physiology, theory, technology and epistemology of cognitive processes, focusing attention on the ways in which all living systems compute their reality. The core group of physicists, neurobiologists, computer scientists and engineers worked with regular guests such as H. Maturana, G. Uribe, W.R. Ashby, G. Pask, L. Lofgren and G. Gunther on studies at the points of intersection between disciplines designed to explore sometimes distant fields. (The Israeli dancer Noa Eshkol also participated in work on movement.)

- the **University of Palo Alto**, California, where a number of figures still renowned in the field of systemic psychotherapy gathered for the first time to develop a research project on schizophrenia. On returning from his anthropological expeditions, **Bateson** (1904–1980) took part in the Macy Conferences and began the studies on the application of the theory of logical types to communication that were then taken up by the Bateson Project (1952–1962). The figures involved during the first two years, with grants from the Rockefeller Foundation, included the ethologists **Konrad Lorenz** and **Nikolaas Timbergen**, the psychiatrist **John Rosen** and the communications expert **Ray Birdwhistell**. With the collaboration of psychologists, social workers and clinicians such as **Jay Haley**, **John Weakland** and **Don D. Jackson** as well as advice from the renowned hypnotherapist **Milton Erickson**, Haley's master and friend, the project identified the double bind as a specific form of communicative conflict deriving from levels of learning and relationship patterns within the family and suggested that it might play a part in the onset of schizophrenia.

The attempt to go beyond a general and generalised framework, the hypothesis of dialogue between "hard" sciences and "social" sciences, and the loss of neutrality and objectivity in observation, all led to considerable changes in theories of knowledge. While this departure from mechanicism took place in different ways and periods for the various disciplines, it always appears to have done so in two phases, one in the first half of the 20th century, following the introduction of relativism by the hard sciences,

and the other more recently as a result of deeper and more mature application of evolutionary and self-referential assumptions.

The Disciplines

These following sections provide a brief outline of the major disciplines characterising the scientific and philosophical world in the twentieth century. Even though we have decided to describe these spheres separately, we wish to stress the connection between these different experiences and hypotheses and the inevitable interpenetration of the different viewpoints. The theories in question are highly structured and present various levels of organisation.

Cybernetics

Introduced in the period around the early 1940s, cybernetics is defined as the ***science of control and communication in the animal and the machine***. It jettisons reference to energy in favour of the flow of information and postulates the universal character of the laws governing control over both organic and inorganic systems. As von Glasersfeld put it, "*Cybernetics is a way of thinking, not a collection of facts*."

Before going on to describe cybernetics in greater depth, we wish to draw attention to three contemporary and related theories, namely field theory, communication theory and game theory. As noted above, the same figures were often involved in the development of different disciplines and approaches at the same time. This shows, in our view, that the disciplines are connected by areas of overlapping and exchange rather than rigidly juxtaposed. It is indeed interesting to note that one of the first scientists to put forward the concept of information as a variable essential to any explanation of how human systems function was **Norbert Wiener**, the father of cybernetics, who insisted on replacing the concepts based on energy with the still to be explored postulates of communication theory. Wiener suggested that the concepts of information and communication theory should be applied to the broader context of biology and the social sciences, and encouraged Bateson in this direction. Like other sciences, engineering had also shifted attention from energy to communication. **McCulloch** considered the science of signals and messages (understood as psycho-biological elements) a useful bridge between the psychology and physiology of mental disturbances. It was precisely these two scholars that provided stimulus for Bateson's future work on the double bind.

Field theory was introduced by Kurt Lewin in the early 1930s as a way of addressing "psychological reality" understood as a dynamic system including both the person and the environment. In this perspective, psychological reality is thus defined as the product of various forces susceptible of constant transformation but nevertheless tending towards equilibrium. Lewin's theory can be considered a successful synthesis of the assumptions of Gestalt theory and early cybernetics. Marking a major stage in epistemology, it develops important reflections on the nature of social interaction, regarding the link between subject and context as indissoluble and seeing behaviour from an integrated viewpoint (a nexus of emotive, cognitive and social factors) as the complex result of relations between various levels. Field theory makes it possible from the clinical standpoint to focus more attention on "contemporaneity" and the factors underpinning behaviour in a precise moment, viewing the future and the past as simultaneous parts of the field. The theory's limitation lies perhaps in its complete adherence to a form of scientific language, the metaphor of the "force field" of physics, which can make the model appear cold and mechanical, like an algebraic sum or a composition of forces and thrusts.
The metaphor of the field has also been used recently by various psychoanalysts (the French couple Madeleine and Willy Baranger, who emigrated to Argentina, as well as Weiss and Sampson) to define a supra-personal situation, a shared context connecting patient and therapist. This view recalls Bateson's conception of the mind.

The founding father of **communication theory** is unquestionably **Claude Shannon**, an electronic engineer who addressed the relaying of information in communication and the relationship between information and entropy by means of a mathematical theory based on probability calculus as applied to imperfectly known systems. Shannon also invented a way of measuring the quantity of information from the source to the destination. **Shannon and Weaver** defined communication in 1949 as the conveying of information through a message from a transmitter to a receiver and put forward a mechanical theory envisaging the passing of information (regarded as a static and immutable element) in a one-way exchange from an active speaker to a passive listener.
Communication theory was anchored for many years to the "realistic" assumption of the relaying of a message that remains unchangeable, like a package or a solid object, in its transfer from one person to another. It was not until the mid-1950s that a two-way model was developed in which the transmitter and receiver are both actively engaged in sending messages to one another, like a game of tennis. Both parties became interacting subjects and attention shifted to the search for a common code.
The theory has since developed to include all of its most recent aspects, including the hypothesis that information is not exchanged in a simple way between two subjects but rather confined to confirming and strengthening already existing information structures. The work of **Henri Atlan** (1972) made it possible to move beyond the rigid dichotomy separating information from noise and studies came to focus no longer on the message but on the listener.
The concept of communication introduced a new gestalt in the analysis of interaction. While continuing adherence to a mechanistic model led initially to a primary focus on manifest communicative behaviour, the "black box" was opened up in time to meaning and hence to the "dance" of reciprocal semantic negotiations and definitions. All the subsequent developments of communication and information theory were to diverge from the initial hypotheses and take shape as the work of individual figures no longer gathered together beneath the banner of a unified theory. The most recent form of communication theory regards the acquisition of information as an operation of computing reality and

in any case opens the door to the study of the world of the mind and representation. (Two theories of information[9] have been used in the last few years, one representational and the other autopoietic[10]). From the exchange of information, communication was then to take on richer significance with the view of humans not as machines that process information but as beings that generate meanings. The function of language was no longer seen as the transmission of information and description of "reality" but rather as the creation of agreement as regards meanings and the coordination of actions between human beings. Language was conceived as the process through which a reality emerges and as a relational dance in which individuals can create one another and help each other to become people of one type or another (Shotter, 1989). Communication thus became what integrates and distinguishes the participation of individuals in groups and communities (Krippendorff,1986).

The third theory we wish to mention is **game theory**, which broke free of mechanistic thinking much later through the new developments of decision theory. Presented by the mathematician **John von Neumann** of the Princeton Institute for Advanced Studies at the first Macy conference as a theory developed together with **Oskar Morgenstern**, and already successfully applied to economics, it uses mathematical procedures and metaphors in the analysis and prediction of behaviour. The possible behavioural solutions are examined in interactive situations with a finite number of moves with respect to a precisely specified objective leading to victory or defeat. It is demonstrated that any finite (zero-sum) game has optimal solutions based on the application of formal rules. In other words, a way is found to identify the moves enabling a player to obtain results superior to all the other options. Born out of concern with the resolution of social conflict, the theory was tried out in various fields such as cooperation, conflict and tension. It was not widely taken up in other fields of study with the above-mentioned exception of decision theory, which currently rests neither on objective logic nor on the application of formal rules.

Wiener presented a model for processes of control and communication in animals and machines developed together with **Arturo Rosenbleuth** at the first Macy Conference in 1947. (His famous book *Cybernetics* was published in 1948.) The circular and retroactive model was put forward as a universal process capable of describing the behaviour of a system.[11]

It should be recalled that **cybernetics**, as it has evolved over time, is not the invention of a single author but the result of a joint effort unprecedented in the field of science. The many figures involved include Wiener, Bigelow, Shannon, McCulloch, Ashby and von Foerster in the field of the hard

[9] The concept of information is understood by Luhman (1989) as a change of internal state, a self-produced aspect deriving from biological curiosity developed through relational exchanges, not as something that exists in the subject's environment and must be sought out and discovered. Information exists in the system as the result of internal and recursive operations. Meaning is therefore not a model or an image, a representation of the world, but rather a new way of addressing complexity, organizing data and constructing frameworks.

[10] An autopoietic machine is a homeostatic mechanism (static to relationships) which has its own organization and defines the relational network as a fundamental invariant (Varela). It means self (auto) production (poiesis), it is a label given by Humberto Maturana and Francisco Varela to indicate the way self organization of a far from equilibrium system manifests itself.

[11] Ampère had already spoken in his *Essai sur la philosophie des sciences* (1843, no. 83) of "*cybernétique*" as the science of government, thus using the term in the same sense as Plato in the dialogue *Gorgias*.

sciences and Margaret Mead, Gregory Bateson, Herbert Brün, Spencer Brown and Gordon Pask in the social sciences.

The crucial importance of the theory lies precisely in having introduced and effectively applied processual logic (the focus being not on static objects but solely on processes and the evolution that occurs in systems and takes shape as patterns of evolutionary interaction[12]) and circularity (understood as an indissoluble relation between the action and feedback of an event[13]), regarded by the authors as the only categories capable of describing the vital and cognitive processes. Even though the initial contributions to cybernetics were of the technological type, i.e. based on the design and construction of "machines" (in **Alan Turing**'s sense) "governed" by circular logic and with marked organisational characteristics, the authors' interests and discussions regarded more general aspects. Their attention was in fact focused on computational machines, the nervous system, the mind and the brain in an attempt to explain the human cognitive processes in mathematical terms and to extend and apply the principles of cybernetics to cognition and hence to other fields of knowledge such as psychiatry, family psychotherapy, management, organisation and economics. Cybernetics examined how systems organise themselves so as to maintain equilibrium, how they reproduce, evolve and learn, addressing all forms of behaviour as long as they are regular, determined and reproducible (mechanistic assumptions). It thus offered and offers a way of scientifically addressing systems in which complexity is at its highest and cannot be ignored.[14] Cybernetics constitutes the perfect terrain for the human and natural sciences to meet in that, as W. Ross Ashby stated, it "*offers the hope of producing effective methods for the study, and control, of systems that are intrinsically extremely complex*.(1956)"

As an example of the circular logic underpinning cybernetics, suffice it to outline the functioning of the thermostat, an extremely simple device apparatus based on twofold feedback. It is feedback that enables the thermostat to regulate itself, ensure its stability and direct its behaviour in accordance with a pre-established goal. The device works on the basis of ***feedforward***, a process of prediction regarding the way to obtain the desired results that leads to goal-directed behaviour, and ***feedbackward***, in which the feedback triggers and organises subsequent behaviour (switching on to keep the air hot or staying off because it is already hot enough).

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[12] Feedback perpetuated over time is identified as a pattern capable of maintaining its stability or fostering evolution towards more complex patterns.

[13] This is the situation in which what happens is the consequence of a previous event but also influences the same in such a way that it proves impossible to determine a simple, linear sequence of before and after.

[14] Cybernetics gave birth to automatic controls and what was latter known as automation as well as robotics (W. McCulloch, S.Papert, J.McCarthy), which was interwoven with the discipline of artificial intelligence.

The key idea of cybernetics was to "close the circle" and bring the output of the machine (the response, in linear terms) back into the computation of the system (seen as input or stimulus). This feedback makes it possible to construct machines capable of oscillating around to defined average values, like the thermostat, and hence to "control" these variables. As von Foerster explained (1985 p. 114–5), the intellectual revolution of (the first) cybernetics lay in combining a machine that was essentially a system guided by a motor with a sensor capable of seeing what the machine did and making corrections to its actions as required when they went astray.

Numerous authors have put forward definitions of cybernetics and those we regard as most significant are listed here. Gregory Bateson describes it as "*the biggest bite out of fruit of the Tree of Knowledge that mankind has taken in the last 2,000 years*"; Jim Rebitzer (1974) as offering access to the world of interaction with complex systems, so as to make them appear simple, and access to apparently simple systems, so as to reveal their complexity; Gordon Pask as a young discipline crossing the interconnected spheres of the natural sciences: the heavens, the earth, animals and plants; Couffignal (1956) as "*l'art d'assurer l'efficacite de l'action*" (the art of ensuring the efficacy of action); Stafford Beer as the science of proper control within any assembly that is treated as an organic whole (1959), as a heuristic that can be applied to any problem.

The introduction of the concept of circularity had great heuristic value and enabled the various authors to imagine biological life and knowledge as based on a circular process whereby problems are decoded by means of the parameters of communication and analysis of relations and feedback. An attempt was therefore made to discover the laws that govern the behaviour of interactive systems. (It was not until later that attention shifted to the laws of self-regulation and self-organisation, processes constituting the principles through which systems grow, attain stability, learn, adapt, structure themselves and evolve.)

As stated above, scientific theories change in relation to the passing of time and changes in technological and social metaphors. Development of the discipline and the evolution of its epistemological implications marked the transition from the first stage – based on the study of systems tending towards equilibrium (focusing on the ontology of systems observed from the outside and conceived as stable entities in which dynamic forces are at work to maintain equilibrium and the status quo) – to what Maruyama called "**the second cybernetics**"(1963). While still observed from the outside, the systems examined were now seen as evolving and attention focused on change and diversification over time, both morphostatic and morphogenetic tendencies (respectively towards stability and evolution), in an attempt to move beyond the confines of an exclusive concern with homeostasis. Interest now shifted to fluctuations susceptible of amplification and capable of altering the

state of the system completely and unpredictably. If speaking about "cybernetics" means referring to the science of control, Heinz von Foerster and Margaret Mead raised the question during the Macy Conferences of what happens when the subject no longer occupies a neutral, external position but is mixed up in the process and the subjective operations of knowledge. They proposed a **cybernetics of cybernetics** or **second-order cybernetics**, which presupposes a different epistemic stance. By introducing the observer into the field of observation, second-order cybernetics seeks to operate recursively on the very operations carried out, performing second-order operations (descriptions of descriptions, thought about thought) and suggests the need to address second-order problems such as dialogue, cognition and attention to social and cultural interaction through social and cultural interaction. Also known as the cybernetics of observing systems, this approach attaches paramount importance to the involvement of the observer in the process of observation and recognises the choices and discriminations leading to the emergence of one particular reality rather than another.

The transition from first-order cybernetics (first and second cybernetics) to second-order cybernetics made it possible to focus attention neither on the system observed nor on the observer taken individually but on the constructive relationship (what Varela would call the mutual specialisation) that emerges from the interaction of the observer and the system observed, on the process of observation and knowledge. Von Foerster expressed the epistemological shift implicit in the inclusion of the speaker in the speech and the observer in the observation process as follows: "*Second-order cybernetics invites you to leave Helmholtz's locus observandi and to step into the dynamic circularity of human give-and-take by becoming part and partner of the universe of discourse and the discourse on the universe.*"

One peculiarity of this approach emerges immediately in the sphere of the study of knowledge: cybernetics suggests that the subject can know only the characteristics of its organisation that its nervous system allows it to know. In other words, it can perceive only such changes in its sensations as it can control through its motor activity (a phenomenon that Piaget, followed by Maturana and Varela, described as "*organisational closure*"(1980)). Understood as superseding the differentiation between product and producer, subject and environment, closure[15] brings out the autonomous characteristics of systems, the essential condition being in fact that the end of the system's domain coincides with its beginning.

[15] The concept of closure led as a natural development to the concept of self-organisation, defined by Maturana and Varela as the capacity of a system to organise autonomously what comes to it by chance from the environment. This idea will be addressed in the following section.

We thus have transition from an initial scientific experience based on the concept of control and the technological definition of circular processes to a new vision of the mental processes and the possibility of investigating them. As Varela put it (1988, p. 267), "*We have been discussing two instances – whether they be cells and the living, or formal systems and un-decidability – where operational closure generates a whole new domain in the apparently harmless act of curling onto itself. At this point, we must take the next step in our examination of the natural history of circularity and explore the next fundamental case where closure changes the picture completely: our own descriptions, our own cognizing*." It was through this shift that cybernetics linked up with the theories of complexity and chaos, which will be discussed below.

The question still remains of the relationship between cybernetics and general systems theory. Some authors claim that each derives from the other, others that systemic ideas were translated into the cybernetic language in the field of engineering over the same period in the 1940s. General systems theory and cybernetics do in fact have numerous points in common and the same authors often contributed to both. What we wish to highlight in this connection is above all the stimulus and the new approach to the problems of knowledge provided by the two disciplines. Krippendorff (1986) maintains that general systems theory refers to a holistic vision and seeks to generalise the structural, behavioural and evolutionary characteristics of living organisms, whereas cybernetics accords priority to an epistemological perspective that considers wholes (sets) susceptible of analysis with no loss of information, like a series of components integrated into their organisation. (Organisation encompasses both the way in which the components of a system interact and how this interaction determines and modifies the structure of the system itself.) Despite its origins in engineering, cybernetics shows no interest in the implications of material form and distinguishes itself from the sciences that are concerned with such aspects, including physics, biology, sociology, engineering and general systems theory itself.

By virtue of its current focus on how organisational systems are regulated, evolve and learn, on how they optimise their organisation, cybernetics could be defined today as the science of effective organization, the art of connecting things so as to obtain the desired result, the art of "processuality" or the discipline of human action (Varela).

General Systems Theory

What was to be called general systems theory (GST) in the 1940s has complex, ramified roots stretching back also to philosophical studies. It was in any case **Ludwig von Bertalanffy** that gave

systematic formulation in the late 1930s to a key theory of the great modern conceptual movement making it possible to address the biological and social sciences on an equal footing with mathematics and physics, and suggested the need to initiate a process for the unification of knowledge through the search for universal laws governing the operation of systems. The author defined this as the science of organisation and totality.

Von Foerster explained in the last interview he granted us before his death how von Bertalanffy started out in Vienna as a physicist working in the field of thermodynamics, which was undergoing great expansion at the time, with the intention of expanding physics into biophysics. Bio-physics did not exist at the time, but he saw the possibility of using the language of thermodynamics as a formalism to talk about theoretical biology. He took as his starting point thermodynamically closed systems that are unusable in biology (systems that have no inflow or outflow of energy, which therefore remains constant), and suggested in 1923 that a thermodynamics of energetically open systems would prove more fruitful. This hypotheses led him to think of GST, namely the possibility of systems being both open and closed in thermodynamic terms. The aim of GST was not to divide things, not to consider them separately, but to connect them with one another and consider their relationship and harmony, as in a choir.

The systemic approach puts forward an innovative conceptual framework in that it involves no breakdown of the objects of study but rather consideration of their relations with the context and a focus on the interconnection of integrated and complex dynamics, with deeper and broader examination of their circularity. It also suggests a view of the world that leaves the elements considered intact but changes the way in which they are assembled and hence their analysis. In an attempt to create an integrated interdisciplinary language capable of moving beyond the "ill-considered" specialisation and fragmentation of scientific knowledge, GST takes into account the contributions of cybernetics, mathematical set theory, Gestalt psychology and the information theory of Shannon and Weaver. Its object of study is in fact the logical-mathematical formulation of principles that are valid for systems in general. In its attempt to create a language capable of reuniting the different fields of knowledge, it established a complex relationship with philosophical traditions of long and ramified development while also picking up various cultural stimuli and echoes from areas like German historicism, Gestalt psychology and the philosophy of Husserl, Heidegger and Merlau-Ponty, as noted by Rossimonti and Vitale (1980). As the authors point out (p. 114), "*Bertalanffy's work constitutes one of the most determined attempts made by biological science in the first half of this century to supersede the conflict*

between mechanicism and vitalism by developing an organismic conception of the living being in which the central importance attaches to the idea of the (open) system."

GST considers the customary constructs of science and philosophy but assembles them in a different way, focusing attention on patterns of connections between elements and relations within a whole. It endeavours to see the wood as an ensemble of trees and considers the interdependence of events in a search for coherence and harmony.

As Accame points out (2002), the scholarly term "system" has come down to us practically unchanged in meaning since the Greeks. Leibnitz defined it in 1666 as a whole of parts and the linguist Saussure in 1922 as an organised totality made up of joint elements that can be only defined in connection with one another, in relation to their positioning within this totality, thus highlighting the organisational aspect. Von Bertalanffy (1950) and Rapaport (1969) also put forward classic definitions of the system, respectively as a set of reciprocally interacting units and a whole that functions as a whole on the basis of its constituent elements.

The universe is not regarded as the sum of separate objects but as an organisation and interrelation of elements that are identified in systems of different magnitude containing one another like nested Russian dolls in a layered world, moving from the very large to the infinitesimal[16] (or vice versa). The classical functionalist view put forward by figures such as the sociologist Talcott Parsons is indeed of a world neatly divided into systems, subsystems and supra-systems, which are regarded as structures given *a priori* (the individual, the couple, the family, the extended society, etc.).[17] It was not until the 1980s that this order was undermined. As a result of the introduction of the observer into the process of observation, the conception (and reification) of systems as static and orderly gave way to one whereby a system is whatever an observer chooses to regard as such and sees in relation to a background. The world is no longer neatly divided and the observer decides what is to be system and what background.

The sociologist and epistemologist **Edgar Morin** highlighted the shift from a reductionist viewpoint to the new model taking into account the relationship between parts as follows (1977, p. 128): "*All the key objects of physics, biology, sociology and astronomy, atoms, molecules, cells, organisms, societies, stars and galaxies, are systems, outside of which there is only the scattering of particles. Our world is an archipelago of systems in the ocean of disorder. Everything that was object has become system.*

[16] Miller (1965) suggests a hierarchical ordering of all living systems on eight levels proceeding from the cellular to the supranational by way of organisms, groups, organisations, communities and societies.

[17] Consistent with this approach is Koestler's concept of the holon (1970). Like the Roman god Janus, every holon or system tends to behave both as a whole and as a part of a larger system. A group can be regarded both as a whole, by virtue

Even everything that was an elementary unit, including and indeed above all the atom, has become system. [...] And so life is a system of systems of systems [...] Nature is a polysystemic whole. It will be necessary to consider all the implications of this idea." He defined a system as a "global unit organised in interactions between elements, actions and individuals".

A system is defined as a complex of elements interacting with one another, and importance is attached not so much to the elements themselves as to the relations and the operations between them. The metaphor used to describe biological organisms and social organisations focused initially on their open character, regarding them as capable of exchanging matter, information and energy with the environment in order to maintain their level of organisation, overcome the decay of time and move towards greater complexity.[18] Some of the key characteristics are outlined below.

- Equifinality is identified as a characteristic peculiar to biological organisms and systems, in the sense that every event witnessed in the present is not organised by a single *a priori* cause but by possible concomitant causes, some of which are amplified by "virtuous" or "vicious" circular reactions according to the circumstances. In other words, it is possible to arrive at the same event from different starting points and the same starting point can lead to different results. The present is not considered sufficient to explain the future, as singular and unrepeatable events capable of altering the overall course of events take place every moment. Necessity is therefore always and in any case constructed *a posteriori*.

- The focus is on non-linearity, i.e. the inadequacy of any linear and cumulative reconstruction simplifying the description of the facts; the constant presence of new and constitutive relations between different aspects of reality; the possibility of non-linear and non-simple descriptions capable of accommodating chance, the unpredictable and the unexpected.

- Importance is attached to circularity,[19] the relationship between parts, elements and patterns; the possibility of thinking in terms of processes (not structures) and of dynamic (not static) units.

- The goal becomes to construct a theory independent both of holistic approaches (which attach more importance to the whole than analysis of the individual parts) and of atomistic approaches (which reduce everything to analysis of the sum of the parts) so as to regard the measure of the whole as

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of its characteristics of autonomy, and as a collection of individuals. This was an early attempt to address systems not as determined *a priori* in a static and univocal way but in relation to other systems.

[18] Closed systems, those that exchange no material or information with their environment, can be indentified in the physical machines of classical science.

[19] Von Foerster (1982) describes circularity as what links eigenvalues and eigenfunctions in mathematics, self-reference in logic, autopoiesis in biology and sociology, the theory of dissipative systems in physics and chemistry, and performative phrases in linguistics.

simultaneously greater and lesser than the sum of the measures of the parts: greater due to the emergence of new characteristics and possibilities; lesser because only one of the possible forms of organisation comes into being.[20] The system as a whole has in fact properties that cannot be attributed to its individual elements.

- For GST as previously for cybernetics, crucial importance attaches to context as a real or figurative place conferring significance on every action and communication in a perspective involving no division between observer and observed and no separation of the system from the environment.

Systems theory, cybernetics and the other theories of the period were in danger of remaining marginal aspects of positivism until the 1970s because they all used the language of mathematics and logic as their primary tools in the process of knowing and shared an orthodox scientific attitude.[21] This rigid mathematical formulation of systems theory is perhaps the one best known both in its theoretical definition and for the practical implications of application to family therapy in the 1960s (what was known as the elementary pragmatic model). This formulation is the one most often referred to by clinicians and theorists, above all in drawing attention to its limitations.

As regards the spread of GST in the field of the social sciences, attention should also be drawn to the contribution of the anthropologist **Gregory Bateson**, the husband of Margaret Mead, who played a key role in relations between von Bertalanffy's ideas, phenomenologists and clinicians. A brilliant populariser and disseminator of ideas, Bateson was not directly concerned with the concept of the system but applied the systemic approach in studies. His interests regarded communication, clinical medicine, play, language and ecology as regards both humans and animals. Launched in 1952, his Bateson Project was an interdisciplinary study group funded by the Rockefeller Foundation (1952–54) that addressed the problem of the classification of behaviour (and the sciences) by applying the theory of logical types to communication. In later years, with funding from the Macy Foundation, he worked with Jackson, Weakland and Haley on schizophrenia and developed the theory of the double bind as well as systemic-cybernetic framework in articles like *Toward a Theory of Schizophrenia* (1956) and *The Group Dynamics of Schizophrenia* (1960).

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[20] The systems theorist Gordon Pask, who worked in London on the application of GST and cybernetics to organisation, called this Super Additive Composition. Formulations like "*the whole is greater than the sum of the parts*" used to infuriate him and he called those using them crazy and ignorant. The definition given in the text is the one he considered correct.

[21] A clear example is provided by the book *Pragmatics of Human Communication* (Watzlawick et al., 1967), a systemic work of importance in the clinical sphere due to its application of the new theories of human communication and a cornerstone of the relational approach. While highly advanced in terms of the authors referred to and quoted, it is restricted by the dominant behaviourist approach as regards content. It eschews examination of personal meanings, uses the black box to avoid any investigation of semantic aspects and adopts a single temporal dimension in the here and now. While the intentions are good, the words needed to put the theory into practice are apparently lacking.

An Outline of Bateson's Ideas (in collaboration with Giovanni Madonna)

- There is a dividing line between the worlds of living and non-living beings, which Bateson referred to respectively as *creatura* and *pleroma*, gnostic terms borrowed from Jung. *Pleroma* is the material universe, characterised by the regularities described by the physical sciences, in which the "cause" of an event can be a collision or a force exerted on one part to the system by another. *Creatura* is the universe of ideas, the biological and social sphere (necessarily embodied in material forms subject to the physical laws of causality), in which the "cause" of an event can be a *difference* detected in the relationship between two parts or a *difference* detected in the relationship between one part at instant 1 and the same part at instant 2, i.e. a *change*. Human knowledge of pleroma is wholly mediated by the creatural processes of response to difference or change.
- Perception operates solely on *difference* and the perception of difference is always limited by a threshold. Receiving *information* always and necessarily means receiving *information about a difference*, which is what leads to the mapping of a certain *territory* (something possible only in creatura). Perception of a difference is the transformation of a difference latent or implicit in the territory into an event within the percipient system subsequent to the crossing of a threshold. In other words, it is a difference that generates a difference, and is synonymous with information.
- Connected with entropy and negative entropy, information reduces the levels of uncertainty inside the system. Information is processed by a self-correcting system that extends beyond the boundaries of the individual and is connected with interactive processes. (See Bateson, 1972, p. 349: "Consider a man felling a tree with an axe. Each stroke of the axe is modified or corrected, according to the shape of the cut face of the tree left by the previous stroke. This self-corrective (i.e., mental) process is brought about by a total system, tree-eyes-brain-muscles-axe-stroke-tree: and it is this total system that has characteristics of immanent mind [...]. But this is not how the average Occidental sees the event sequence of tree-felling. He says, 'I cut down the tree,' and he even believes that there is a delimited agent, the 'self,' which performed a delimited 'purposive' action upon a delimited object.")
- The criteria for the identification of "mind" are listed as follows (1979, p. 126): "1. Mind is an aggregate of interacting parts or components. 2. The interaction between parts of mind is triggered by difference. 3. Mental process requires collateral energy. 4. Mental process requires circular (or more complex) chains of determination. 5. In mental process the effects of difference are to be regarded as transforms (that is, coded versions) of the difference which preceded them. 6. The description and classification of these processes of transformation discloses a hierarchy of logical types immanent in the phenomena." M.C. Bateson proposed as a seventh criterion that in mental processes information must be distributed in a non-uniform way between the interacting parts (1987, p. 134). Mind is therefore not enclosed within the limits of the individual and is the result of interaction between a number of recursively interconnected units.
- Individual and environment co-evolve and influence one another. This interaction between organism and environment cannot be overlooked.
- Human nature is socially constructed and the assembly of living beings becomes a very important context for the acquisition of meaning.
- With respect to human beings, attention is not paid to intrapsychic forces; concepts such as "character", "quality", "defect" are recombined to account for the relations in which they emerge.
- The organic unity of behaviour is not divided into categories; the parts of a whole and the participants in interaction are placed in relation to one another.
- The descriptive language of traditional science is grounded on phenotypic description, which helps to pinpoint differences and identify categories, i.e. to classify. When living beings are described, genotypic description, which focuses instead on relations and helps to establish connections, is more

suitable because it prompts awareness of our integration into the ecosystem and is less imprecise because of its greater respect for and harmony with biological communication. (The organisation of living organisms has the nature of a message and is propagated inside every organism and between different organisms.)
- The system of relations within an organism, which acts as the basis for its communication either internally or with other organisms, is the *pattern that connects* all living beings, the biological foundation of life. What all living beings have in common is the fact that in order to know, they need a process to decode information from the outside world and a punctuation of the sequence of events.
- Genotypic description is therefore biological thought, thinking as nature thinks, i.e. *thinking in stories*.
- A *story* is a pattern that unfolds in time and *connects* its characters in a *context* that gives meaning to what happens. The events of a story must be relevant to one another. *Relevance* is a kind of connection in virtue of which what happens after must be based on what happened before. It imposes contextual constraints and therefore confers meaning.
- The context is the physical situation in which people communicate and, at the same time, the dance of meaning that emerges from interaction. The individual acquires meaning in interaction with the context.
- *Deutero-learning* (learning to learn) is learning how to expect and deal with a certain type of context for adaptive action. The assumptions acquired at the level of deuteron-learning are very firmly rooted because they are self-validating and guide individuals.
- *Double description* (one example of which is binocular vision) is a method of study and a way to communicate that helps to attain deeper awareness, to be less attached to one's convictions and assumptions, and therefore also more tolerant.

As we shall see, the systemic revolution that began in the 1940s and is still underway has involved numerous disciplines and fields of knowledge, albeit in successive phases, suggesting a variety of pathways and bringing out particular key words and procedures for each. The ideas of von Bertalanffy, Bateson and others have been used with many shades of meaning in different historical periods as a series of operative assumptions taking on a variety of senses in relation to the time, the context and the disciplines to which they have been applied. It almost appears that Bateson's systemic ideas are better understood and appreciated more deeply in recent years.

As we described the evolution of cybernetics in a number of phases, we can also identify evolution in the way of understanding systems. It is possible to identify a movement that observes systems "from the outside" (the model of **observed systems**) and focuses on systems in equilibrium (homeostatic systems considered in a state of dynamic equilibrium) and mechanisms for maintenance of the status quo (the **homeostatic model**[22] associated with the first cybernetics). The insights of Wiener and Bertalanffy were taken up by Magorah Maruyama (1963), who attached great importance to evolving

[22] It was in the 1940s that Ross Ashby (1956) constructed his Homeostat. Homeostasis is the capacity of a system to maintain its internal equilibrium while embarking on various processes of change.

biological and social systems and gave rise to a movement focusing on an **evolutionary paradigm** (similar and connected to second cybernetics) based on the assumption that no living system can be considered permanently stable and that it is necessary to take into account the possibility of change, evolution (in jumps) and the development of new forms. It was **Ervin Laszlo** (1972) that laid greater stress on the evolution of systems,[23] introducing and developing studies on how the organisation of systems evolves and proposing a shift of the same type as the one from first-order to second-order cybernetics with the introduction of what von Foerster was to call **observing systems** (which include the observer).

Our purpose in describing the latest developments and introducing the concept of **self-organisation** is to highlight the branch of systems theory that abandoned the mechanistic model and drew upon the ideas of Bateson and von Foerster to open the doors to **systemics**, with a new focus on concepts such as adaptation, evolution, learning, multiple equilibrium, emergence, complexity, unpredictability and chaotic systems. The concept of self-organisation: 1. puts the emphasis on structure, adaptation and dynamic equilibrium characterizing the initial forms of GST and cybernetics; 2. entails abandonment of the usual view of systems as organised by a goal, involved in an instructive relationship with the environment, and inevitably connected with the external world; 3. introduces the hypothesis that there is no transfer of information from one person to another but rather that every system is organised by its assumptions and prepared to admit only information consistent with its form of organisation. The first step in this direction was the one described by Maturana of distinguishing self-referential systems – which can, as living systems, be characterised only in relation to themselves – from systems that must be characterised in relationship to a context.

Erich Jantsch regards the **model of self-organisation**[24] as an emergent and unifying systemic paradigm that sheds unexpected light on the phenomenon of evolution in that it makes it possible to develop a viewpoint based on the interconnection of natural dynamics at all the levels of the evolution of systems (both micro and macro). Attention had previously focused on the unitary organisation of the living system (the individual as member of a species) and there was no theory to explain the "new". According to Jantsch (1980, p. 6), this new understanding can be characterised as process-oriented and contrasts with the emphasis given to the solid components of systems and the structures composed of them. The emphasis is on becoming and even the being appears in dynamic systems as an aspect of

[23] The process of creating new organisations in interaction (structural coupling) with a constantly changing environment is described as morphogenetic. The morphogenesis of a system can prove adaptive or destructive.

becoming. The very idea of a system is no longer linked to a specific spatial or spatiotemporal structure or to a configuration of particular components undergoing change.

As regards biological and social systems, the tendency is to describe them as *thermodynamically open* and *organisationally closed*, i.e. as systems open to the exchange of energy but closed to such new elements as might endanger their identity; systems whose behaviour depends on their inner structure. These systems are active and autonomous in that they are actively concerned with maintaining their self-developing organisation over time through behaviour based on rules that are not externally defined. These are systems that take all the stimuli of the environment, all the possible perturbations, and select those that are admissible and those that are not. Some stimuli are incorporated and others ignored so as to respect their inner structure (and avoid their destruction). They are also defined as **autopoietic**,[25] i.e. capable of giving themselves their name and characteristics on their own, of creating new elements from within through the emergence of a new organisational-psychological-social form that cannot be predicted *a priori* but only retroactively. This is how the self-regulation of cybernetics gave way to the self-production involved in the concept of autopoiesis.

Francisco Varela, Umberto Maturana and **Gabriela Uribe** (San Diego School of Biology and Thinking, 1974) highlighted self-organisation and autopoiesis as the peculiar characteristics of living beings.[26] Maturana described the concept of autopoiesis as a name with no history and hence no risk of association with pre-established semantic implications, and suitable for this very reason to indicate what happens in the dynamics of the autonomy of living systems. The authors put forward a general theory of knowledge that is also a theory of life, in that cognition is considered the prerequisite for the existence of living organisms, the *sine qua non* of their physical existence. Autopoiesis is presented as the characteristic of living systems to renew themselves continuously and organise this process so as to maintain their integrity. Maturana regards living systems as determined not by the external environment but by their nervous system and hence their structure.[27] In other words, the changes

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[24] The first interdisciplinary conference on self-organised systems was held in 1959 by the Information System Branch of the Office of Naval Research and the Illinois Institute of Technology.

[25] Stafford Beer defined autopoiesis as a specific case of homeostasis in which the critical variable of the system kept stable is its organisation.

[26] Constantly associated for years, Maturana and Varela, now appear to have drawn apart in terms of theoretical vision and fields of investigation.

[27] Composite systems can be considered in terms of their organisation and structure, the former being understood as the series of relations between components defining that particular composite unit with respect to others. (For example, if a chair is to be regarded as such rather than as a stool, it must have four legs and a back.) Structure is instead defined as the set of components and effective relations that make a system the particular system it is. (The structure of the chair is the set of variables – whether it is wooden, metal, padded, coloured, etc. – that can change without in any case affecting its identity as a chair.) The distinction between structure and organisation makes it possible to think in terms of a fixed nucleus of

subsequent to interaction are determined by the system's inner structure, which specifies which patterns are meaningful, which are possible and which are meaningless. It follows from this that instructive interaction between two people is impossible. In other words, communication does not move like liquid in a pipe; one party can only disturb the other, who will respond in accordance with his structure, understood as his history, values, developed system of meaning, rules, relations and so on. Maturana's ontological biology takes the discourse initiated by Bateson to extremes. For Bateson, there is an external world that is always and necessarily filtered through subjective lenses; for Maturana, the nervous system functions as a closed system (a self-contained and self-referential unit) and contains no codified representations of the environment. According to the theory of autopoiesis, the biological function that guides the living being is cognition. Thinking and living become the same thing in that it is through the process of knowing – through "languaging", a process of coordinating action and nominalising through linguistic action – that the system causes a world to emerge. According to the authors, biological evolution permits a dual domain of possibilities, both biological and socio-linguistic, which intersect ontologically but must be examined as independent factors. As Carmagnola (1999) points out, this is not a theory of social relations but a biological and physical basis to address social interaction.

While Maturana and Varela were primarily concerned with human systems, **Niklas Luhmann** applied the theory of autopoietic systems to the sociological sphere in 1990, regarding social systems as systems based on the idea of sense and consisting of the linguistic acts performed in them, and hence as constructed on the basis of self-referring relations that use communication.

Systems appear to display new characteristics. Attention has shifted from the exchange of information, the focal point of cybernetics, to the ability of systems to evolve towards levels of more complex organisation and to build new order out of chaos and disorder. It is no longer possible to discover a general law predicting the future behaviour of the system in the case of systems far from equilibrium. According to **Ilya Prigogine** (1967),[28] every system far away from thermodynamic equilibrium includes constantly fluctuating subsystems. A single fluctuation or group of fluctuations can sometimes

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relations and a set of constantly changing possibilities, in that organisation involves a class of relations that can manifest themselves through various possible structures (Varela).

[28] Together with his group in Brussels and the University of Texas, Ilya Prigogine won the Nobel Prize in 1977 for his application of the second law of thermodynamics to open systems, for which the possibility of change, fluctuation and greater complexity was suggested. His contribution altered the paradigm of thermodynamics and challenged the second law, thus making it possible to study systems in conditions far from equilibrium and highlighting the characteristics of self-organising systems. Prigogine put forward a holistic view of the universe and can be regarded as reintroducing time and history in processes far from equilibrium: time appears to acquire an arrow and nature a history. The reintroduction of time, a pluralistic world, dissipative structures and bifurcation points are concepts addressed in this text.

become so powerful (as a result of positive feedback) as to plunge the previous organisation into a state of crisis and lead to drastic changes in which the system can evolve towards chaos or higher levels of organisation. We are dealing in such cases with bifurcation points, emergences, moments in which it becomes impossible to determine the direction of change. In other words, it is impossible to predict whether the system will enter a state of chaos or organise itself in a more complex form of order. Some systems far from equilibrium are described as dissipative,[29] in the sense that while requiring a great deal of energy for the purpose of transformation, they can attain more complex organisation through their fluctuations. This theory bears out the hypothesis that order and organisation can be born spontaneously out of disorder and chaos through a process of self-organisation (order out of noise, order out of disorder, as theorized by von Foerster and others). It also confirms the possibility of organised behaviour emerging in the system even in the absence of a plan, solely as a result of the feedbacks underway.

In a self-organisational perspective, interest focuses on the possible relations between systems and the environment (systems in equilibrium with the environment, close to equilibrium and far from equilibrium[30]). The history of the interaction between a system and its environment (or medium) becomes a history of mutual adaptation, the history of the structural coupling between the two. Structural coupling with the environment is the phenomenon that underscores and effectively constitutes what is called cognition, in that being coupled with the medium means behaving intelligently.

There is thus a change in the concept of adaptation, traditionally regarded in a Darwinian perspective as the organism's progressive response to the requirements of the environment through structural change aimed at optimising its exploitation. Now instead, the environment becomes a disturbing element that facilitates or fails to facilitate an ineluctable evolution of the system, which takes place through successive differentiations on the basis of the redundancy with which the system is endowed. (The more a system interacts with the environment, the more we can assume that it is endowed with differentiation of its internal structure.) For Maturana and Varela (1984, p. 104), "*Evolution occurs as a phenomenon of structural drift under ongoing phylogenetic selection. In that phenomenon there is no program or optimization of the use of the individual, but only conservation of adaptation and autopoiesis. It is a process in which organism and individual remain in a continuous structural*

[29] A dissipative structure is a new form of organisation that emerges spontaneously when a system is pushed beyond its point of equilibrium.

[30] Systems very sensitive to the outside in which reorganisation takes place through very small perturbations that can be expanded into very large changes through fluctuations and amplifications of feedback.

coupling." The authors highlight the reciprocal determination of system and environment whereby evolution becomes a process of conservation of autonomy and the survival of the fit (not the fittest, as some erroneously suggest that Darwin claimed). From the internal viewpoint of the system, it is no longer relevant to speak of instructive information from the environment or of disorder, noise, transformations and evolution. The internal viewpoint is the viewpoint of the autonomy of the system, of closure and the maintenance of identity through the maintenance of organisation. The external viewpoint is the viewpoint in which the problem arises of the integration of the system into a meta-system, the problem of transformation and evolution.

Ernst von Glasersfeld (1977) takes the same approach, defining adaptation as adequacy and coherence between the system and the medium in total respect for their mutual autonomy. The environment loses its instructive character and is no longer believed to influence the system directly: "*From the organism's point of view, on the biological level as on the cognitive one, the environment is no more and no less than the sum of constraints within which the organism can operate. The organism's activities and operations are successful when they are not impeded or foiled by constraints, i.e., when they are viable. Hence it is only when actions or operations fail that one can speak of "contact" with the environment, but not when they succeed*."

It is possible to regard the systemic metaphor increasingly as a way of thinking and an epistemological stance that entails connecting spheres previously considered incommensurable and taking their processual and evolutionary aspects into account.[31] In any case, it always involves subjective choice on the part of the observer, choice that is very poor and very rich at the same time. As Morin tells us (19877, it is poor to perceive the human only as a system, but rich and useful to regard it also as a system.

Pathways of Evolution

While modern evolutionary biology has seen a whole succession of different models, the aspect we wish to stress here does not regard one single idea or theory. What has taken shape over the last few years is the possibility of combining various theories defined and described in terms of irreconcilable dualities such as continuity and discontinuity, stability and change. The new approach put forward by

[31] The family therapist Minuchin (personal communication), who identifies with the sistemic paradigm, points out that the language of cybernetics is very obviously impoverished, excluding the sweat, tears, sorrow, hopes, confusion, ambiguity, boredom, passion and fatigue that characterise human encounters. The world of systemics is a world of ideas, which are are organised on different levels. They have to do with ideal typologies and can come into conflict and be eliminated with no bloodshed, unlike people.

Gregory Bateson consists precisely in reformulating these conceptual dichotomies within broader ecological conceptions of a unified nature, so that they are no longer considered in terms of opposition but contextualised inside a "connecting structure". Modern evolutionary biology presents itself as a meeting place for these "eternal" polarities and seeks possible "borderlands" in which forms and concepts arise and dissolve, processes crystallise and evolve. The theory of punctuated equilibrium developed by **Niles Eldredge** and **Stephen Jay Gould** in 1972 was one of the first to succeed in reorganising the dichotomy of stability and change. According to the authors, the life of a species is not characterised exclusively by a process of gradual transformation of single characters but also by the alternation of long periods of stability and short periods of rapid transformation. This theory challenged the image of change put forward by the Darwinian theories.

Eldredge and Gould suggest that the rise of a new species derives not only from gradual genetic transformation (the Darwinian view) but also from discontinuity and accelerated branching in a peripheral population. The theory of punctuated equilibrium saw considerable development during the 1970s in the works of M. Ghiselin (1981) and D. Hull (1974), who put forward a view of species as homeostatic systems, tending towards stability but capable of sudden, episodic and localised changes. White described a great variety of processes for the birth of new species (allopatric, sympatric, parapatric, chromosomal, asexual and other kinds of speciation) in which evolutionary change emerges from basic stability and not as the "obvious" conclusion of a linear process made up of various steps all leading in the same direction.

The theory of punctuated equilibrium led to modification of the principle of causality in the explanation of evolution and reappraisal of the role of chance as a factor of change alongside natural selection.

We would also attach great importance to the hierarchical theory of evolution of **Richard C. Lewontin** and **Elisabeth Vrba**, which regards not only organisms but also genes and species as subject to selection. Instead of a theory of monotone selection, it is possible to discern "complex" selection related to the relationship between levels (macro-evolutionary, meso-evolutionary and micro-evolutionary) in a sort of mosaic-like process. It is possible in this way to speak of *adaptation* in the strict sense when selection acts by effectively fixing a character for its final function, and of ***aptation***[32] when selection acts by fixing a character regardless of its present or future function. These theories

[32] As we say further aptation is a characters formed for a specific reason and then "fortunately" available for the selection of another function.

have shown the extreme variability of genetic evolution and of species, thus filling in the gaps of Darwinian theory as regards "intermediate structures" such as a rudimentary eye or form of camouflage.

Darwin had already realised that teleological hypotheses – like the view of a rudimentary eye as a bridge towards perfectly structured future forms – were not valid for intermediate structures. It was for this very reason that he put forward the theory of pre-adaptation, according to which parts of the organism serving some ancestral function are readapted in line with momentary (opportunistic) requirements for new functions. Gould and Vrba used the term "aptations" in 1982 for characters formed for a specific reason and then "fortunately" available for the selection of another function. From this point of view, not all the cases in which there is a substantial change of function are attributable to processes of adaptation. There are also exaptations, in which a rudimentary trait can be used for new and unsuspected functions.

As a result of these new theories, evolution is seen not as the realm of necessity but rather as the unforeseeable result of contingent processes. A finalistic and predefined perspective has thus given way to a rhapsodic image in which the evolution of species looks less like a plan with a specific goal and more like a harlequin's cape made up of patches of variously coloured materials originally used for different garments. This change in perspective has led to reformulation of the hypotheses of development and a view of organisms and their environmental niches as (indivisible) co-evolutionary subjects forming an integrated system of development.

A living being is thus no longer described as a sum of traits and passive subject of selection but as an autonomous and active entity that contributes to the creation of contexts and their possible developments or evolution. The dichotomous categories of internal and external no longer describe the processes of evolution and selection; it instead proves necessary to address the ecological dynamics of constraint and possibility, where the constraints of the environment do not only constitute limits but also become possibilities of change and unexpected trajectories. Evolution can thus be described, to quote Cerruti and Pievani (1998), as "a labyrinth of forking histories" in which every change follows a form of "evolutionary contingency" and cannot be defined *a priori*.

Chance and **disorder** become central aspects of knowledge and take part in the construction of hypotheses, eliminating predictability as the bedrock characteristic. No system can justify its state when taken at a particular moment without reference to its ***history*** and hence a retracing of the process leading up to the present. It is therefore necessary to introduce ***time or times***, understood as histories

connected with the evolution of the system. Crucial importance attaches to the development of the system, the processes leading up to its present state rather than analysis of that state as static and final.
The concept of circularity gives way to recursivity, defined as the ability of a system to raise questions about its descriptions, thus giving rise to an endless process of descriptions and descriptions of descriptions.
The most up-to-date definition we can supply of "system" is a series of interacting elements chosen by an observer as a figure, an entity made up of components that an observer distinguishes from what does not belong to the system, from its background. This definition underscores that systems have no *a priori* existence in nature: it is the observer that maps the boundaries of a system and constructs it, albeit with the obligation of then explaining the distinctions drawn in its construction and obtaining social agreement on the same. An individual is also therefore a cybernetic system that can be considered in terms of its recursive, self-adjusting organisation and that acquires stability through a process of change. A group of heterogeneous people who semantically share a definition or a problem can also be regarded as a system.[33]

The Paradigm of Complexity

The various models presented above are the direct expression of the culture originating in the physical and biological sciences, theories choosing to employ the formal language of mathematics at the initial risk of a return to reductionist operations.
One interesting formal model that did not originate in physics and takes advantage of the innovations introduced by cybernetics and systems theory without taking up the language of the "exact sciences" is the one of sociological derivation focusing attention on **complexity**. This puts forward a different approach to knowledge and definitively undermines the mechanistic model. It abandons the illusion of possible generalization and regards every theory as "local", shifting attention from the systemic theories and their search for a transversal and universal language and definition of knowledge to perspectives capable of accounting for the variety of viewpoints and the many possible definitions of the same object, thus teaching us to distrust unambiguous and linear explanations. As **Edgar Morin**

[33] Interest attaches to the transition in clinical practice from regarding problems as engendered by the system in which they manifest themselves (the system determines the problem) to a focus of semantic sharing, whereby those sharing a definition or problem are regarded as a system with respect to a background (the system determined by the problem) (Anderson Goolishian 1988).

(1977,1983,1985) puts it, complexity presents itself as difficulty and uncertainty rather than clarity and an answer. Attention thus focuses primarily on the variety of views and definitions.

In this perspective, every hypothesis is defined by the model of reference chosen, the template of coding and decoding used, and the historical and social context in which events are seen. Every point of view is considered partial, only part of the truth. The complementary nature of descriptions and the composition of knowledge are put forward as possible ways to "approach" the complexity of the real world. There is more than just one universe to be known, hence the introduction of concepts such as **multiverse, pluriverse** and **polyphony**, and the abandonment of simplified, univocal accounts of events. We are reminded of Bateson and his "cybernetic brain", i.e. the need to have more than one head addressing the same problem in order to grasp its complexity and avoid the risk of reductionism and simplification that inevitably arises with just one individual.

Etymologically, *complexus* means what is held together to form a single fabric. Complexity thus becomes a call for the interconnecting of languages in which the dynamics of situations and events in natural and social systems can be expressed. This approach proposes that very different theories should be taken into consideration and introduces a scientific method that was to be used by different and sometimes distant disciplines. Donata Fabbri (1990) reminds us that complexity is not a recent discovery: "*What is recent is the fact of taking cognisance of it and the desire to respect phenomena of any type whatsoever in their dynamic totality and the reciprocity of their relations with the context accommodating them*." (p. 21) She continues (p. 117): "*The message that complexity has left us is to open up our minds to a universe of possibilities, to discover the pleasure of discovery, to invent not only new rules of play (believing this to be more than sufficient) but also the game itself (the game of knowing and teaching, if I may be allowed the metaphor), which there is no reason to regard as already defined forever*."[34]

The need was felt to identify pathways making it possible to explore complexity, as the certainty of explanation gave way to the uncertainty of hypothesis. **Alberto Munari** describes complexity as the surprise that prompts a cognitive jump, a radically different way of thinking about mankind, the world and knowledge itself. Complexity makes disciplinary boundaries obsolete by showing how every discipline is contained in every other within a fabric of circular interconnections and intricate hierarchies in constant motion. The real challenge becomes the search for new cognitive tools, new

[34] The numerous conferences held on complexity in Italy during the 1980s include The Challenge of Complexity (*La sfida della complessità*, Milan 1983), the AIF national conference of 1986, Communication, Organisation and New Complexity (*Comunicazione, organizzazione e nuove complessità*) …

ways of thinking, new metaphors and new strategies of knowledge. As Zanarini (1990) puts it, "*A 'consciously complex' thought is one that while it thinks, also thinks of 'itself thinking', a thought capable of consciously grasping different dimensions and relating them to one another within a structured continuity of observation and self-observation, knowledge and self-knowledge.*"

Isabel Stengers (1985) suggests that complexity is the discovery of problems rather than a solution.

The first article pointing out the potential and the scientific character of the concept of complexity was *Science and Complexity* (1947) by Warren Weaver. The person responsible for introducing complexity into the sphere of the social sciences was, however, Edgar Morin, who understood it as the attitude of those who, regarding themselves as playing an active part in the relationship with knowledge, no longer observe a simple phenomenon or consider themselves a simple subject but recognise the composite nature of reality and hence abandon neutrality, objectivity and truth. As a property of the object, complexity differs, however, from complication, which is regarded as a difficulty in representation.

Morin's Paths of Complexity

Morin puts forward a number of operative pathways that can lead to complexity, as outlined below.

- A perspective is introduced capable of taking into account the singular nature of events and laws, and of superseding universalist abstraction.
- It becomes necessary to take stock of the plurality and pluralism of the elements in play. Every viewpoint is syncretic and plural. What is observed through one frame is different from what is observed through another.
- The need is felt not to dissolve the many in the one and the one in the many. In this connection, stress is laid more vigorously on the concept of ***unitas multiplex*** (Angyal, 1941), unity in diversity, a concept introduced into psychology by Victor Frankl to describe the human being endowed with a dimension that is emotive, social and historical as well as cognitive.
- The dualism of subject and object is superseded and attention shifts to the forms of analysis.
- The concepts of order, disorder and organisation become complementary and interwoven.
- The focus on a process of unification is abandoned in favour of complementary viewpoints. There is no attempt to summarise or simplify the data of reality.
- The clear demarcation of science and non-science, true and false, is undermined.
- The most interesting consequence in the sphere of the social sciences unquestionably involves a new attitude, a way of existing and approaching knowledge with curiosity rather than in search of answers.
- The subject takes on an interpretive function, becoming one who not only observes and interacts with the objects of observation but also gives sense and meaning to what is observed.
- The need emerges to abandon exclusively theoretical speculation for practice and an active role.
- The gap between systems of conceptualization and value systems is bridged. Participation becomes a paramount postulate.
- Interdisciplinarity implements a practice that respects the different levels of reality.
- There is no hegemony of one language over another but rather the constant juxtaposition of different languages, all endowed with equal verisimilitude. ("The richness of reality surpasses any language.")

The complexity approach is not confined to consideration of the plurality of theories of knowledge but puts forward a methodology of reflexive polyphony consistent with second-order cybernetics. Two examples will help to illustrate the characteristics of complex models, namely **James Lovelock's Gaia hypothesis** (1979), now renowned within the biological sciences, and **Hermann Haken's synergetics** (1983). In our view, it is useful to stress the continuity between systems theory and the subsequent theories of chaos and not to suggest a hiatus, a drastic and paradigmatic change brought about with the emergence of unpredictability and uncertainty, catastrophe and chaos, as Lyotard does in *The Postmodern Condition* (1984).

To return to complex systems, Lovelock suggests that the earth can be studied as a living system in which climate and all of the planet's chemical reactions are stabilised by the interaction of living organisms and their environment. This hypothesis leads to examination of the ***evolutionary coupling*** of the various species with their environment, thus bringing the historically divided biological, geological and environmental studies all together in a single discipline. The Gaia hypothesis introduces the image of evolution through ***punctuated equilibria***, in which the interconnected system of living beings and environment remains stable until chance perturbations drive it through oscillations towards a new state of equilibrium. Evolution is not therefore regarded as a pathway of successive, pre-established stages but as shaped like a "structural drift" (as in the model of Maturana and Varela) deriving from the relationship between subsystems and momentary contingencies.

Haken's hypothesis is interesting in that it suggests a way of studying systems that are not susceptible of prediction through analysis of their components. **Synergetics** is so called precisely in order to emphasise the cooperation between elements, which can lead to the emergence of characteristics extraneous to the individual components (a viewpoint closely resembling the above-mentioned theory of systems far from equilibrium). The peculiarity of this contribution lies in putting together two different viewpoints, namely the microscopic and the macroscopic. As **Gianluca Bocchi** and **Mauro Ceruti** point out in their presentation of Haken's article in the excellent book *La sfida della complessità* (1980, p. 14), "*Synergetics seeks to identify the general principles governing behaviour (the behaviour of complex systems); governing the self-organising processes of the microscopic elements of a system out of which its macroscopic state is generated with no specific intervention from outside.*" The innovative aspect of this approach, whose application ranges from laser emissions to social and biological phenomena, lies precisely in the structuring and transformation of the order of analysis between the microscopic and macroscopic levels, which are considered interacting, as a possible melting pot of unforeseen change.

Complexity also engendered chaos and its associated theories, a parallel development that began back in the 1940s (with von Neumann, Turing, McCulloch and Pitts). It was not until the 1970's that this took shape in an algebraic, numerical, combinatory hypothesis that led also to (computational) studies into complex systems (including the immune system, the brain, the description of an ants' nest, the stock market and the national economy) and the investigation of phenomena defined as chaotic. "*Phenomena can be called chaotic when it proves possible in a process to arrive at very different results even when starting from two points very close to one another. This happens when the value of the function that describes the process is highly sensitive to small variations in the point of application. Take the example of billiards, where the slightest error in the stroke is sufficient to send the ball in a direction very different from the one desired. Great sensitivity is a natural requisite for chaos.*" (Cadenotti, 1996) Hence the impossibility of understanding non-linear systems by breaking them down into their constituent elements; hence also the growth of an indeterminate science that studies irregularities, a type of mathematics that no longer represents a biunique correspondence with nature and moves farther and farther away from causality. Schmid (1996) points out that while the classical forms of motion of mind and matter are rectilinear, periodic and causal, chaos is a creative movement that dances with time, highly sensitive, self-aware, going its own way and mirroring itself in itself .

As scholars of chaos put it, chaos begins where classical science stops.

One possible development of these studies is the model put forward by **René Thom** (1975), regarded as the father of **catastrophe theory**, work on which began in the early 1970s. This qualitative model, a theory suggesting the possibility of a finite number of sudden changes in the course of a structurally stable natural process, was hailed as a revolutionary application of mathematics to natural and social phenomena in order to investigate the forms of discontinuity. As Krippendorff explains (1986), this is a topological theory describing the change of a system's structure along a continuous "morphogenetic landscape" including occasional jumps: the seven types of elementary catastrophe identified by Thom intervene in the relationship between the structure of the whole and the properties of the parts, leading to a break or discontinuity and giving rise to possible dynamic figures that are generated out of one another at different times to unfold in space at different levels.

René Thom thus proposes a new approach to the relationships between the whole and the parts in organised systems. Atlan points out (1979, p. 271) that applied to the study of living beings, this approach evidently bucks the trend with respect to the modern, analytical, reductionist, molecular biology rooted in biochemistry.

It was precisely the evolution of the theory of complexity that laid the foundations for the **theories of chaos**,[35] which suggest that there can be a marked limitation of predictability also in deterministic systems due to dependency on the initial conditions. The very definition of chaos is related to the difficulty in understanding the data and in predicting the evolution of a dynamic system. One example of a simple dynamic system is a pendulum in conditions of friction. After a certain period of time, such a system will attain stability around the position of rest (punctual attractor) describing the final state of the system. Dynamic systems do not, however, always present a point of rest, but often oscillate around two values (as in the case of heartbeat). The function capable of describing this motion is that of a limit cycle (or node attractor), a circular trajectory that the system repeats over time. The toroidal attractor was introduced for more complex phenomena, such as oscillating systems with three variables (three degrees of freedom). When the variables in play display still higher degrees of complexity, we find what are known as chaotic motions (introduced by David Ruelle and Edward Lorenz), which can only be described by means of a "tangle of curves" presenting a fractal dimension, i.e. intermediate between two discrete dimensions.

We have thus arrived at the dimension of chaotic behaviour typical of systems characterised by a **strange attractor** (**Ruelle**). Prigogine and Stengers (1979) explain that behaviour is chaotic if trajectories generated from nearby points move away from one another exponentially over time (in accordance with the Lupanov variable): after a period of evolution that is long in relation to Lupanov time, our knowledge of the initial state of the system loses its relevance and no longer makes it possible to determine its trajectory. (p. 75) The resulting temporal horizon, typical of chaotic systems, determines a difference between what can be seen and foreseen and the "erratic", unpredictable behaviour common to all systems characterised by the chaotic attractor. This hypothesis makes it possible to imagine and seek to define possible pathways for the study of chaos.

Chaotic systems thus appear extremely sensitive to their initial conditions and are constantly remixed in orbits whose behaviour is always different, thereby eliminating any possibility of prediction and causal links between present and future. One well-known example is the **butterfly effect** described by **Edward Lorenz** (1963), where unforeseen changes connect the beating of a butterfly's wings in the Caribbean with the meteorological conditions of North America. It should finally be noted that the tangle of trajectories of the chaotic attractor is neither one-dimensional, as the trajectories are not

[35] According to G. Israel, the first truly important example of the phenomenon of chaos was given by the French mathematician Jacques Hadamard in a purely mathematical article on the geodetics of surfaces with negative curvature.

closed on themselves, nor two-dimensional, as it does not fill a volume, but rather involves fractal dimensions.

Benoit Mandelbrot coined the term **fractal geometry** to indicate the possibility of representing complex objects (like curves repeated infinitely in a finite space) graphically and formally, defining it as a mathematical language capable of grasping the complex forms and structures of nature, a geometry making it possible to capture the architecture of a cloud, the eddies of turbulence, the shape of a snowflake or a jagged coastline with the same precision as an architect using Euclidean geometry to draw up the plans for a house. Schmid offers a very interesting definition of fractals as self-similar structures representing the beautiful, irregular and fragmentary aspects of nature, and the fractal as a mathematical object endowed with self-similarity.[36]

The complex geometry of fractals constitutes a privileged form of self-organisation in biology and can explain the relationship between a simple rule and a complex, structured image capable of simulating the complexity and indeterminacy of natural and social phenomena. Consistent with these concepts is the **eigenvalue** construct[37] of von Foerster, who claims that stable behaviours manifest themselves in the circular motion of an organised and organisationally closed system and lead to the emergence of eigenvalues, similar to plateaux of organisation, peculiar to (idiosyncratic of) that particular system. Every system has its own form of organisation and inside this it is possible to identify behaviour-attracting values (currently known as strange attractors). These eigenvalues change with the complexity of the system's organisation.

Marco d'Eramo wrote an article in 1970 comparing Thom's catastrophe theory, developed in the 1970s, with chaos theory and found some cultural aspects accounting for the appearance of the former and transition to the latter. As he points out, the 1970s was a period wholly characterised by the concept of crisis (the oil crisis, crisis of the model of development) and therefore sensitive to a theory of catastrophes, whereas the chaos theory of the 1980s and 90s emerged with the collective image of science as weak and postmodern: "*From this point of view, chaotic theories would be a postmodern form of physics in the sense of thought that acts while aware of its weakness, science that moderates its claims and turns from demiurgic into do-it-yourself, a sort of scientific minimalism*." The author points

[36] A fractal structure is possessed, for example, by a fir, where the shape of the tree is repeated in the banches and all the way down to the needles. Further examples include cabbages and snowflakes.

[37] The term "eigenvalue" was coined by the German mathematician David Hilbert around 1900. Applied to social systems, it indicates the stability that each system generates with respect to its operations. Von Foerster gives the example of using a pocket calculator to obtain the square root of any number and then repeating the operation on the result obtained and so on recursively until you arrive, in this case, at the number 1, regardless of the figure you started from. The eigenvalue of the operation of calculating the square root is 1.

out one aspect that we find particularly interesting, namely the possibility of approaching these new developments in science either with the same outlook as before or with a focus on the epistemological changes proposed. In other words, theories of complexity can either refute or serve to verify and develop the ancient mechanistic tradition (dispelling mists, increasing knowledge, instilling order, discovering the laws of nature and so on).

The place that attracted many theorists of chaos was the **Santa Fe Institute** in New Mexico, where physicists, biologists, economists, mathematicians and information scientists gathered as from 1984 to investigate complexity and chaos and develop studies applied to the science of complexity and to the new forms of prediction of complex phenomena and fractals on the borderline between order and chaos (a continuation of the Manhattan Group and the Los Alamos Center for Non-linear Studies). The group, including **Brian Arthur**, **Murray Gell-Mann** and **Stuart Kauffman**, took the study of dynamic systems and non-linear dynamics as their starting point to investigate complex adaptive systems (such as the brain, the immune system, ecological systems, cells and organisations of individuals or animals) and created a place of intellectual reflection (Waldrop, 1987). Economics was also addressed in this context, the neoclassical approach – which had reduced complexity to a small number of principles divorced from culture and politics and focused on diminishing returns, static equilibrium and perfect rationality – being reconsidered by the Santa Fe group in the light of theories according priority to increasing returns, limited rationality and the dynamics of evolution and learning. S. Riziello (1996) describes this framework of uncertainty as "economics of the mind". Catastrophe theory was, however, applied over a vast range of fields. The British mathematician E. C. Zeeman (1965) suggested applications to physics (analysis of starlight and the stability of ships), biology and socio-psychological and physiological phenomena such as mental disturbance, prison riots, traffic flows, holistic medicine and the organisation of space in geopolitical evolution.

Constructivism and Constructionism: the role of language in knowledge

Realism could be defined as the epistemology that attributes the universe with an ontological reality that is not exclusively conceptual and linguistic. According to this view of knowledge, the American continent, mental illness and a person's character are objects of study like all the others, things we can try to investigate by means of the tools of the hard sciences, namely physics, mathematics and chemistry. This way of thinking clashes with others that refer directly to complexity.

Von Foerster has this to say about the process of acquiring knowledge. If subjects are asked whether a certain number, say 426,875, is divisible by five, they will immediately answer yes on the basis of the

mathematical model they have learned, the one dominant in our culture. If they are instead asked how the universe came into being, they will respond on the basis of their personal convictions, each one giving a different answer. Von Foerster classifies the first question among the propositions that he defines as "undecidable", meaning that the decision and the result depend on the binary mathematical model shared by our culture and hence already decided *a priori*. Questions of the second type are instead "decidable" in that the subjects are required to fill a gap in knowledge and must therefore choose between the various models known to them or invent new ones; they must take on the responsibility of answering the question by choosing the theory of reference. The answers in this case will depend on the subjects' beliefs, and it is only this second type of question that leaves them all free to decide on the stance they prefer to adopt with respect to the world. Within the sphere of decidable questions, von Foerster asks whether the world is discovered or invented and whether he is separate from or part of it. He answers that he regards the world as "invented" by each individual subject through his or her actions and endorsed in interaction by the social exchange between subjects inside the communities to which each individual belongs through the sharing of language. This view leads to a particular attitude with respect to knowledge that is consistent with the theories of complexity: no system of reference can be considered true and correct *a priori*; every observation (construction) is instead determined by the interpretive lens and linguistic choices of the subject (choices that define him or her as subject and determine the emergence of one world rather than another). This is the attitude characterising **constructivism** (*construo*: I construct).[38] Every observation is determined by the methodological stance, interpretive lens, aims, language, culture and interactions in which the subject is involved, which define him or her and which he or she defines.

Once again we have a repudiation of neutrality, objectivity, metaphysical realism and Truth with a capital T. It is precisely this relationship between the observer and the phenomenon observed that establishes once and for all the complex and composite character of reality. As von Foerster says, every description implies the person describing; every description is an interpretation. According to Maturana, everything said is said by an observer to another observer, who may be the same person. (1978). Morin (1983) adds that failure to make explicit the way in which a system (subsystem, supra-system, etc.) is chosen and the operation leading to its delineation means separating the system from the observer when they instead constitute a complex and shared totality.

We thus have continuous circular evolution, whereby the very operation of constructing and organising

[38] It should be recalled that "constructivism" was also the name of an artistic movement in the Soviet Union over the period 1920–32.

experience constitutes a constraint on the possibility of doing so. Personal epistemology and assumptions determine what is seen and the behaviour constructed in interaction with the world determines the events in the world and leads us to maintain a particular epistemology. The self-referential nature of the cognitive process is highlighted together with the active role of the individual in the relationship with the environment. All this should lead to new awareness, to knowing that we wear glasses and have various pairs to change into.

Constructivism therefore focuses on the operations of knowing, which are defined as "constructions" in that they have no reference directly correlated to external reality and acquire meaning as actions of the subject in the context in which they take place. We are reminded of the words spoken by Shakespeare's Hamlet: "*There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy*."

Constructivism is not a recent invention. **Von Glasersfeld** (1977), one of its leading representatives, subjectively selects ideas from the works of modern and ancient philosophers to trace a path connecting various assumptions with the constructivist theories, rejecting and moving beyond the naturalistic concept of "reality". Those cited include Vico, the pre-Socratics, Heidegger, the hermeneutic tradition and the later Wittgenstein (1953).[39]

He identifies three branches of contemporary scientific thought as based on the constructivist meta-theory, namely **cybernetics**, of which we have already spoken, operationalist psychology and Piaget's psychological theories.

As regards operationalism, von Glasersfeld emphasises the contribution of the epistemologist and logician **Silvio Ceccato**,[40] who founded the *Scuola Operativa Italiana* or *Italian Operative School* in 1940. Ceccato criticised conventional epistemology, examined the operations required for the construction of concepts, and put forward a analysis of the semantic operations implicit in knowing.

Von Glasersfeld also stresses the contribution of **Jean Piaget** to knowledge, with particular reference

[39] Von Glasersfeld traces constructivist ideas back to the following sources: the pre-Socratic philosophers of the 4th and 3rd century BC; the sceptics (Pyrrho, c. 365–275 BC), who maintained the impossibility of true and certain knowledge; the Byzantine theologians of the 4th century AD, who drew a distinction between the knowledge obtainable by man and the knowledge of God; instrumentalism as represented by the German Protestant theologian Osiander (1498–1552), who wrote a preface to Copernicus's work; Cardinal Bellarmino (1532–1621), who wrote on the eve of Galileo's trial that any scientist can choose the theories he needs in order to make calculations but not in order to seek truths that are truer than religious dogma; the architect and mathematician Juan Caramuel (1606–1682), who devised a binary mathematics as an "operation of the mind"; Giambattista Vico (1668–1744), the author of *De Antiquissima Italorum Sapientia*, the first statement of the limits of human knowledge, who asked what the mind had to do in order to obtain facts; the English philosopher and jurist Jeremy Bentham (1748–1832), who studied the role of language and the mental costruction of appropriate structure. He also mentions Heidegger (1889–1976), with his ontology based on moving beyond the epistemology of representation, and hermeneutics, understood as the universal circularity of knowing.

[40] Ceccato's work is currently carried on by the Società di Cultura Metodologico-Operativa and by a group investigating the mental operations constituting meaning under the guidance of Giuseppe Vaccarino and Felice Accame.

to genetic epistemology and the studies into the child's construction of reality (1936), where the Swiss psychologist likens the acquisition of knowledge to the construction of objects through operations of abstraction, which he conceives as universal and temporally defined during the stages of the child's development.[41] While Piaget's child constructs his or her world in solitude ("*intelligence organises the world by organising itself*"), **von Foerster**, another illustrious representative of constructivist ideas, identifies three essential prerequisites for any talk of construction, namely subjects, the language they use and the society they form by using it. The elements of inter-subjectivity and cultural dependency in von Foerster's conception underscore the view that the acquisition of knowledge takes place not in solitude or a social vacuum but through consensus and agreement within a community of observers, as maintained also by Varela in 1979.[42] He reminds us that believing that reality exists is a choice; we are free to choose to adopt the relativity principle or not, thus it allows us to abandon *solipsism*: "*If I refuse it I find myself at the centre of the universe, my reality emerges from my dreams and nightmares , my language is monological, my logic a mono-logic. If I adopt the relativity principle, nor myself nor the other can be at the centre of the universe. As in the heliocentric system a third must exist who constitutes the central point of reference. This third is the relation among I and you, and this relationship is the IDENTITY: Reality = Community* (von Foerster 1974, pag 233[43]) Within von Foerster positioning, therefore, the ethical choice to renounce to the idea that the world is "*only a phantasmagoria, a dream, an illusion in our phantasy*" (ibidem p.54) is essentially the recognition of the existence of the other: the relationship with the other, with the YOU, identifies with "reality", becomes "reality" (Bianciardi 2009).

Trivial constructivism and *radical constructivism* are spoken of as approaches opposed to realism. A trivial constructivist is one who maintains that we invent and construct our reality but nevertheless remains convinced of the existence of an objective and ontological external world. A radical constructivist rejects all conventions and suggests that knowledge makes no reference to an *a priori* external world but rather brings out, organises and gives meaning to a world constructed solely on the basis of experience. As von Glasersfeld puts it (1985, p. 50), "*Knowledge is not passively received either through the senses or by way of communication; knowledge is actively built up by the cognizing*

[41] One of Piaget's autobiographical works (1952) refers to his desire to devote his life to the biological explanation of knowledge. It should be noted that scholars such as Maturana, Varela, and von Foerster also see knowledge as a biological function and hence a form of adaptation.

[42] Von Foerster and Varela both prefer to speak of a "community of observers", as they regard the individual as possessing status only in relation to others.

[43] Translated from the Italian by the authors

subject. The function of cognition is adaptive, in the biological sense of the term, tending towards fit or viability. Cognition serves the subject's organization of the experiential world, not the discovery of an objective ontological reality."

All the intermediate pathways between these two positions are practicable and have been explored by various authors in both theoretical and practical terms.[44]

Constructivism established itself to a major degree but was also criticized for undue attention to individuals and their cognitive operations. Its focus was in fact on the identity of the system and its cognitive domain, understood as the domain of interaction in which a system can operate by virtue of its operational plasticity with no risk of losing its organisational closure. In a constructivist perspective, perception is reinterpreted in terms of a relationship that involves the nerve centres (cortical and subcortical), individual and culturally shared ideas, theories about the self and the world, expectations and emotional patterns so as "then" to involve others necessarily through the shared language. We do not, however, use the senses "simply" in order to work out ideas: the relationship between subject and object is also mediated by actions. Maturana regards objects as generated through language (the activity of languaging, i.e. linguistic action). Action and language are neither necessarily simultaneous nor two overlapping concepts for von Foerster (1974), who describes objects as symbols of self-behaviour generated by motor actions, asserts the primacy of action over nominalisation, and says that if you wish to know, you must learn how to act, as the way you act determines what you see.[45] The "world" is not known in an abstract, *a priori* way but only through the actions that the subject performs in an attempt to interact with and understand it. Constructivism therefore focuses on the operations of knowing and leaves in the background the community of observers and doers where knowledge emerges, despite considering it fundamental.

Let us now look at another, slightly later movement in which the stress is always on the cognitive relation, amplifying in this case what derives from the social construction of knowledge. We attach importance to careful description of its characteristics and cultural roots so as to highlight the primary role of language in the modern theories of science and philosophy and to outline the debate now

[44] Among the vast range, Laura Fruggeri (1992) describes a socio-costructivism that accentuates the distinction between mental and social processes and includes studies on the processes of cognitive development (Doise and Mugny 1981, Carugati et al., 1985), the theory of social representations (Moscovici, 1961, 1981, 1988, …) and the genetic model of processes of social influence.

[45] Von Foerster also recalls two 19th-century mathematicians, namely the German Leopold Kronecker and the Dutchman Luitzen Brounwer, who described themselves as constructivists on mathematical grounds, arguing that the demonstration of a mathematical object necessitated plan or strategy for its construction.

underway.[46]

The term "**social constructionism**" was introduced by **Kenneth J. and Mary M. Gergen** in the mid-1980s to describe an approach distinguished not only from cognitivism and constructivism but also from the "naturalistic" perspective. The term covers some philosophers (**Rom Harré** and **Grant Gillett**) and numerous social psychologists (including the Gergens) as well as family therapists (**Harlene Anderson**, **Harry Goolishan**, **Lynn Hoffman** and **Sheila McNamee**). It proves very complicated to describe the development of this group, whose members initially distinguished themselves above all from the "naturalistic" approach to the emotions and used the terms *constructivism* and *constructionism* as synonyms. It was not until a later stage that they broke away from constructivism.

The constructionist approach was born out of the rejection of biological determinants as possible explanations of human behaviour in favour of shared linguistic definitions and social explanations.[47] Careful examination of the early constructionist writings shows that the opposition to the "naturalistic" approach was firm and resolute. A reading of *The Social Construction of the Emotions* reveals a sharp contrast to a dominant paradigm intent in every way on ignoring the social and cultural aspects of the emotions. It is interesting to note, however, that the naturalistic approach was presented in simplistic, reductive terms and practically never described apart from a few comments on 19th-century Darwinian theories and vague references to the universal nature of the expression of the emotions. Was opposition to Darwinian theories still possible halfway through the 1980s? The authors appear to have regarded such theories as still dominant, deeply rooted and in any case opposed to the social perspective. Examination of the theories of the emotions put forward by biologists, cognitivists, physiologists, neuroscientists today, however, reveals an integrated, multi-factorial theory put forward by a group of

[46] Having so far addresed past events and therefore presented a historical account, we shall express our views on the issue in this case and take sides in the debate.

[47] As Hoffman (1990) explains, the two movements share common ground in that both challenge the modern idea of the existence of a real world that can be known with objective certainty. Opting for the model of social constructionism, the author then traces its origins and suggests, somewhat ingenuously in our view, a connection with the deconstructionist approach first put forward in 1967 by Jacques Derrida. As a post-structuralist, Derrida holds that meaning and significance are not closely interconnected but instead separate constantly to join up again in new combinations. (The task of the philosopher is to call into question the texts of other authors by using them to show, sometimes successfully, that their underlying assumption prove contradictory with respect to the initial intentions if taken to their logical conclusions.) Hoffman connects the rise of social constructionism with the debate in poetry, literature and art, and the view that no element can function as sign without referring to another element that is not present in what is written or made. She then links it to renewed interest in the work of Foucault, the post-structuralist author of books and articles regarded as politically penetrating. The third link suggested is with the femminist movement of the 1980s, when women used deconstructionist ideas to criticise the writings of many male authors as well as certain practices (in medicine, therapy and other fields) by highlighting the concealed gender prejudices. The challenging method of deconstruction that emerged focused on need to make the underlying assumptions of a written work, author or practice.

serious scholars that have taken the integration of the social, cognitive and biological aspects of the emotions for granted for some 20 years now.[48] A reading of the best-known theories in the sector (like those of Edelman (1992) and Damasio (1994) outlined in the following section) shows an attempt to put forward a viewpoint combining the cognitive and social aspects and the biological modifications of the predisposition to act that together form the complex phenomenon of the emotions. The situation appears still more evident if we take into consideration the theories of the emotions in social psychology, which are based on multi-factorial concepts seen precisely from a social viewpoint.

The social constructionists did not, however, feel adequately represented by such theories. The point at issue was evidently not just the social role of the emotions but the presentation of another perspective, a new label capable in their view of overturning the modern psychological and clinical metaphors. The constructionist approach was seen by some as an advance in knowledge (the possibility of new metaphors and new practices no longer linked to tradition, "freed" from the assumptions built up in years of post-positivist praxis, an opportunity to focus on the interactive aspects of knowledge), and by others as a return to theories – Wittgensteinian and hermeneutic ideas – that had already shown the bonds of their assumptions in the field of philosophy.

If we are to understand constructionism, it will be necessary to provide a brief description of the philosophical tradition from which it derives, namely the Wittgensteinian approach. It is precisely this viewpoint that makes comparison with multi-factorial and social theories impossible. Wittgenstein's theories are not only a cultural influence but also the bedrock of the constructionist approach, above all for the philosophers of the group, who were its greatest theoreticians. The connection between the constructionist ideas and those of Wittgenstein was expressly made by the movement's leading figures. Harré and Gillett (1994) paint a disappointed picture of the "first" cognitivist revolution,[49] regarded as guilty of presenting a model of "private" mental processes lying outside consciousness and linguistic conventions. They counter this "misguided" revolution with another born out of Wittgenstein's *Philosophical Investigations*. As Harré and Gillett observe (p. 24), it is but a short step from there to the inclusion of another aspect of Wittgenstein's later philosophy and a further conceptual revolution in our conception of psychology. We do not know whether the step is short, but it is certainly one to be described and considered.

[48] Let us take the paradigmatic case of an author very far removed from social psychology, namely the psychobiologist and materialist monist Alberto Oliverio, who defines the emotions as "an assessment of the gap existing between our view of the world and the signals received from the world itself. This assessment is based both on a number of instinctive mechanisms and above all on strategies of a cognitive nature." (1996 p. 92) The author describes the latter as derived from the social and cultural matrix.

After the *Tractatus* (1922), in which he put forward a logical theory of knowledge and suggested substantial correspondence between external reality and representation (the picture theory), Wittgenstein changed course completely and introduced the theory of "language games" (1953). It should be recalled that his reflections are not to be regarded as the exposition of a theory but as "examples of a style of thought" (Sbisà, 1975, p. 69). The style of the *Investigations* is in fact colloquial, rhapsodic, non-systematic, often dialogical and questioning. The book focuses on the internal characteristics of language games, grammar and the concrete use of language. The language described is verbal: "*It is primarily the apparatus of our ordinary language, of our word-language, that we call language; and then other things by analogy or comparability with this*." (no. 494) This definition of language appears open and therefore partially indeterminate precisely because of the author's view that concepts cannot refer to a closed set of events or objects but rather to phenomena "*related* to one another in many different ways" (no. 65) by "family resemblances" (no. 67).

Well, this definition would make it possible to include also the non-verbal and relational aspects in the family of language. Wittgenstein is, however, determined to deny the existence of these aspects, first drawing a sharp distinction between "private" and "public" language, between linguistic aspects and sensations, and then denying the role of the private aspects. Brief examination of the *Philosophical Investigations* is sufficient to show how Wittgenstein endeavours to deny the value of feelings and even memories: '*And yet you again and again reach the conclusion that the sensation itself is a nothing.' Not at all. He is not a something but not a nothing either*." (no. 304) This view is taken up in its entirety by the constructionists when they assert that a sensation "exists" insofar as it is described by language, thus decreeing the hegemony of language over everything that is not language.[50] (Harre, 1986, and Gergen, 1985, even go so far as to call emotion a linguistic label.) Wittgenstein is, however, well aware of the consequences of these ideas in his *Investigations*: "*To deny the mental process would mean to deny the remembering; to deny that anyone ever remembers anything*." (no. 306) The response is a question: "*Are you not really a behaviourist in disguise*?" (no. 307) To which he replies: "*And now it looks as if we had denied the mental processes. And naturally we don't want to deny them.*" (no. 308) But what Wittgenstein does is precisely to divide social processes from individual processes and then show the meaninglessness of the latter (as clearly described also by Kenny, 1973, in his tenth chapter

[49] The same criticisms have been extended in recent writings, often incorrectly, first to Kelly and then the constructivists.

[50] The same psychological dispute can be seen in the 1930s between those who maintained that everything was language and language was the gateway of intelligence, and those who regarded the mental processes as partly linguistic and partly non-linguistic.

on the private language argument). In the same way, Harré asserts that the ghost world of mental activity hidden behind discourse, in which the individual develops things in private, does not necessarily exist; what goes through the mind is accessible (at our disposal) through what we create together conversationally, and if our mental activity is also symbolic, we can make it available or otherwise as the situation appears to require. (p. 31) There clearly emerges an exclusively "rational" and explicit view of the mental processes and a perhaps ingenuous confidence in introspection. Clinicians are well aware that the verbal description of behaviour or intentions is by no means "accessible" and anything but at our disposal, deriving rather from a sometimes contradictory set of possible descriptions. The constructionists' allergy to the individual biological and cognitive aspects of the emotions appears to derive also from the legitimate aspiration to highlight the social dimension of knowledge, out of the need to deny individual aspects because they clash with a definition of language as "objective reality" accepted by society and governed by rules. The model of these mental processes is reductive in our view. Thought is equated with language, the emotions are "*entities psychologically equivalent to affirmations*", the feelings are the manifest expression of social accepted moral judgments, relations risk to boil down to linguistic exchanges (expressed in the metaphor of **being in conversation**), and subjects are "*language locations*" sharing a normative language. To summarise, constructionists believe that by studying language they can investigate areas such as thought, perception, relations, connective patterns, the mind, society and the individual. It is clear to anyone familiar with the theories that what is put forward is an *arché* or first principle capable of encompassing and explaining everything.

While the stress laid by the constructionists on the social, cultural and interactive aspects of experience, the emotions and identity, and on the absolute need to seek meaning also within the expanded system of belonging was in any case useful, the dispute commenced by constructionists and constructivists in the early 1990s in the clinical sphere proved less fruitful. Described by the systemic clinician Minuchin as an argument between cousins, it appears sterile if not completely pointless, developed at an overly theoretical level divorced from the concrete substance and suffering present in clinical situations. It should, however, be pointed out that the clinical model deriving from social constructionism is "new" in that it pays greater attention to the evolutionary and adaptive processes of clinical situations, takes great care over the language used and takes respect as its cornerstone.

Some constructionist authors have complained about the constructivists' lack of interest in language. It is certainly not our task to defend the constructivists and recall the key importance attached precisely to the role of language by von Foerster, Maturana and Varela – and stressed by von Foerster also in these

pages – putting forward as early as the 1970s the metaphor of being in conversation, which is also that of the constructionists, albeit understood in a different way. Von Foerster suggests that language is made up of two "tracks": the linguistic definition and the social relationship. The language family described by Wittgenstein thus expands to encompass aspects that are not directly connected with language but form part of it. While verbal language creates labels, definitions, names and denotations, the social relationship or dance is a connotative process of lived experience, only partially translatable in words, based on common doing. The interesting aspect of the idea put forward by von Foerster (1980) is precisely the impossibility of separating the two processes – the linguistic from the affective, the private/emotive aspect of language sharing from the public – in that together they permit the (always completely social) construction of the world.[51] It is only through the constant connecting of verbal labels and bodily states (symbols of self-behaviour), the linking of concrete actions in the social context, that the world can emerge. Denying the corporeal, biological, non-verbal, processual aspects leads to a "*disembodied*" and coldly rationalistic vision. Maturana and Varela (1984) also devote a great deal of space to the role of language in knowledge, seeking always to pinpoint the biological and cultural co-determinations and defining language in its processual aspect as a description of interaction behaviours that depends on the history of the transformations of structural couplings, whose description implies the modification of future interactions. (p. 171) Their linguistic theories always appear to consist of two tracks, one verbal and the other corporeal and relational, precisely what Wittgenstein (1953) found unacceptable and Harré described as the "misguided revolution". As Maturana puts it (1990, p. 81), "*We human beings are living systems that exist in language. This means that although we exist as human beings in language and although our cognitive domains (domains of adequate actions) as such take place in the domain of languaging, our languaging takes place through our operation as living system*." Maturana speaks in his definition of "languaging" (something like the action of using language more than simply language itself), in which stress can be laid alternatively on the ontogenetic aspect or the interactions underway.

It should finally be recalled that Bateson also puts forward a complex definition of language, where the just emphasis on the aspects shared in culture regards the level of actions, habits and the unconscious (not as a Freudian model but as a wordless, untranslatable system) rather than the realistic level of an

[51] According to S. Moscovici (1988), representations have a congenital dialogical nature and are the product of thinking society, not single individuals. Existence is therefore interpreted not ontologically but epistemologically; it is a cognitive process, a way of operating on the world, not of "being" in the traditional sense (von Glasersfeld). As we see it, language is thus considered epistemologiclly as an aspect of knowledge by the constructivists and ontologically by the costructionists and the hermeneutic tradition.

all-inclusive language. His theory of the double bind and the transcontextual syndrome is entirely based on the hiatus between language and the non-verbal system, which the author never uses as synonyms or terms susceptible of translation into one other. (One of the many possible examples is *Style, Grace and Information in Primitive Art*, where a reduced role is given to consciousness and other levels of communication are defined.)

Language became a key subject providing insight into human cognitive activities in the second half of the 20th century but proves useful as a concept only when juxtaposed with what language is not. In addition to **language games**, we therefore suggest taking into consideration also **emotional and relational games**, understood as independent and parallel processes that jointly constitute the (always and exclusively social) game of the construction of "reality". It is not possible to reduce social complexity to an exchange between social norms and prescriptions. This is a process that takes place also with contradictory solutions (as all clinicians know) and that cannot be addressed exclusively from a single viewpoint that denies all the other components. In our view, the problem is not one of unravelling an alleged dispute between constructivism and constructionism in dualistic terms but of pinpointing various moments in the formation of knowledge and assigning the "right" role to language.

Precisely in this connection, the various contributions of constructivist epistemology can be regarded as characterised by a "bottom-up" view of knowledge. This model describes the development of knowledge starting from sensations, from the observer/observed relationship, and finally works up to representation, thus placing in the background social language sharing, social and cultural representation, and the semantic definition that precedes and partially guides the relationship itself. There is an alternation in the field of knowledge of moments in which the consensual character of the epistemological assumptions governing the construction of reality manifests itself (a constructionist viewpoint) and moments in which the focus is on the constructive role of the individual in his or her (concrete, individual) relationship with the environment (the constructivist viewpoint). The concept of mind used by Bateson can be considered a possible precursor of this juxtaposition, in that the author proceeds along an axis that joins the observer's viewpoint – with no fear of speaking about his or her representations – with what we shall call the "meta-viewpoint", whereby the mind is regarded precisely as immanent in the complex of actions and interactions. This approach may be able to transcend the dichotomy of constructivism and constructionism in that it makes it possible to describe the individual as observer and author of his or her representations and to connect his or her ideas, expressed through narratives, to the **immanent mind of the system**, i.e. the set of actions, feedbacks, assumptions and behaviours of the expanded system, including the subject and its context. Interest is thus focused on the

links of the conversational and emotional contexts connecting the observer and the object observed. This is the core positioning of the Milan school clinicians.

In order to understand the complementary nature of these viewpoints, it will be useful to recall the hypotheses of **Vernon Cronen, Johnson and Lannaman** as regards the double bind (1982). They picture knowledge as a process in which precisely these different moments (the *implicative force* of constructivism and the *contextual force* of constructivism) alternate in a constant Heraclitean dialectic for the creation of meaning, the two forces being defined as integrable and continuously interacting. If it is true that we participate in a *hermeneutic circle* in which we constantly "discover" our linguistic assumptions, knowledge also presents moments of "preverbal" emotional relationship preceding linguistic definition and classification.

The new theories of the neurosciences also put forward models involving a non-linguistic, procedural matrix of knowledge. We see it as the duty of systemicists to combine the emotional, biological and social aspects with the "*contextual knowledge*" drawn from anthropology and linguistics, and so dialogue becomes the only way out. For this unavoidable reason, the following section will present hypotheses drawn from the latest works in the fields of cognitivism and the neurosciences, even though these are at risk of offering a view of the human domain divorced from the social dimension and share assumptions that do not always appear to be in line with modern epistemology.

One last note regards hermeneutics, invoked by von Glasersfeld for the constructivists and assumed as a partner by the social constructionists. This is a comment that partially reiterates the above remarks on constructionism.

Hermeneutics

The art of interpretation (*hermeneutike techne*) in ancient Greece concerned the conveying of messages from the gods to men. The late etymon derives hermeneutics from Hermes, the messenger of the gods, and refers to the forms of "uncertain" knowledge, such as oracles and poems, as a whole. With the advent of Alexander the Great, the widespread circulation of the Homeric poems and the alternation of different populations (Sannites and Latins), interpretation took on the new meaning of philological investigation of the faraway Greek world.

Philological studies were accompanied in the Jewish culture by a form of religious study that was to be followed by juridical hermeneutics, born out of the need for correct interpretation of the legal codes (which led to the Justinian Code). In the Italian humanism of the 14th century, hermeneutics became the interpretation of a bygone world, of past historical eras. The 18th century saw projects for

"universal hermeneutics" as a fundamental key to knowledge. Hermeneutics is now a contemporary school of philosophy the developed about halfway through the 20th century and is characterised by the idea that truth is the result of interpretation. Today we can identify a general hermeneutics focusing primarily on the "problem of truth" (which is the problem of being in philosophy) and understanding. The model of the comprehension of written texts is applied to the comprehension of being in that the things we try to understand behave like the written language.

Martin Heidegger became the key author of the new hermeneutic era with *Being and Time* (1927), marking a break with traditional hermeneutics. The German philosopher regards our entire existence as hermeneutics in that we ourselves form part of a historical and linguistic tradition peculiar to the sciences of the mind. Our belonging to tradition is described as circular, just as our possibility of knowledge is linked to the "hermeneutic circle", i.e. to the (re)discovery of the assumptions of our tradition. Every piece of our knowledge is always and in any case an interpretation and will never succeed in attaining objectivity. Heidegger thus regards hermeneutics as "*the centre of every type of knowledge*" and the opposite of scientific knowledge.

Hans Georg Gadamer took up the link between being and language with his *Truth and Method* (1960) and defined the "linguistic turn" of hermeneutics as follows. 1) Language is un-transcendable, in that every criticism is in any case made within language. 2) There is a natural indivisibility of word and thing. 3) It is only through language that we conceive a world. 4) We do not govern language, which is rather a place that we "inhabit" (the home of being) and that precedes us, a total place.

Hermeneutics acquired an entirely philosophical dimension with existentialism and ended up becoming "*the 'lingua franca' of contemporary philosophy*" (**Gianni Vattimo**, 1989). The basis for this was the view that objectivity cannot constitute the ultimate frame of reference in that it is determined by tradition and history; as Nietzsche put it, "*There are no facts, only interpretations*."

While these views are open to many criticisms (see Ferraris, 1998), the most controversial aspect is the equation of being and language. The pervasiveness and priority of language as the only means for the comprehension of being (a hazy, confused and indefinable concept resembling the idea of God) puts the knowledge process on a par with the reading and interpretation of texts. The metaphor of the text and language leads in our view to the risk of panlinguism (the view that everything is language) and of textualism (there is nothing outside the text), which reduces the richness of human experience to rational interpretation alone and wholly neglects the experienced, "embodied" and extra-linguistic aspects of knowledge, for which there is no room as they are "colonised" by language.

According to Ferraris (1997, p. 394), the assumptions of modern hermeneutics have not manifested

themselves "*at the level of hermeneutics but in the questionable terms of a linguistic holism ensuing from an alleged crisis of philosophy*". In the author's opinion, the watchword of hermeneutics – "*Being that can be understood is language*" (Gadamer, 1960) – is a form of reductionism "*all the more insidious because less evident*"; born out of an abandonment of philosophy, it is the emblem of a crisis rather than a triumph, expressing the powerlessness of a literary philosophy with respect to science.

The risk of linguistic holism in hermeneutics is pointed out by various philosophers including Davidson and the Italian Veca, who has this to say (1997, p. 6): "*Accepting the linguistic turn and not taking seriously everything that is not language is ultimately a way of not taking seriously the reasons for which language is terribly important and relevant. Language is important in a world of agents and patients (and obviously of speakers and thinkers). Its importance evaporates in caricature fashion if the role is set for a (possible) world of disembodied speakers, a sort of post-Frege Cartesian ego. If everything is language, language is hardly interesting and attractive enough as a candidate for intellectual resources and energies to be devoted in philosophy for an electoral campaign in its favour. Recognising this means recognising something about the importance of language, giving unto language what belongs to language, what it is entitled to.*"

In order to avoid yielding to scientism, modern hermeneutics (Gadamer, 1960) began by abandoning any technical claims, then rejected any tool of verification and finally downgraded any form of epistemology and demanded equal ontological importance for its own elaborations. In addressing being, which is not the being of the entity, this ontology assumes that it is immune to all objectivity, in agreement with the assumption that objectivity is despotic. As Ferraris explains (p. 415), "*According to Rorty, the primary thrust of the linguistic turn consisted in abandoning the project of a philosophy capable of addressing empirical subjects. It is obvious that once this decision has been taken (to abandon any claim to knowledge of objects), language becomes the only possible subject for philosophy. Even assuming that philosophy lacks the tools for the attainment of empirical knowledge, opting for confinement in a trap of words seems like motiveless amputation.*"

Greater interest appears to attach to the proposal put forward by hermeneutics for reflection involving us and others in the same game together with criticism of the concept of truth, an aspect already highlighted by the constructivists. We refer to the idea that truth always proves partial in that what the subject knows is not an objective reality but what he or she is related to and presupposed by, which involved a circular reflection (the "hermeneutic circle"). It should be recalled that recent years have seen a tendency to identify hermeneutics with a praxis that proposes a "dialogical and recursive" relationship between words, text and context, and a tendency to use this construct to symbolise a

"different" way of thinking free from the rigid constraints of science. The hermeneutic approach is in any case opposed to scientific knowledge, which it seeks to counter with what **Jacques Derrida** called knowledge "*as beautiful as an essay and as true as a novel*". One of the few exceptions to this opposition is the approach proposed by Vattimo, who suggests that philosophy can act as a spur to science, since both can only construct models but cannot attain truth.

We shall briefly mention just two movements deriving from this linguistic turn that have been taken up by psychologists, namely **narrativism** and the idea of the **rhizome.**

Reference to a **narrative model** (**Jerome Bruner**, 1990) appears frequent even in spheres distant from one another. This means according priority to a model that rejects a realistic epistemology and to interpretation as the primary tool in order to foster relationality and the construction of multiple complementary stories. In which spheres is it applied? Attention is drawn to the narrative modality of thought, the narrative construction of reality and the collective accumulation of narratives that engender different cultures and cultural traditions. Referring to a narrative model involves focusing attention on language and on personal and interpersonal meanings more than the drives and constitutive energy of the individual (the meta-psychological model); a new concern with time, memory and remembering; according priority to the processual character of a story (of an idea, model, person or group), coherence between past, present and future, and re-contextualisation with respect to the present; drawing away from any claim to real constructions in favour of a hermeneutics of relation. Referring to narrative thought means abandoning tests, demonstrations and an objective conception ("paradigmatic thinking") in favour of a perspective vision; transition from the general to the particular. The narrative model is also regarded as the structure of human experience.

The operation in question involves recalling personal experience through a biographical narrative construction. While the text that emerges is apparently connected with the "faithful" remembering of childhood, life or an event, it is a matter not so much of causing memories to resurface as shaping them and rearranging them in a coherent story that can change over time. Narrative action is therefore the process through which individuals tell various stories to themselves and about themselves, others and the world in order to organise their experience and present themselves to others at the time in which this operation takes place.

Our life is governed by attributions of meaning, by interpretations that make up the vocabulary, syntax and templates serving to determine and decode the world in which we live and how we move in it. Narrating can be regarded as an operation of knowing, in that narration organises the structure of human experience at the level both of sensory information and of concepts and attributions of meaning. There are only our descriptions, our interpretations arranged into stories, in a more or less sought-after process of evolution. Consequential and apparently coherent stories with a beginning, middle and end. People endow their lives with meaning by telling the tale of their experiences. The very act of telling provides the opportunity to create (unconsciously) a version of our lives and therefore of ourselves. It makes it possible to have an audience (which can also consist of oneself) and to contextualise the meaning of experience. It makes it possible to re-contextualise experience and construct different versions of the same story in relation to changes in life, traumatic events or just the passing of time.

The Rhizome: thought and change

The concept of the **rhizome** was developed in the philosophical sphere in the 1970s by **Gilles Deleuze** and **Félix Guattari** in order to describe knowledge and thought. The rhizome is a part of the root of ferns and aquatic plants that is capable by itself of generating new extroversions, new roots, and permitting reproduction of the entire plant. The two French philosophers (Guattari was also a psychologist and psychoanalyst) took botany as an example to describe the growth and transformation of ideas.

This metaphor enabled them to move beyond the representation of an orderly and hierarchical development of ideas – the offspring of linear, Aristotelian logic – and show instead how knowledge can also sprout from barren soil and migrate to spread in new contexts and habitats. In the same way, according to Deleuze and Guattari, ideas are born in a specific context and spread, taking root in different environments like weeds.

With this new meaning, the history of ideas, the "archaeology" of knowledge inaugurated by Foucault, lost its place as a cornerstone to a more diachronic type of description that saw the dialectic of ideas as its true driving force. Ideas are mobile. They spread even without solid roots and grow and scatter in search of a terrain to colonise, a space that will only take shape through the meeting of different rhizomes, roots capable of generating new plants and giving birth to new ideas.

Interest attaches in this connection not only to individual representations but also to an authentic "ecology" of knowledge in which different ideas confront, replace and alternate with one another, to take up the metaphor put forward by Gregory Bateson back in the early 1950s.

On this view, the various habitats are nothing other than social contexts, places for the meeting, production and dissemination of ideas. As attested by the success of the Internet and social networks, the launching of new ideas does not require a hierarchical organisation of social contexts. If anything, these appear to us in a nexus all on the same level (albeit with different degrees of charisma) in accordance with a "horizontal" representation of systems of knowledge. Ideas are born out of this fabric like authentic emergent entities, spread first in some specific contexts and then come to constitute thoughts broadly accepted by the community only at a later stage in the expanded context.

The American clinicians **Lynn Hoffmann** and the Canadian **Christopher Kinman** have used the model developed by Deleuze and Guattari to describe some forms of action that can be taken in accordance with these assumptions. They speak of a language of gifts, of not knowing, witnessing process, of local wisdom and rhizome connections (Kinman 2000, Hoffman 2001)

The Cognitive Sciences

While the question of which areas of study are or are not systemic could be examined, greater interest attaches in our view to pinpointing the assumptions and viewpoints also of areas of knowledge other than the already provisional and plural field of "systems science". If this is essentially aimed at understanding and integrating the various forms of knowledge, as von Foerster tells us, dividing these up into systemic and non-systemic proves a sterile operation. Importance appears instead to attach to the ability to move along the boundaries (faint borderlines, temporary frontiers) and look out on other approaches, systems of knowledge and theories for the purpose of giving an idea of the variety of the landscape and proposing the fundamental "systemic operation" of the juxtaposition and possible enrichment of different viewpoints and disciplines. We are opposed to the tendency of recent years to

crush the sciences into separate, non-communicating models like disposable articles. In accordance with the systemic approach, we consider it indispensable to take into consideration also authors who do not describe themselves as systemic but put forward avant-garde theories.

We shall now present some recent models drawn from the neurosciences that are arousing great interest precisely because they put forward theories of knowledge capable also of encompassing a procedural matrix. In our view, it is a duty of systemicists to combine the new theories with the constructivist and constructionist assumptions and the "contextual knowledge" drawn from anthropology and linguistics.

Heinz von Foerster regarded life as computation[52] (*cum-putare*: to consider things in combination, together), i.e. as a not necessarily numerical operation of transforming and organising physical data within a medium. The author addressed operations for the acquisition of knowledge, understood as the activity of information processing determined in the organism's experience by invariants of the nervous system rather than structures and events in the outside world. Von Foerster (1990) understood cognition not as an operation of re-presentation of a world existing *a priori* but as a continuous operation serving to bring out the image of a world through the process and actions of common life. From this viewpoint, knowledge becomes ontogenetic. Living becomes a cognitive process, an epistemological operation; it becomes knowing, in a process in which the knower and what is known, subject and object, originate together.[53]

Recent years have seen the growth of cognitive science,[54] which combines the studies of neuroscientists into the complex structure of the brain, of cognitivist psychologists examining the processes of thought and consciousness, and of those working in the field of artificial intelligence to reproduce thought processes by means of computers. A pioneering role in this field was played by *A logical calculus of the ideas immanent in nervous activity* (**McCulloch** and **Pitts**, 1943), where the authors suggest the possibility of constructing a model of the brain through a network of logical operations. This was the first example of a neural network, the first attempt to consider mental activity

[52] Alan Turing (1937), the inventor of the modern conception of computation is often referred to by von Foerster.

[53] The principle of undifferentiated encoding holds that the response of a cell does not select the physical nature of the agent triggering the response. What is encoded is only "how much" took place in a part of the body, **not** "what". In other words, the activity of a nerve cell encodes only the magnitude of the perturbation, not the nature of the perturbing agent.

[54] Francisco Varela (1985) divides cognitive science into four phases: an initial cybernetic phase that saw the creation of a science of the mind; a cognitivist phase based on information processing (the rule-based manipulation of symbols), which gave birth to artificial intelligence; a phase using the metaphors of self-organisation as the kernel of the brain's operations (the computational approach put forward also by von Foerster), which led to connectionism and network dynamics; a fourth phase, to be set in motion or unveiled, which criticises the use of the concept of representation of the world and the idea of intelligence as problem solving, and proposes a process of interpretation capable of involving our language and history indivisibly. Cognition becomes an affective act, the story of a structural coupling that puts forth a world.

in terms of data processing. It was an attempt to open up the black box and jettison the behaviourist, mechanistic model in the sciences.

This brief overview will examine recent studies in the area of the neurosciences, understood as an interdisciplinary branch that rejects the Enlightenment myth of monological knowledge and seeks to understand how the brain works by bringing together in a single family disciplines with very different traditions such as neuroanatomy and neurophysiology, genetics, linguistics, biochemistry, artificial intelligence, immunology, mathematical model theory, anthropology and psychology.

The first cognitive studies were born out of dissatisfaction with the behaviourist approach that came to predominate in American universities as early as the end of World War II. The basis of the behaviourist theories was an attempt to determine predictable relations between the stimuli administered to an organism and its responses (Watson's S-R model). Every possible reference to mind was outlawed, even though many authors suggested the action of "variables" inside the organism. Works by authors taking the opposite approach to the behaviourists, such as **Jean Piaget** in Geneva and **Vygotsky** in Russia, were known as early as the 1950s. Approaches based on different assumptions were also developed in other fields, such as linguistics with **Chomsky**[55] and the above-mentioned cybernetic revolution, which was concerned precisely with the visible behaviour and functioning of the organism and the machine (more subjective aspects of knowledge being relegated to the "black box"). The transition from the behavioural to the cognitive approach did not, however, come about all at once, as some historical reconstructions would have you believe, but rather saw the coexistence of different assumptions (including mechanistic views) that can be traced also in some contemporary authors.

The first works marking the birth of cognitivism are **Broadbent's *Perception and Communication*** (1958) and ***Plans and the Stucture of Behaviour*** (1960) by **Miller, Galanter and Pribram** (1960). Broadbent was the first to present a complete model of the working of the mind (perception, memory and behaviour) in the form of a flow chart. It is precisely this type of diagram, which describes the flows of information and elaborations on the part of "agents" (shown as boxes) that characterised the subsequent cognitivist models (which ignore the physiological substrate). It should be recalled that Broadbent continued to describe himself as a behaviourist and that Miller, Galanter and Pribram were self-proclaimed "subjective behaviourists". It was their book that drew an explicit analogy between the mind and the computer through the description of the "plan" (the famous TOTE: Test – Operate – Test

[55] According to Varela, 1956 was the year when the cognitivist phase of the science of cognition came into being through two meetings held in Cambridge Dartmouth with the participation of Herbert Simon, Noam Chomsky, Marvin Minsky and John McCarthy.

– Exit) as a computational operation.

The cognitivist model was defined in **Ulric Neisser's *Cognitive Psychology*** (1967),[56] where the examination of an enormous number of experiments served as a basis to develop a new approach, no longer concerned with behaviour but with the description of mental processes. Neisser's book was so successful as to attract the attention of all researchers working on "scientific psychology" and was greeted as evidence rather than the proposal of a theoretical model. This uncritical acceptance led in the 1970s to a spate of "micro-analytical" studies aimed at developing "micro-models".[57] The yearned-for reconquest of the mind ultimately proved to be a wholly illusory aspiration. Cognitivism led initially to reaffirmation of the analytical and mechanistic viewpoint, which left some of its own advocates dissatisfied. In outlining the evolution of cognitivism, **Jerome Bruner** (1990, p. 34) recalls that the original aim of the cognitive revolution was to prompt psychology to collaborate with the humanistic hermeneutic disciplines. He soon noted that this aim was becoming increasingly distant and that the initial interest in meaning had given way to a focus on the acquisition of information as described in engineering and mechanical terms. According to Bruner, the greatest development of cognitivism lay in the information technology leading to a form of "new reductionism". In this way (p. 24), "even the old S-R learning theorist and associationist student of memory could come right back into the fold of the cognitive revolution so long as they wrapped their old concepts in the new terms of information processing. One did not have to truck with 'mental' processes […]. So long as there was a computable program, there was a 'mind'. " When we speak about cognitivism or neurosciences today, we are therefore speaking about a heterogeneous set of frameworks ranging from the more typically reductionist type to those sensitive to epistemological changes and the new approaches to knowledge.[58]

The growth of "atomistic" and compartmentalised models of the human mind was also paralleled by the development of holistic or molar models, as in Neisser's subsequent work ***Cognition and Reality*** (1976), which put forward the ecological viewpoint (derived from Gibson) and the "perceptual circle" as complex models taking into account also the expectations and knowledge of the epistemic subject.

Among the various molar viewpoints, interest unquestionably attaches to what is known as **connectionism**. (**Farmer** (1990) had the key idea of representing a population of interactive agents as a

[56] The term "cognitive" was first introduced here.

[57] All respected authors gave their names to models in that period.

[58] Classical cognitivism put forward a "sandwich" model with perception (the sensory apparatus) acting on cognition and cognition guiding action (like a machine that emits electrical impulses and produces movement). Evolutionary psychology saw the brain as equipped with increasingly sophisticated modules, like a Swiss penknife: our biological nature conditions the way we represent ourselves and act in the world, and representation is influenced by who we are. Mentalisation involves

series of "nodes" linked by "connections".[59]) If information processing is seen by cognitivists as the manipulation of abstract symbols on the basis of defined syntactic rules, connectionism proposes a different viewpoint that dispenses with creative thought and the idea that networks of connections are *a priori* and perennial frameworks. Leading connectionist authors such as **David McLelland**, **David Rumelhart** and **Domenico Parisi** take as their starting point the observation that no predefined rules of processing or control centres can be identified in the brain. In their view, the brain works through massive interconnections distributed in such way as to alter their degree of connectivity in relation to changes in experience (in accordance with self-organised capacities). In other words, the models developed present parallel operations capable of attaining the speed of decision-making that sequential models failed to simulate. One substantial difference between the two models (sequential and parallel) concerns representations, regarded as representations of external reality by cognitivists and as depending exclusively on the values and degree of internal connections by connectionists. On this view, the various connections form a network that makes possible the emergence of global states of the system (**attractors**). Connectionists see the cognitive capacities as the emergence of global states of the neural networks. This line of investigation can be traced back to the work of Hebb, who suggested as early as 1949 that the brain's changes in connectivity might be related to the degree of coordinated activity of the neurons. Connectionist models were better able than their classical counterparts to account for the swift recognition of even partial configurations as well as the work of the associative memory and categorial generalisation.

These changes and this proliferation of models and tools of investigation made possible a new exchange of ideas between cognitivist studies and the dialogue between neurologists, physiologists and authors working in the field of **artificial intelligence** (**AI**).[60] This fertile soil saw the growth of the comparative study of the fields that were to be gathered together under the name of neurosciences. The epistemological approaches are heterogeneous also in the neurosciences, not so much a coherent set of studies and a homogeneous group of scholars as researchers that address the same problems but disagree emphatically on how to solve them. For this reason, we shall describe only the work of two

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the brain/body system interacting in a specific and located environment of other brain/body systems. Knowledge becomes embodied.

[59] See also Stephen Grossberg, *Neural Networks and Natural Intelligence*, MIT Press, Cambridge 1988.

[60] John McCarthy coined the term *artificial intelligence* during the seminar held in Dartmouth during the summer of 1956. Claude Shannon, Marvin Minsky, Frank Rosenblatt, Herbert Simon and Alan Newell were among the participants. There are currently different versions of the computational theory of the mind including strong AI (the mind is a computer program) and weak AI (which regards the computer as a useful tool for simulations of the mind). See Searle (1990). Attention currently focuses on artificial life rather than AI.

contemporary figures, namely **Antonio Damasio** and **Gerald Edelman**. Though among the most esteemed and studied authors, they are often described as "hard scientists" and do not put forward an epistemology capable of accounting for the cultural and social aspects of knowledge. In accordance with the approach of systemics, we believe that importance attaches not to accepting or rejecting every author en bloc but rather to the attempt to contextualise models and see some of their aspects also from perspectives that they overlook (The social aspects can, for example, be incorporated into the models put forward by the neurosciences). In this case, we believe it is indispensable to come to terms with these highly advanced models of the mind, which acknowledge in themselves the social viewpoint, albeit only in part.

Brief mention must be made of **Karl H. Pribram**, perhaps one of first neuroscientists to develop a model of the mental processes based on the identification of two different types, namely the **tacit** and the **explicit**, resting respectively on procedural and linguistic knowledge. It is precisely these elements that underpin the models we are about to describe.

Damasio's work (1994) ideally continues (albeit only in part) the studies of Maturana and Varela on the mind as considered from a biological standpoint, reintegrating in the mind and the thought processes the bodily (or "embodied" for Varela) aspects emerging from the interaction between the subject and the natural and social environment. Damasio's model expressly deals with the neurology of vision, memory and language, and takes into consideration the organism as a whole rather than just the brain, as is common practice in neurology. It sees the mind as effecting a connection between abstract symbolic aspects (language) and some bodily states (actions, visual information). On this view, a representation of an object (a screwdriver for example) comprehends not only the semantic definition but also all the actions and sensations experienced in ordinary use, it having in fact been established by the Portuguese neurologist that the brain uses the same processes to "construct" both linguistic representations and those of other types. His approach seeks to supersede the Cartesian antinomies, above all the juxtaposition of mind and body, reason and emotion. The examination of patients with neurological lesions (to the prefrontal lobes) has shown that the emotional aspects are indispensable for the rational processes and indeed constitute the platform enabling them to take shape. Emotion is cognition and the two are therefore no longer regarded as antithetical. Even though they are two neurologically independent systems (the lesions can even be selective), they activate associative processes – the connections between logical reasoning and emotionality – that can be regarded as regulating both biological and social life. There is no control centre of the mind or consciousness (what Daniel Dennett calls a "Cartesian theater"). The mind is a process (like consciousness), emerging due

to the interconnections between parallel processes that establish communication between cerebral areas that may also be very distant from one another (according to the connectionist approach).

Interest attaches to Damasio's numerous studies into language, which identify three groups of interacting structures:

* a large collection of neural systems in both hemispheres representing non-linguistic interactions between subject and environment guided by the sensory and motor system

* a small number of neurons belonging to the left hemisphere that represent phonemes and syntactic rules for the production of words

* a third group of cells, again in the left hemisphere, which perform the task of mediating between the first two groups and are essential to the understanding of concepts

As a representative of human symbolic activity, language is seen in this model as made up of an interpenetration of abstract concepts and concrete experiences (as suggested by William James with his conception of the "I" and the "Me" as early as 1890). "Meaning" thus becomes such only when a concept is confronted with "sense", i.e. when connected with an experienced sensation that provides a physiological, biological substrate for knowledge.

The second model examined here is the one developed by **Edelman** over the last twenty years at Rockefeller University, which has many points in common with Damasio's model. Both interpret consciousness and the mind as an emergence due to the interconnection of a multiplicity of parallel processes, as emerging from the relationship between different centres of the brain connected by feedback processes. In 1972, the year in which he was awarded the Nobel Prize, Edelman suggested that the nervous system "worked" as a selection system, classifying and categorising the subject's experiences in order to develop a model of the world (a map capable of guiding action). Edelman regards selection as acting over both over a subject's lifetime and in very short periods, and as connected with groups of brain cells. The Nobel laureate identifies two types of selection, one operating in development and the other due to experience. Every organism possesses minimal elements of pre-programmed information that Edelman calls "values" (including selective attention, hunger and the active pursuit of stimuli), which guide the subject's actions and attach different importance to the various experiences. These values are perceived by the subject as sensations (such as hunger, annoyance and pleasure). Through new experiences, the subject selects the corresponding neural circuits and the categories used to "construct" an image of the world, a world of subjective meanings due to an experienced history emerging in the relation with the environment. Experience thus strengthens or weakens the connections between neural groups by stimulating new connections. On

this view, the subject plays an active role through social action in building up the maps, which include the subject's motor responses. Edelman's map is not an ordinary representation but an interconnected series of neural groups that responds to events of a specific category. The perception of an object therefore depends on the synchronisation of a number of mappings spread over different areas (visual, sensory, motor) so as to create a subjective connection between the categorisation and the actions experienced. Perceptual generalisation and the "re-entrant signalling" process – a feedback process that consists in a continuous loop of communication between the active maps – make the maps used stable while maintaining the possibility of including new elements. Maps are defined through modulation of the re-entry (of output) and those existing are used to create maps of maps (as in language). On this view, memory is nothing other than a new and continuous categorisation of maps on the basis of the previous categories. It is precisely in the relationship between the new maps and those in the memory that Edelman locates the problem of the mind and consciousness. He identifies two types of **consciousness**, namely **primary** and **higher-order**. While the former is the state of mental awareness of things in the world in which we have mental images of the present, the latter, which involves recognition of the subject's affects, incorporates the models of personal identity, the past and the future as well as the present model (1992, p. 174). The primary consciousness thus puts the multiple categorisations involved in perception together in a scene in accordance with a subjective sequence based on what possessed "value" for the subject in the past. The "scene" is not a figurative image but rather a correlation between different types of categorization (a **hypertext**, in our view). The primary consciousness is therefore a prerequisite for the higher-order consciousness but lacks the concept of a personal self and the capacity to model the past and future as parts of a correlated scene (ibid., p. 190). Edelman thus proposes the integration of two different processes, one linked to the present (to the memory as a categorial value) and the other to the symbolic memory and concepts. The concepts of self, past and future can therefore be connected with the primary consciousness. As in Damasio's model, there is no consciousness totally detached from biological processes and sensations due to the relations between the subject and the context.

Both models present an image of the mind that cannot be separated from pre-logical and pre-verbal aspects or from the bodily aspects of the emotions experienced by the subject in relation to his or her social context.

The field of the neurosciences has also seen a series of studies focusing great attention once again on neurophysiological explanations of human activities. We refer to the discovery/invention of **mirror neurons** by a group working at Parma University, Italy, under **Giacomo Rizzolatti** and **Vittorio**

Gallese (1991).

By examining the behaviour of some neuronal groups, first in the more complex monkeys and then in man, the researchers identified a series of neurons situated in the pre-motor frontal cortices, which are triggered when the subjects perform certain self-directed actions (such as lifting food to the mouth) and also when the subjects are simply shown the same actions performed by others.

According to these studies, perceiving is acting and vice versa, at least from the neuronal standpoint. These "discoveries" open up new ways of understanding empathy and emotions in inter-subjective relations. According to the authors, emotional experiences do not refer solely to individuals but also to relations and are propagated between subjects through a process of cenesthesic imitation with no mediation on the part of the more complex symbolic circuits linked primarily to language. Acting as an experimental analog, the body experiences the same sensations as those performing significant actions in that it actively reproduces them.

Through the action of the mirror neurons, affective communication is always active in face-to-face exchanges and characterises both primates and man. The studies of Gallese and Rizzolatti now provide insight into the biological substrate of empathy and the ability to understand the intentions of others immediately. These forms of communication are of primary interest to clinicians of all types, who have always used such resources in an attempt to lend greater complexity to the dis-adaptive schemata of their patients and their systems, thus creating forms of communication that are more widely accepted and always open to new definitions of meaning. The contribution of the neurosciences is increasingly precious today and regards the very processes examined by clinicians, thus becoming a transversal form of knowledge, a set of basic ideas about man, human biology and forms of human interaction.

The Present-Day Panorama: knowing the metaphors of knowledge

So far we have described the historical evolution of the major fields of knowledge. This section will describe the present-day panorama, no longer by listing theories but by seeking to pinpoint the spirit and the attitudes of the scholars involved.

A somewhat new situation has taken shape in the wake of a period of swift and drastic paradigm shifts and the evolution of viewpoints regarding the universe, mankind and knowledge. For many years, every discipline presented its own tradition of studies and research, a sharply defined theoretical nucleus and a delimited and clearly stated object of investigation. This state of affairs appears to have

undergone considerable change today. After the "enterprise" of cybernetics and systemics, the challenge of complexity and the proposals of the evolutionary paradigm, dialogue between the various disciplines has become at least standard if not indeed obligatory practice. The "new" proposals have not been organised into a unified and all-inclusive science. What we have is fortunately not a new and superior vantage point offering a panoramic view (Gianni Zanarini, 1990, points out the risk of "transdisciplinary euphoria") but a way of thinking, a new relationship with knowledge: "*It is precisely this awareness of the limitations of every approach together with the need to combine different approaches that the science of complexity can suggest*."

If the "classical" studies concentrated on a single viewpoint (suffice it to recall how psychoanalysis was calcified for years around the work of just one thinker), using a "fundamental" metaphor and a univocal research methodology, the wares on the counter of knowledge today are varied and often interconnected. If "clear and coherent" ideas were once indispensable, the prerequisite now is what the French philosopher Deleuze called "nomadic thought", manifold and complex thinking that emerges from a web of sometimes contradictory knowledge. (Use is made, for example, of Bateson's abduction, understood as a form of reasoning in which a similarity between two elements suggests the possibility of further similarities.)

The need is felt for a broadening of horizons and many authors and clinicians have reformulated their categories. The change has been qualitative in nature and led to a gap between the many tools used and the reality (or realities?) addressed. The explicative difference between different approaches is not, however, to be seen as a battle for the definition of a paramount paradigm but rather as a logic of complementarity between viewpoints, observers and levels of observation.

Our reconstruction of the major phases of epistemological evolution would have been impossible without simplifying the different transitions and sketching a broad outline of the history in terms of categories and schools of thought. Knowledge evolves, however, in the dialogue between different views and perspectives through emergent situations and local events. The cybernetics of cybernetics, the challenge of complexity and the shift to theories about self-organising systems created a fertile terrain giving birth to the network and the hypertext, which transcend the inevitable process of "linearization" and precise elucidation of theories.

One of the innovations that we intend to address regards the now established awareness of the use of metaphor in knowledge. Considered as a fundamental process of thought rather than a figure of speech, metaphor plays an important role that has been underestimated for far too long. For example, while the mind has always constituted a sort of puzzle for theories of knowledge, the metaphor of the computer

appears to shed some light on this. If the mind is a computer, it will have hardware, software, a working memory, long-term memory, buffers and so on.

Bateson, the recent author who laid most stress on the value of metaphors in science, took the parallel between development (biological evolution) and the mind as the basis of his speculative thought. Thanks to the "magic" of metaphor, the theories of evolution could thus be regarded as useful guides in describing the evolution of ideas. In this way, the theories of Gould, Lewontin and Bocchi and Ceruti have been taken up as theories of the mind by those working in this field and investigating change in mental processes in communities and social groups. And the same holds for the new sociological and anthropological discoveries, the new advances in technology and AI, and the mathematical and physical theories described here as well as other developments. All these images of knowledge enable us to think of new theories that become what Dennett called "intuition pumps". In this context, the role of modern researchers and systemicists is not to define an object of knowledge but to engage in "dialogue" with all the possible definitions of the same object, to open up their mental horizons and the discourse to unforeseen developments. The role of systemic researchers is to put forward models capable of inspiring other models, to act so as to increase the possibility of choice both for themselves and for those they are addressing, the readers in our case. Their task is not to put up one idea or metaphor in opposition to another, adopting a model of exclusion, but to accept the complementary nature of viewpoints and the overlapping of theories.

In our view, the risk involved in the metaphorical application of knowledge from a known field to one we wish to investigate is of performing a sort of conjuring trick whereby, for example, knowing a lot about computers also means knowing (presuming that you know) a lot about the mind. Those who use metaphors – like every artist, scientist or philosopher – must be fully aware of their characteristics and also assume all the responsibilities connected with their extraordinary use.

The danger is that this knowledge can be used to organise studies and experiments and thus to develop a model of the mind out of nothing. This use of metaphor seems to derive from the fear of ignorance and an attempt to control the world by putting forward all-embracing frameworks, based on an "ancient" view of knowledge as a process of accumulation. The risk emerges of seeking to establish the identity of a theory or a group of researchers solely in terms of differences, through the identification of an external enemy to fight against.

Well, the present historical moment presents no key metaphor or group of metaphors but rather a vast array of models that can be regarded as useful with a view to exploring other fields, raising new doubts and identifying areas of darkness. Because science does not illuminate but continually expands our

horizons where there was once ignorance where once only metaphor had enabled us to arrive. . It reveals areas to be investigated, examined and understood without the use of previous techniques and knowledge. There is thus a positive use of metaphor as a guide in exploring new avenues of knowledge, investigating and even refuting new conceptualisations. The resulting models and maps must then be tested in new ways through new ideas, because knowledge is never simply reproductive.
To give just one example, the concept of the dissipative structure is used in geology to account for continental drift, among other things, and in meteorology to address thunderstorms, hurricanes and the climatic system.

From Systems Theory to Systemics

Systemic thinking is understood in this introduction as the result of various evolutionary stages and not as derived solely from general systems theory. As we have seen, it involves a focus on the relations and dependence between objects, be they human, natural, companies or parts of a whole. What is put forward is therefore not so much an explanatory theory as a framework for the observation and understanding of events, a set of proposals, some of the many possible interpretive lenses, those we regard as still relevant and still delight in discussing.
The philosopher of science Thomas Kuhn (1962) asserted that transition from one paradigm to another took place through scientists with one foot in the tradition and one on the new path. In order to combine respect for the past with an interest in new developments, we suggest that the evolution of systemic thought should be taken as a fundamental epistemological operation of knowledge. We take up Heinz von Foerster's invitation to use systemics (the ability to consider things together) as an operation to be placed alongside the traditional operations of science.
Clarification of what this means will be provided by the following remarks made by the Viennese epistemologist during the two days spent in Rome to supervise plans for this work in April 1998:
"There should be two complementary ways of seeing and thinking. One is the way peculiar to science (currently thought of too often with a capital S), which comes from σχι (divide) and also puts forward a definitive methodology. Then there is the complementary way of thinking and observing of systemics, which comes from συν (put together), in such a way that the different divided parts together form a whole. If you choose to divide, it's science. If you are instead concerned with complementarity, you can enter a systemic paradigm whereby one logic is capable of representing another and complementarity

and overlapping are reflected in each. In this way, each of the two modalities represents and defines the other. General systems theory already set itself the goal of not dividing things and observations but connecting them to one another and considering them together. The strength of the work done in physics lies instead precisely in division, whereby if I don't understand the whole, I can divide the parts and understand some of them even though the whole escapes me. To talk about science, art or even the weather, you have to make a choice. You can use the scientific model with its way of organising the data: carry out research, test a theory, try to refute it, devise models, discard hypothesis. You can also opt for the systemic approach based on dialogue, on a typical form of focus on human relations that reinstates science in its original domain of human dialogue.

The problem of physics and the so-called hard sciences (physics, chemistry and biology) is that they deal with soft problems, i.e. problems that can always be divided to the point where you are left with units that are easy to handle. The so-called soft sciences (sociology, psychology, anthropology) instead deal with 'hard' problems, i.e. complex problems that cannot be reduced to simpler forms.

Systemics is concerned with the rules of composition and deals above all with interaction between parts. The term "systemic" is frequently misused if understood as an adjective, as in a systemic approach, a systemic therapy, a systemic way of thinking. What actually happens is that we don't think sufficiently about what we are doing, how we operate as systemicists. My proposal is to invent a new term, namely the noun systemics. Systemics thus becomes a way of observing and addressing the world. There is a splendid term for science in German, namely Wissenschaft, which means knowledge production, something that produces knowledge. Knowledge can be produced in very different ways. It can be produced by separating things or putting them together: separating things and looking for differences or putting them together and looking for similarities, points of contact. The term system derives precisely from the Greek word for one and συν (put together). What it means etymologically is putting things in one, making them one.

I propose to consider systemics as a position, a way of observing, a cognitive attitude. Drawing a distinction is scientific; seeing complementarity is systemic. In this perspective, concepts overlap through the reciprocal definition of self and the other.

It is not necessary to choose one approach or the other. We must use both at the same time in order to obtain greater depth of field.

You ask me to go on talking about what systemics is? I will reply by explaining my interest in the form of the question and the form of the answer. I think that the idea of "form" is not fully understood. If someone asks me what consciousness is, for example, I can say, 'Let's look it up in a good dictionary.'

If he isn't happy with the form of the dictionary, I can suggest looking it up in an etymological dictionary. He could then reply that he isn't interested in where the term comes from but in something else.

When you ask me what systemics is and invite me to go on talking about it, I reply that I am interested in the form of your question and also in your expectations as regards the answer. My question comes to regard the forms in which a dialogue works and develops. Addressing the form of the questions and answers leads to thinking of a dialogue, which I see as a dance; a dialogue understood as an interactive operation in which causality disappears. If we are talking about a scientific definition of consciousness, for example, we can look it up in the books. When we look for a definition of systemics, significance attaches not so much to the answer as to the dance prompted by the question, which becomes a dialogue. It becomes interaction and builds up complementarity between two people who come into contact. Even though we have called them complementary, these are therefore two very different domains. Systemics is developed by people who want dialogue, who want to think together, to dance. Examining the form of the question means highlighting or in any case negotiating a common domain. Analysing the context of the question means not giving answers that bring the conservation to an end but asking which shared domain the question was framed in. Dialogue makes it possible to meet and to move beyond separate identities and the fragmentary nature of language. Being together becomes the important thing. This is an interactive operation in which two people become one, in which I have to put myself in the other person's shoes in order to talk and s/he is forced to put him/herself in mine. We each see ourselves through the eyes of the other. In this way we come to form a unity. Separate identity disappears. Identity loses its explicative and explanatory power, and the very idea of explanation takes on a different dimension. I would also say that the logic of the two systems, the scientific and the systemic, are completely different. As regards language, we have two completely different spheres. In one there is appearance and appearance defines identity. It separates. It is similar to science. Appearance is always syntax. A person wishing to construct a meaningful sentence has to organise it with a subject and predicate, to put in the commas, make pauses at certain points, decide how to do it. A part of language has to do with understanding sentences but the other aspect, the semantic aspect, is a miracle. Syntax presents a linear and logical causality. Semantics is organised like a network. It establishes a net-like relationship stretching in many different directions.

Personally, I regard men as tending more towards syntax and women towards semantics. There are two different forms of logic, one syntactic and one semantic.

The arguments of McCulloch and Bateson are typical examples of semantic logic. In his renowned article on the heterarchy of values determined by the topology of the nervous system, McCulloch demonstrated that there are systems as rigid as military or religious structures that think in terms of a universal "best". In actual fact, the salient aspect that McCulloch demonstrates is that the nervous system cannot compute a definitive value but works through a heterarchy, i.e. through a constant selection of values based on circular logic. I regard this as one of the greatest contributions to science of the 20th century. McCulloch said: Suppose a person has the choice of an apple and a banana, and chooses the banana. Then he has the choice of a banana and a cherry, and chooses the cherry. If he is now asked to choose between an apple and a cherry, a logician will assume that he must go for the cherry again, whereas the apple is also a possibility from the semantic standpoint. The logician will say: "Look how stupid people are. They cannot think logically." Bateson and McCulloch instead say: "Look how stupid logicians are. They can't even understand how people think."

How can we develop a logic capable of accommodating this unpredictability? The new definitions and the new problems in science are not invented but emerge in the dialogue between two or more people who do not know how to solve a problem and try to address it in a joint dance. Scientists do not therefore sit down at their desks and invent new concepts; new concepts emerge from their dance, from their shared doubts and relationship. Let me give another quick example to clarify the difference between the two ways of approaching knowledge. In his day, von Bertallanffy put forward a general theory of systems that was in line with the times. The word "theory" would not be included in my "systemic dictionary", however. Theory is a concept that belongs to the domain of science, not of systemics. In order to be valid, a theory must be falsifiable and Popper's concept of falsifiability, though very valid and indeed indispensable, is not consistent with systemics because it presupposes a linear logic. Systemic logic is related to semantic logic, whereas scientific logic is syntactic and its rules are given from outside. The simple logic of syntax is crucial in order to examine, understand, analyse and dissect the rules of the sounds made in order to speak; the role of semantics is to make sense of the sounds. The logic of semantics is required to connect innumerable data."

Systemics is understood by Heinz von Foerster – and by the authors of this work – as the result of the various movements described rather than just general systems theory. It involves considering the effects of the connections between people both in the context of everyday life and in structured organisations. It involves suggesting approaches that take into consideration the aesthetic and the ethical dimension at the same time. The proposal is to accept the indescribable, the possibility of speculation, fancy and the imagination as possible modalities of knowledge. Access to what is not yet

explicable would be placed alongside what is already predictable and calculable in a complementary vision, a broader vision in which both ways of thinking are accepted.

Heinz von Foerster has proposed a form of knowledge to place beside the traditional scientific method, one that takes relations into account as a tool of knowledge and language as a tool of experience, as well as the necessary assertion of the researcher's responsibility. This is an operation in line with the complementarity of cybernetics, with processuality, with the revolution outlined in these pages.

The purpose of this book (*Systemics*, that came out only in Italian in 2003) is to present the words and keywords of the new epistemology, to explain them through subjective pathways of a logical, historical and philological nature put forward by the co-authors, to connect the different constructs with one another and also to outline some practical implications. Readers will in turn be able to plot their own course through the work on the basis of their selection of words and identification of strands of meaning running through the array of possible subjects and the specific material of interest.

The book also examines the methodology and operations of systemic logic in greater depth through analysis of the key concepts in order to use systemics itself as a frame to consider the problems, a processual and holistic frame that accompanies but does not replace what is known as classical science.

Conclusions

What subjects will science be called upon to address next? What epistemological revolution lies in wait around the bend? We cannot say but are very curious to find out.

We are aware that we have not been exhaustive in these pages, where we have offered stimuli and arbitrarily chosen the path along which to lead the reader. We draw comfort from Montesquieu's words: "It is not necessary always to so exhaust a subject that one leaves nothing for the reader to do. The task is not to make him read but to make him think." (*De l'esprit des lois*, XI, 20) We do not say this out of self-justification but as a further exemplification of the epistemology that has guided us in the relationship between constraints and possibilities, out of respect for who we are and what we have done so far.

In conclusion, we must admit that as it develops, every theory expands the area of the unknowable and that this, by increasing our awareness of our ignorance, also increases the drive for exploration. As Bateson wrote (1991, p. 395), this attitude could in particular lead the human race to a type of wisdom capable of preventing the wanton destruction of our biological environment and eliminating some of the strange attitudes we display towards patients, foreigners, minorities, our wives, husbands and children, and also towards one another.

The following are some thought on the application of what we have been saying till now to some specific fields and therefore the changes which have taken place within a complex systemic frame.

THE SYSTEMIC METAPHOR APPLIED TO PSYCHOLOGY, PSYCHIATRY AND CLINICAL PRACTICE

Umberta Telfener

Within the sphere of psychology, psychiatry and clinical practice in general, the systems-theoretical approach has not been applied exclusive to psychotherapy, even though it has been established there as a strong model, a sort of super-specialisation exploiting all the potential offered. While GST has had a direct and explicit impact on techniques of intervention, the relations between clinical psychology and the systemic model appear less sharply defined, being aimed primarily at the elimination of jargon and the linking of viewpoints. In the reductionist perspective, psychology appears as a provisional discipline, a stopgap until biology can explain what is described for the time being in psychological language. The attempt to move beyond a positivist framework and the transition from a psychological monoculture dominated by behaviourism and psychoanalysis have led to a polyphony of theories about the human dimension and greater attention to socio-cultural context and evolutionary processes. The application of systems theory as a framework to consider events and human beings has involved a number of developments that we wish to highlight, as listed below.

- an attempt to move beyond the compartmentalisation and incommensurability of theories and spheres of study so as to foster dialogue between them
- a shift of focus from energy circuits to communication, the relational perspective being characterised, as Jackson observed as early as 1965, by the assertion that human nature and social order are products of communicate
- the abandonment in explanations and theories about human beings of a single time (the present) and linear temporal sequentiality (from the past to the present to the future)
- the superseding of a fragmented vision of the human dimension in which predominance is accorded alternately to behaviour (behaviourism), cognition (cognitivism) and the emotions (theories of psychoanalytic derivation); hence an end to sterile battles and recognition of the primacy of interaction
- the adoption of a bio-psycho-social framework in which every aspect is regarded as part of a whole and attention is focused on multiple levels of organisation and reciprocal influence between biological and psychological processes and environmental and social conditions (context, culture and society as well as private contexts such as family, the couple, school and work)
- the adoption of relational, interactionist dynamic and processual models
- the contextualisation of study of the person and his or her development in a processual and evolutionary perspective (Buber's "human becoming") rather than predetermined phases
- a new view of the relationship between hereditary and environmental factors in terms of relative plasticity, the relationship between nature and culture being seen as an inextricable overlapping of levels
- the adoption of the model of autopoiesis to consider the human being, its development and the theories explaining the same, the individual, the couple and the family being considered as complex

systems that are organisationally closed (concerned to maintain their identity) and thermodynamically open (ready to exchange information and energy with the environment) in a permanent state of evolution through moments of order, disorder and reorganisation

- the abandonment of a theory of development based on the attainment of a predefined and predetermined final stage reached through maturational (hereditary) elements or environmental elements (experiences); the shift from a primary focus on the initial years of life and phases of development to consideration of the entire span of existence; the jettisoning of an idea of development as a single evolutionary pathway characterised by a single structure of change in favour of multidirectional development during life (plasticity that is in any case relative and not absolute)
- the transition from concepts of continuity to concepts of discontinuity with respect to change and evolution
- the non-predictability of evolution: the fact that subjects sharing certain factors of evolutionary risk (socio-cultural disadvantages, problems with family relations, poor health care and education, organic diseases and so on) take different and unforeseeable paths and arrive at different evolutionary results in relation both to individual differences discernable even in infancy and to differences in environmental context
- the abandonment of models based on homeostasis and equilibrium in favour of a processual and dialectical framework capable of combining homeostatic and evolutionary aspects and taking into consideration the presence of moments of crisis and moments in which the system is far from equilibrium
- the adoption of theories concerned with not only the pathogenic but also the health-generating aspects of life and the living creature and focusing on the processes and forms of adaptation during the life cycle as well as life skills, resources and other elements

Alternative epistemologies have led to a focus on language and qualitative methodologies of intervention in the definition of "reality". They have also suggested narrative and phenomenological tools as well as the use of subjectivity in the examination of human experience. The present conceptual frameworks respect the complexity and the multifactorial composition of experience, abandoning the security of knowledge in favour of the "wisdom of insecurity" (Watts, 1951). We regard a number of "movements" as highlighting the not always direct influence of systemic thought, as listed below.

The birth of the psychology of health as a sign of a primary focus on the bio-psycho-social aspects of the individual as permanently embedded in a context with which he or she must interact. This constitutes an extreme attempt on the part of psychology to move away from the model of medicine and a problematic, negative vision of life in favour of appreciation of its evolutionary aspects and potential.

The development of an integrated body-mind/mind-body approach capable of moving beyond the psychosomatic perspective and its rigid causal relationship between bodily aspects and manifest symptoms so as to create interconnection and dialogue between different aspects of human experience. Varela (1997) calls this approach "neurophenomenology", understood as an approach capable of jointly considering the structures of the brain and the subjective and phenomenological experiences of the mind (creating a recursive loop that binds them inextricably).

The non-identification of intervention with psychotherapy: the possibility of intervention appears to be born in a more contextual way and to take shape in the very place where the problems arise, thus eliminating the utopia of a "clean" setting. Therapists enter into a relationship with the context, the knowledge of the other and the situation. They adopt a stance, get their hands dirty, and become more

aware that they are always, necessarily operating within a culture. They thus go out into the streets, enter homes, schools and organisations, and develop preventive projects in addition to treatment. It becomes important that therapists themselves should institute a movement of sense endowment capable of bringing out the requirements and the demand for development and intervention of users embedded in different contexts, even in what we can call "first level" interventions.

The process of the psychology of connection as a way of improving the services supplied to people through integration and coordination of the treatment process and the possibility of giving a sense to the care received. This involves the creation, within a perspective of connection, of a case manager to supervise the various resources present in the community and to trace either *a priori* or *a posteriori* the direction of the path to be taken by users so as to coordinate all the efforts of the system.

A primary focus on culture as the key parameter for any understanding of a group, family or organisation. Between universalism (the problems are the same in all cultures) and relativism (a certain culture can only be understood by an expert in that culture), the task is to bring out the shared narratives, patterns of behaviour and linguistic and emotive points of reference that constitute the culture of encounter, the subsoil of that particular moment and that particular demand (Telfener, 2000). Therapists do not intervene on these specific cultures from within, as they cannot have full knowledge and command of all of them. It is, however, necessary for them to establish contact and propose a process of negotiation through an operation of demand analysis accentuating the possibility of coexistence with the various items.

A focus on the transpersonal and spiritual dimensions reflecting an effort and determination to accept not only the values of western culture (individualism hinging on personal happiness, pragmatism according priority to what is manifest, and scientism) but also different forms of culture in order to draw closer to traditional beliefs of a less elaborate nature and develop an "integral culture" capable of leading to the emergence of higher planes of understanding. This also means the investigation of inner space as the development of awareness and the possibility of exploring non-western forms of care and contact.

The adoption of the constructivist-constructionist model as a transversal interpretive model and common denominator of different psychotherapeutic models (a development addressed in the next section).

METAPHORS FOR SYSTEMIC PSYCHOTHERAPY

Umberta Telfener

After meteorology, anthropology and other social sciences, clinical psychology also came under the influence of changes in the scientific paradigm. Three dominant schools of psychology can be identified in the United States during the 1950s, namely behaviourism (which sees the person as an organic machine and object of study), psychoanalysis (which regards the individual as at the mercy of inner forces) and humanistic psychology (concerned with creative aspects and laying the foundations for the transpersonal psychology of the end of the century). The systemic model draws heavily on the

psychology rooted in phenomenology and existentialism. Initially applied to the new therapeutic model based on seeing families together, systems theory then became a lens used always and in any case to decode psychological and contextual situations regardless of the persons selected for involvement in the treatment process.

Family therapy was born in the 1950s out of the desire to complexify beyond the individual and utilize the resources of the context. The initial stage saw experimentation in situations of severe pathology with the involvement of the family as a resource providing help in the treatment of psychotic patients. This led to realisation that the behaviour of one was linked to the behaviour of all the others and the focusing of attention on the system as a whole. There was a shift from the observation of a single individual to the dyad (the schizophrenia-inducing mother of the well-known psychiatrist Fromm Reichmann) and then entire families, using some of the knowledge derived above all from the systemic and cybernetic revolution as an interpretive framework. While family therapy came to be identified with the systemic approach in the 1960s, clinicians with different backgrounds and psychoanalysts as well as a smaller number of behaviourists all experimented with families (**Murray Bowen**, **James Framo** and **Ivan Bosznomeri-Nagy** have been our fathers). In 1974, during the Philadelphia Conference, the so-called **systems purists** broke away from the other clinicians (whose training was predominantly psychoanalytical) by opting exclusively for an approach in line with the systemic principles.

In any case, the systemic therapeutic model derived some of its assumptions from behaviourism, just as general systems theory was taken up precisely by those from whom it sought to distance itself. At present, there no longer appears to be any convergence between family therapy and the systemic approach, and clinicians with different backgrounds also involve the entire family in treatment, while of course differing greatly in terms of theory and practice from those who proclaim their adherence to Bateson's ideas and cybernetics (often at the expense of respect for complexity).

As regards the systems purists, it is possible to identify an initial elementary pragmatic model with ***Pragmatics of Human Communication*** (1967) as its text of reference and associated primarily with the Palo Alto group. Focusing on communication, this uses the metaphor of the black box to address behaviour in the here and now and, not showing any interest in history, explanations, assumptions, fantasies and anything mental (still taking a scientist/behaviourist approach), they concentrate on communicational patterns and on what the system brings to therapy. Adopting the viewpoint and knowledge of the first cybernetics, the therapists behave as simple, external observers of the pathological system, upon which they act mechanically in such a way as to alter its patterns of behaviour and feedback circuits.

The therapy proposed by the **Mental Research Institute (MRI) of Palo Alto** (**Paul Watzlawick**, **John H. Weakland** and **Richard Fish**) seeks to resolve symptoms by addressing the circular interaction between the problem and the attempts of the subject and the family to solve it. In this perspective, intervention focuses on the attempts to solve the problem and the risk of these working instead to stabilise it. The therapists seek to interrupt the vicious circle thus created through redefinition of the problem itself. The strategic therapist therefore corrects a defective or inappropriate family structure. According to Keeney (1985), successful MRI therapy depends on avoiding attempts to understand the situation first of all.

According to the **structural approach** (**Salvador Minuchin, Bernice Rossman, Bralio Montalvo**), a system "finds" equilibrium in the feedback of the various components, and it is impairment of this equilibrium that leads to dysfunctions and pathologies. This model focuses on the structure (boundaries, alliances, rules, etc.) of the family understood as a system made homeostatic by the symptom, a structure confronted with an external and *a priori* norm. The shared assumption is that by modifying the communicative and therefore social organisation of the system, the recursive

relationship between problem and solution is also modified. According to these authors, the disadaptive organisation can be restructured and replaced with one that is more efficient. There are two typical dysfunctional configurations, namely entangled and disengaged families, which differ in terms of relations between subsystems and quality of boundaries as defined through analysis of the patterns of communication between members.

For **Jay Haley** and **Cloe Madaness** the solution of the problem within his **strategic model** must be framed in a broader social context. In his view, the "organisation" is disturbed when different hierarchical levels form coalitions, and especially when these are kept hidden (1971). The clinician addresses "triangulations", i.e. alliances that cross or get round the boundaries between the various subsystems, and intervenes directly by proposing tasks designed to challenge the usual behaviour patterns and lead to experience of a new situation.

Another systemic approach is the **experiential model** of the therapist **Carl Whitaker**, who uses absurdity and his own person to disrupt the family, proposing unusual and highly personal pathways to explore their assumptions as regards the symptoms and life.

Among the purists of the systems-theoretical approach, **Mara Selvini Palazzoli**, **Luigi Boscolo**, **Gianfranco Cecchin** and **Giuliana Prata** of the **Milan group** of clinicians were the first to open up the black box in order to address meanings and to introduce time and history into therapy (questions about the past, present and future). Their school has been described as **systemic** by virtue of its particularly rigorous adherence to Bateson's ideas. The members of the Milan school are concerned primarily with understanding why that particular family started treatment at that particular moment and how the request for therapy can constitute the last move in a three-generational relational game that will also involve the therapist and the referring physician. The systemicists of the Milan school are thus interested in the semantic contexts that frame and organise the symptom, which are analysed by a cybernetic brain made up of a number of clinicians, one in the therapy room and the others behind a one-way mirror. The therapeutic strategy of this group consists in the construction of explanatory hypotheses regarding the family's organisation and behaviour, the formulation of circular questions prompting new connections between the ideas of all those in the therapy room (the clinician included), and harnessing the neutrality/curiosity of the clinician, whose task it is to pose questions rather than "swallow" the hypotheses with which the system presents itself, which requires the ability to avoid forming an alliance with one part of the system "against" the other members. The systemic hypothesis becomes a semantic frame of reference that seeks to explain the family's behaviour. Among the various "methods" of conducting the session, attention should be drawn to the importance of questions that are not asked with a view to knowledge of the system but in order to intervene and comment on events and to introduce differences with respect to the hypotheses with which the system presents itself. As von Foerster also maintains, "circular" and "triadic" questions are authentic interventions that prompt people to depart from their habitual scripts and invent themselves in a different way.

We can also draw another distinction to speak about the different schools of systemic family therapy, namely the difference between ***first-order*** and ***second-order cybernetics*** and the transition from the theory of observed systems to the inclusion of the clinician in the field of observation with the theory of observing and self-organised systems. Families were first described as machines or homeostatic mechanisms and the therapists saw themselves as social engineers or mechanics. Attention has now shifted from servomechanisms to assumptions and meanings, thus leading to view of systems as aggregates of assumptions, values and aims. Families are regarded both as aggregates of people and as networks of meanings and the social dimension is introduced in order to work on the ideas born out of the collective dialogue, which includes the clinician and his or her network of reference. The many articles describing this transition include Malagoli,Telfener 1983, Telfener & Cingolani 1987, Ugazio 1984 and 1985, Fruggeri 1992, and Telfener & Casadio 2003.

As Keeney (1985) observes, the elementary cybernetic perspective seems to above all regard the way in which the therapist evaluates and gets to know a certain system, while the cybernetics of cybernetics prescribes the way to intervene or take part in the system. As many therapists know, it is sometimes advantageous to ignore your participation in what you are observing and intervening in. If therapists should, however, decide to call their own actions in the therapeutic system into question, they can switch to observation of their own participation in the construction of what they are observing. (p. 231)

Clinical interventions are seen as the formation of a shared reality within a context of collaboration and dialogue. The units of observation are neither families, understood as groups-with-history, nor individuals but rather the mental processes running through social units.

Nothing is good or harmful in itself within a cybernetic epistemology. It can be defined in one way or the other only inside a relationship and a context. It is not a matter of acquiring new techniques or inventing new theories in order to interpret systems and contexts but of reflecting more and more on one's actions and the moves that we already know/make with a view to constructing an evolutionary and responsible praxis.

The recursive relationship between what we see and how we organise what we see necessarily entails an attitude of self-reflection and participation. What is presented to us? What does it mean? What relationship has been constructed? How has it been constructed? The questions that clinicians must ask themselves are many. It thus becomes essential to reflect on the patterns of connection between individual/family and clinician, and the levels of observation become more complex: not only what the system brings – its primary form of organisation – but also how it is connected with the clinician and what emerges from the encounter with respect to the dominant culture in which all the parties are involved. The cybernetic epistemology obliges us to perform operations on operations, second-order operations, leading us to speak about knowledge of our knowledge that intervenes in the coordination of the coordination of actions and meanings. This regards the reflective capacity making it possible to identify the path and the choices that led to one "reality" rather than another (diagnosis of the diagnosis, constant evaluation of the evaluation process, change in the usual modalities of change). The intervention becomes an operation on the customary clinical operations, thus making it possible to speak of treatment of the treatment. Another aspect deriving from the epistemological revolution is attention to blind spots, to what clinicians know they do not know and to what they do not know they do not to know, and hence to bottomless and constitutive ignorance. The presence of ineradicable collusion and blind spots is not regarded as a defect but as an unavoidable characteristic of clinical knowledge, among other things. Clinicians lose their status as experts, as those who know, to take up a position in which it is possible to combine knowledge in a whole variety of ways. The invitation is to appreciate the ignorance that distinguishes us and abandon any presumptuous claim to the capacity to know and control.

We consider it important to point out how above all the Milan group of Boscolo and Cecchin has continued and developed the epistemological dictates of the 1980s and '90s (after the division in two and then three teams in 1980) and how students and teachers have together effected modifications in order to follow the theoretical changes underway. The first of these regarded the need for a rethinking and revision of the model, originally organised in a private context, so as to adapt it to the praxis in public institutions. Subsequent changes involved therapeutic praxis in the private sphere, the way of considering problems and their onset, and attention to the construction of the therapeutic system as well as theories on the evolution and increasing complexity of systems and on the role of the clinician.

It was also within the systemic perspective that an interpretive approach was introduced and the idea of therapeutic conversation, **Socratic dialogue** and **hermeneutics**. Like every human undertaking, interventions are based on the hermeneutic circle of interpretation and action. Words acquire meaning not through their ability to represent reality but for their usefulness and coherence in the social

exchange between therapist and subject. Sense-making becomes the reason for being together.
Among the adherents of a systemic clinical praxis, attention must also be drawn to the representatives of the "**post-Milan teams**" operating in Europe and Nord America. Directly or indirectly trained by **Boscolo** and **Cecchin**, these teams of equals have developed their practice to arrive at systemic models and theories that are sometimes very original and still faithful to the principles of group work (the construction of a cybernetic brain), constructivism and polyphony. Among the most active the Irish group with **Imelda McCarthy, Nollaig Byrne** and **Philip Kearney**; the sweedish group **Mia Anderson, Ernst Salamon** and **Klas Grevelius**; **Monica McGoldrick** and the Multicultural Institute of New Jersey played a big part in the early days, herself and her colleague **Nydia Garcia Preto** continued their connection with Gianfranco Cecchin for a long time. **Peggy Penn** was a big player in New York. The Norwegian **Tom Andersen** proposed the "reflecting team" which lead to increased transparency, sharing and dialogue between the clinical system in the therapy room (family and therapist) and the extended therapeutic system (those behind the one-way mirror). There are then other charismatic figures who worked with their colleagues in order to organize a reflexive mind: **Davin Campbell, Bebe Speed, Ros Draper** in London, **Elsa Jones** in Wales, **Helga Hanks** and **Peter Stratton** in Leeds, **John Burnham** in Birmingham, **Patrick Sweeney** in Ireland, **Sullyann Roth** in Cambridge, USA, **Ben Furman** in Helsinki, **Helm Stierlin** in Heidelberg, **Eia Asen** at the Malborough Family Unit of Eastern London, **Karl Tomm** in Calgary, **Eduardo Villar** in Colombia, **Moni Elkaim** in Belgium, **Ofra Ayalon** trauma expert in Haifa, **Luis Miguel Neto** and **Helena Marujo** in Lisbon, **Kyriaki** and **Petros Polychronis** in Athens, **Janine Roberts** at Amherst.
Harry Goolishian and **Harlene Andersen** in Galveston, the London-based KCC team of **Peter** and **Susan Lang, Martin Liddle and Elsbeth McAdam,** did their training within the post Milan atmosphere, have then accentuated the new post-modernist approach and developed a form of conversational-narrative therapy connected with positive and appreciative inquiry, together with many others: **M.White, Mary** & **Kenneth Gergen, John Shotter**, **Vernon Cronen, Sheila McNamee**[61]**…**
In our view, each of the metaphors put forward can well be developed within the systemic framework.
Separate mention must be made of **Lynn Hoffman**: having followed the pioneers and worked at the Philadelphia Child Guidance Clinic back in the 1960s, she has followed the movement in all its evolutions, enthusiastically embracing its tenets and making considerable contributions of her own. She has also been the "Godmother" of many of the teams and brought us together in the international teams conferences. Together with **Christopher Kinman**, she currently describes herself as a follower of the rhizomatic movement.
The teachers and students of the Milan group and the representatives of the post-Milan teams adopted a praxis consistent with constructivism/constructionism. The Italian teachers of the Milan school have made more effort than other groups to combine constructivism and constructionism, with very interesting results in both theoretical and clinical terms (**Laura Fruggeri, Massimo Matteini, Anna Castellucci, Maurizio Marzari, Pio Peruzzi, Andrea Mosconi**, **Maurizio Viaro, Lia Mastropaolo, Piergiorgio Semboloni, Piero Sannasardo, Pietro Barbetta, Gabriella Gaspari, Marco Bianciardi, Paolo Bertrando, Valeria Ugazio, Umberta Telfener**)
As regards systemically-oriented therapy, which is no longer identifiable and identified with involvement of the family as a whole, it should be recalled that the 1980s saw a number of interesting

[61] It is interesting that Michael White (1992) was at one or two of the earliest international teams conferences and went on to develop his Narrative Therapy, while Anderson and Goolishian were at most of the teams conferences as they were developing their Colloaborative Approach. Routes to and from Milan were very fluent as the generative conversational matrix that was there through the 80s, as Imelda McCarthy notes. Each clinician chose his/her path according to personal preferences.

theories on the relationship between individual and family and later on **systemic individual therapy** (see the special issue of *Terapia Familiare*, no. 31, 1989, Boscolo Bertrando 1996, Telfener 2008).
We shall make only a brief mention of the systemic interventions other than psychotherapy that blossomed with the employment of more personnel in the public system. The systemic-relational approach increasingly developed from a therapeutic model into a grid for the interpretation of clinical situations and relationships between therapists, interventions and the services involved with a view to proposing network operations. This framework paved the way for a "weak" praxis that takes advantage of the various skills and theoretical maps of the therapists in addition to the context in which the treatment takes place.
The other clinical models (psychoanalysis, cognitivism and gestalt, which are increasingly engaged in dialogue) in Italy have been influenced in turn by systems theory and cybernetics as well as the ideas of constructivism and complexity and the resulting process of theoretical revision. There has, however, been no public avowal of the latter influence. We wish instead to recall the **post-rationalist cognitivist model** put forward by **Vittorio Guidano** (1987), which uses the perturbative relationship between therapist and patient in order to work on the self-referential construction of personal experience. Therapy is regarded as reorganisation of the immediate experience of self and uses methods such as self-observation, reconstruction of affective style and history of development. It therefore uses history, time and the relationship with the therapist understood as a strategically-oriented perturber and a conceptualisation of the individual as a self-regulated and conscious system.

SYSTEMICS AND PSYCHOANALYSIS

Luca Casadio

Influenced both by modern epistemology and by systems theory, with Beatrice Beebe and Frank Lachmann (2002) even advocating a form of "systemic psychoanalysis", a new generation of **psychoanalysts** have inherited the task of definitively mothballing the old Freudian theories based on drives and energy, and replacing the "hydraulic model" of classical meta-psychology with a relational and social view of human activity. This change in perspective has led to a fragmentation of psychoanalytic theory into numerous schools of thought, each with its own theory of reference. We can thus identify "hermeneutic" (**Schaffer, Spence**), "clinical" (**Weiss & Sampson, Mitchell, Ogden**) and "evolutionary" (**Stern, Lichtemberg**) approaches, to mention just the best-known.
The approach causing the greatest changes to classical theory has unquestionably been the evolutionary model, especially the work of Daniel Stern and his juxtaposition of the modern theories and observations of the psychology of development with the old "reconstructive" Freudian theories. These studies have demonstrated that newborns possess interactive capacities, thus refuting the old images of children based on the theory of "primary narcissism" or "symbiosis", which failed to take the rich relational world of infants into account. Stern's interest in early infantile relations led him to examine the non-verbal aspects of primary exchanges and appreciate the importance of "procedural memories" and "tacit" (devoid of language) aspects of knowledge based on action rather than semantic explanation: relational competencies, aspects experienced as sensations, emotions that belong to the realm of relations and the subject's significant contexts. Like the neuroscientists, Stern also distinguishes the semantic, linguistic aspects from those of a relational, pre-verbal character (identifying, among other things, a subjective and a verbal sense of "self"). This division makes it possible to appreciate connections. the concomitance of shared actions and the explanations of the

same actions (the semantic and political frameworks of Keeney 1985). Psychoanalytic therapy is thus defined as "immersion" in the relational (procedural) matrix of analyst and patient (Mitchell 1988) (where the analyst's role is no longer neutral and his view no longer objective) so as then to attempt to foster a new joint description of the same relation "from the inside". In this perspective, interpretations are no longer truths revealed to the patient but authentic joint constructions, hypotheses, "weak interpretations" (to use the terminology of **Bezoari** and **Ferro** 1992, Italian authors adopting the hermeneutic viewpoint) and provisional truths. The metaphor capable of describing this approach is that of two people (with their own affective, professional competencies) in conversation, grappling with a relationship that can crystallise or present new elements (and thus take shape as a "transformative" or "corrective emotional experience"; see Antonino Ferro 1999). By refuting the old hypotheses, psychoanalysis thus opened up to contact and the exchange of ideas with other models. (Modell 1990 makes explicit reference to the physiological model of Gerard Edelman, Gill 1994 to constructivist epistemology and **Bucci** 1997 to cognitivist theory as a whole.)

Clinical practice in general has seen the creation of groups occupying a transversal position with respect to the classical schools (systems-theoretical, psychoanalytical and cognitivist) and the use of philosophical, biological and anthropological ideas as new theories of reference. These various theories of reference have become a shared legacy of knowledge. Psychoanalysis has discovered psychotherapy (short, focal, interactive) and consultation. The differences between the schools have become increasingly theoretical, instances of opposition have turned into complementary approaches, and traditions are now lines on a sheet of paper, coordinates for orientation in a splintered and constantly changing panorama in response to the new social conditions and demands. There is thus also a change in the relationship of clinicians with the social context. Regardless of their orientation, clinicians are now called upon to address different contexts: to plan, shape, mediate, work and interact with groups, institutions, schools and factories in a rapidly evolving situation that disrupts the customary maps and territories and turns the previous divisions into an opportunity for deep cultural exchange. The knowledge of the neurosciences, evolutionary psychology and contemporary epistemology have become a shared heritage belonging to all approaches and clinicians (with no further adjectives). Concrete action has taken its place alongside theory and content is combined with a greater focus on process and the attempt to attain an operative understanding of the possible changes set in motion by relations. A great contribution has been made in this direction by studies on the verification of psychotherapies. Even though the path still appears to be long and difficult, the attempt to develop operative parameters for the verification of psychotherapies make it possible to discuss the various techniques not in ideological terms but with a view to identifying pragmatic elements capable of explaining the change that has taken place in psychotherapy. A new horizon has thus opened up in which theory, observation and empirical studies can create new theoretical and interpretive frameworks through dialogue.

METAPHORS FOR ECONOMICS

Lucio Biggiero

The relations between cybernetics and economics are numerous but very "hazy" and full of misunderstanding at the same time. There are three points to be clarified straight away. First, the field of economics is divided into the two great spheres of political economy and business economics. While the former has roots stretching back to the second half of the 18th century and underwent rapid development in the 20th, the latter dates back to the early bookkeeping techniques of the late 15th century but developed fully only in the period after World War II. A sort of "division of labour" existed between the two until the mid-1970s, whereby political economy was mainly (but not exclusively) concerned with macroeconomics, i.e. large aggregates such as the economy of markets and industries, the international economy and economic policy, whereas business economics focused on the management techniques of individual companies. A sort of reciprocal encroachment on terrain has been underway since halfway through the 1970s and interesting future developments are expected from the inevitable contact and collision between the two disciplines.

Second, each of the two spheres has different traditions of research that can be initially divided into approaches based on either neoclassical or behaviourist economic theory. The former sees economic activity as an exchange between economic agents that can be described entirely in terms of utility functions and are independent and opportunistic. Modern neoclassical economic theory consists essentially of a decision theory in which perfectly rational agents maximise their utility functions. Apart from the problems due to insufficient realism and the requisites that these choices and agents must satisfy, this approach interprets the economic system as a system of linear equations whose solution provides the equilibrium point. Moreover, the system of equations refers to an objectively perceptible and measurable real world. Behaviourist theory instead regards economic agents as irreducible to utility functions, only limitedly rational and not independent. It further holds that the aggregate behaviour (of families, firms, regions, etc.) gives rise to emergent properties and non-linear dynamics. Finally, it suggests that the world is not objectively perceptible and, in some recent variants, that it is a social construction on a par with all human knowledge.

Third, the economy is effectively characterised by the phenomena studied by cybernetics, such as aggregate behaviour with emergent properties, non-linear dynamics, feedback functions, recursive interaction, structural coupling, processes of self-organisation and self-reference, the interplay of expectations, and computational and relational complexity. It could indeed hardly be otherwise. As human beings are the classic exemplars of cybernetic behaviour, it would be very strange if economic activities failed to display the same phenomena. The economy is made up of human beings in that the generation of value entails the supply of human labour, even if only in mental form. The problem is therefore to understand why certain authors and traditions of research have ignored the cybernetic aspect of economic activity.

Even though the original and paramount *raison d'être* of political economy is precisely to regulate and govern economic activity, the neoclassical tradition in this sphere ignores some of the basic concepts of cybernetics, at least in its dominant versions. The existence of emergent properties and the subjective nature of economic reality are denied and the system of equations describing this reality are set in linear form so as to become manageable. The only important exception admitted is feedback, which is indeed regarded as the foundation of economic interaction. Typical examples are the famous law of supply and demand, according to which an increase in demand with no change in supply leads to an increase in price that restores equilibrium either by reducing demand or by increasing supply. This also holds in the competitive relationship between two resources, where an increase in demand for one leads to the exploitation of less productive areas and thus makes the other more advantageous, a process that is reiterated until the relations between the two resources return to their initial position. The Keynesian multiplier of income is yet another example, and Lange has shown that its formula coincides exactly

with that of the feedback multiplier, i.e. with the feedback function as a whole. This concept is, however, "purged" of its explosive force, namely the characteristics that would make it incompatible with the neoclassical economic theory and above all with the theory of general economic equilibrium, which is the very essence of the neoclassical approach. First of all, attention is focused solely on the case of negative feedback with total disregard for positive feedback, which could give rise to non-linear dynamics and thus prove dangerous (for the theory of the general equilibrium economic). Second, with a view to avoiding further problems of non-linearity and complexity, the only systems considered are "banal", meaning devoid of internal memory (internal states). Third, the problem of the feedback process is completely overlooked by assuming instantaneous adjustments so as to avoid potential problems of deterministic chaos. Finally, the "relational" aspects of feedback are denied by taking into consideration only quantitative variables such as the price and quantity of goods, and wholly disregarding qualitative variables like confidence and significance. The economic agents are "perfect computational machines". While there are of course some specific studies and exceptions (Arthur, 1990; Farmer, 1993; Lange, 1965), these are immediately excluded from the mainstream as incompatible with its fundamental theoretical hypotheses and cognitive claims.

There are essentially two reasons for this attitude. First and foremost, the dominant paradigm of neoclassical economics, namely the neo-Walrasian approach to general economic equilibrium, is rooted in an explicit attempt to emulate Newtonian physics. Walras intended to create a "physics of the economy", as did the engineer Pareto, his direct disciple. It is therefore hardly surprising that the neoclassical epistemological framework and mathematical apparatus should present the same limitations as classical physics. This approach appears to be perfectly consistent with cybernetics in some respects, and is indeed presented as its most sensational confirmation. One of the key concepts of second-order cybernetics is in fact self-organisation, and Adam Smith's "invisible hand" and its modern artificial-life versions can be seen precisely as a clear process of self-organisation. Left free to act, the market finds its own point of equilibrium, which is moreover a point that ensures the greatest efficiency through the optimal allocation of resources. In other words, human beings work for the good of all precisely by virtue of their selfishness. Unfortunately for neoclassical economic theory, the formal demonstration of this possibility is attained only at the price of absolutely unrealistic hypotheses about the behaviour of economic agents and the nature of economic goods. Moreover, the demonstration fails in its attempt to describe this as a process of self-organisation, since it only demonstrates that at least one equilibrium exists but is incapable of proving that it is stable and unique. In other words, it is not a process but an instantaneous equilibrium, a fixed point. The idea that at least one point of this kind exists and maximises the well-being of all the economic agents is, however, so fascinating as to constitute the second reason for neoclassical economic theory to deny the cybernetic principles. In order to justify capitalism as the best of all possible worlds, it must in fact explain the fundamental economic magnitudes – profit, interest and income – as natural categories rather than social constructs. It must therefore give a technical explanation capable of excluding the interplay of expectations, expected results and compromises between conflicting objectives, and of presenting them as exceptional situations in such a "purified" form as to make them compatible with the theory's constraints. The behaviourist tradition is instead free from both influences and therefore fully embraces the concepts of cybernetics. It is certainly no coincidence that its founder, the Nobel laureate Herbert A. Simon (1969), is also one of the founders of cybernetics itself. His most important pupil James G. March (1988, 1994; March and Simon, 1958) developed the behaviourist approach to the point of embracing some recent contributions from business economics and sociology marking radical departures from the neoclassical theory (Biggiero, 1990; Biggiero & Laise, 1998a, 1998b).

Strange though this may seem at first sight, business economics has not had the same apologetic and emulative intentions as political economy. It has drawn abundantly on psychology, anthropology and

sociology, all of which are greatly influenced by cybernetics. As a result, systems theory (von Bertalanffy, 1950, 1968) and cybernetics (Beer, 1959, 1972, 1974) made their entrance into the sphere of managerial sciences back in the early 1950s and interest reached its peak in the late 1960s (Emery, 1969; Lawrence and Lorsch 1967; Thompson 1967), when the systemic vision of organisation became dominant. Due to a general decline of interest in systems theory and a certain naivety and superficiality in its application to the specific field of business economics, the next 15 years saw a shift of focus in business economics towards the more intangible and less structural aspects of organisations such as culture, symbols and history as well as the cognitive processes and behaviour of personnel. These areas appear at first sight to constitute a departure from the systemic approach, which was confined to structural aspects and connected with the opening of organisations. The development of second-order cybernetics and constructivism is instead bringing cybernetics and business economics closer together. As anticipated by some social psychologists (Weick, 1969), the interest of cybernetics in management (Ulrich and Probst, 1984) and of management in cybernetics (von Krogh and Roos, 1996; Weick, 1995) promises new and interesting developments.

SYSTEMICS FOR MANAGEMENT

Theories of management and organisations have enjoyed a period of brisk creativity in the last few years by harnessing the hypotheses discussed here with greater elasticity than clinical practice, fostering dialogue and "contamination" between models so as to avoid simplification. The most currently relevant theories see companies as systems open to information but organisationally closed, driven to maintain their identity through a process of constant evolution; complex systems in which the behaviour of members depends on the internal structure of the company (autonomous and self-referential systems), whose organisation must be studied.

Many theories of management have followed one another over the years and attention has been drawn to some of them. The mechanistic model put forward a wholly comprehensible world through an analysis in which the organisation of the company was simplistically seen as deriving directly from the actions of management and having no life of its own. The organisation of labour was broken down into elementary tasks in accordance with the dictates of positivist epistemology. The company was viewed as an elementary machine (of predictable behaviour). People were taught to behave as parts of the machine, thus giving rise to a bureaucratic structure with little space for learning and adaptability. The organismic model regards the company as an organism whose task is to survive and therefore to grow in a way closely linked to the environment. Adaptation becomes the primary concern and the parts are considered solely in relation to the whole. Planning consists of hypotheses about the development of the environment, which is regarded as beyond all control. The social systems model adopts the systemic approach and focuses on the development of the company (the whole) and its working components (the parts) at the same time. The role of knowledge and information in social systems is analogous to that of energy in physical systems, hence the focus on transformation and learning (learning to learn) understood as the ability to challenge basic assumptions and attain constant renewal. (Systems are considered first as stable, then as tending towards evolution, and finally in terms of the process through which organisations with ever-greater levels of complexity and order emerge.)

We could also propose a distinction based on whether the organisation or the individuals participating in it constitute the primary focus of attention. The classical theories regard man as a dependent variable of the organisation, a passive subject that carries out its orders, and the organisation as a predictable

machine with its own internal structure independent of relations with the environment. The social theories instead see man as the driving force and crucial element of success. McGregor thus defines efficient organisation as permitting the maximum utilisation of individual and collective resources. The social theories take into consideration working relations, the relations between base and apex, and the needs that each satisfy by working. Importance is attached not so much to the company's formal organisation as to the informal structures built up in its functioning. The attempt is to humanise work and the factory with a division of the burden of production between labour and management. The third model is the systemic approach, which seeks to avoid adversarial dichotomies, sees the relations between individual, group and organisation and between organisation and environment as the basis of organisational behaviour, and proposes that work should be organised in such a way that importance is attached to objectives and control is focused on feedback, i.e. on results rather than directly on action.

We wish to draw attention to the most up-to-date form of global thinking (self-eco-organisation), which addresses the nature of the internal coherence of the system (the ties, tacit rules, repetitive practices and rituals) and takes into consideration what maintains the organisation over time, the plans and relations that cause its specific identity to emerge and define the unity of the organisation itself. The structure of the system emerges from the common culture, understood as a shared image including experiences, beliefs, attitudes, myths, rituals and ideals that emerge from and are maintained by the history of the firm and then shape its common identity.

The metaphor of the army, a structure hierarchically organised through the rigid definition of roles and power structures, was initially used to describe the coordination of human actions inside the factory in order to attain a common purpose. The alternative metaphor is a game of soccer, involving self-coordination within the context of a polycentric system through reciprocal adaptation and modification in a constantly changing process required to cope with the unexpected (Probst). In other words, there has been a switch to a polyphonic form of strategic structuring in which flexibility (attention to history and the sharing of practices) becomes a primary characteristic and the yardstick of adaptability.

The organisation theorist Morgan (1996) considers the various metaphors used to interpret companies and act upon their organisational structure. Without necessarily according primacy to any one metaphor, he regards those put forward as windows through which the organisational reality can be viewed. The author thus describes organisations as machines, organisms, political systems, mental prisons, brains and tools of domination.

A constant pursuit of new models making it possible to understand the dynamics of social systems and organise choices and planning can be found in the managerial sphere. Strategies regarding market formation as well as business operations and consultancy also draw upon the latest models for a reading of social systems. Apart from specific content, it appears that managers undertake no in-depth epistemological analysis of the models available and companies call in consultants who are able, precisely by virtue of being outsiders, to introduce theories that are in any case new (ethnographic analyses, symbolic perspectives and a whole range of models: psycho-socio-analytical, systemic, evolutionary, cultural and so on) and to use these different analytical categories and innovations in order to analyse the firm and reflect on its internal strategies and interfaces with the market. (A good example of the companies showing real-time responsiveness to the epistemological debate is provided by the Royal Dutch Shell Corporation, which demonstrated its interest in theoretical developments as early as 1985, when it invited Francisco Varela to deliver a lecture in London on the grounds that Shell needed to understand itself as a complex learning system.)

The current approach has lost its illusions as regards solving problems and prefers to consider the strengths of a company and individuals. It has abandoned long-term planning of the future in favour of constant analysis of the strategic issues that affect the running of the business in real time. It focuses on the analysis of information regarding the environment and its evolution (environmental dynamism).

Priority is no longer given to ready-made solutions but to the possibility of work with all members of staff in order to help them to learn and reflect within a perspective conducive to the search for rational and effective solutions, a view of the firm and its employees as a constantly evolving process, and a world characterised by uncertainty, unpredictability, discontinuity, turbulence and chaos.
The systemic metaphor of the learning organisation is increasingly used to describe a shared viewpoint based on generative conversations between the participants and common action. This regards the possibility of establishing a common process that is not top-down and opens up spaces for learning. The cornerstone is the rejection of piecemeal thinking in favour of the "memory of the whole", the rejection of competition in favour of collaboration (the self is communitarian in nature), the transition from a problem-solving approach to one aimed at the construction and creation of evolutionary pathways, the central importance of language (its generative power) and the pursuit of coherent interpretations rather than absolute truths.

COMPLEXITY IN EDUCATION AND TRAINING

Recent years have seen growing interest in education and the processes of learning and teaching. The presence of children with difficulties and the cognitive revolution of the last few years have enabled schools to address learning, previously considered as a process divorced from context, time and singularities, and to raise crucial questions about the factors that permit or prevent it and its relationship with teaching strategies (Perticari, 1992). These questions have halted what von Foerster (1991) describes as the banal view of learning as the transfer of information, as a praxis making it possible to amputate and simplify conceptual categories, to reinforce predictable behaviour patterns and to block all independent appraisal so as to ensure compliance with norms imposed by the relevant authorities.
Learning can mean increasing the number of internal states and the complexity of the elements making it possible to evaluate, decide and select, attaining greater structural richness, gaining experience and establishing a dialectical relationship with respect to one's own grids, and curiosity about the learning processes as the ability to learn how to learn. In its modern sense, learning becomes a relational, affective and dialogical process that entails operations on objects as well as oneself, one's maps and one's relations with others, and necessarily involves the subject's responsibility and experience Learning and teaching become complementary processes.
Paolo Perticari (1992, 1996) suggests that the everyday scholastic reality of meeting, living together and developing crafts can serve as the starting point for reflection on teaching and learning. His view encompasses the possibility of feeling astonishment and discovering meaning also in what is unexpected or normally considered insignificant or wrong.
Rosalba Conserva (1996) applies Bateson's ideas to a possible ecological and epistemological conception of learning. Her shifting of the processes of education and learning from the realm of the decidable to the undecidable (von Foerster) leads to the emergence of a process in which learning and cognition are seen as affective action, the history of a structural coupling capable of giving birth to a world. Intelligence is regarded not as the ability to solve problems but rather as "readiness to enter a common world".
Ugo Morelli and **Carla Weber** (1996) highlight the crucial importance of learning in the living process and suggest a form of education focused more on learning than on teaching.
Mauro Ceruti describes education as playing the role that physics had in the 18th century and economics in the 19th.
Education is regarded as the ability to take a new form, as a process of learning (being in knowledge) that also involves knowing how to be and knowing how to do, and hence reflection on the process of

education itself. As a rich and varied process taking place on different levels at the same time and in sequence, education begins by asking about the time, objectives, contexts and modalities needed to attain a new form. The affective, cognitive, experiential, relational, perceptual and behavioural levels are activated idiosyncratically and the person as a whole is involved in a reorganisation of his or her maps. While the potential of learning/teaching necessitates planning and motivation in the teacher/learner relationship, education is instead a process that can only be assessed *a posteriori* and cannot envision a path that is defined *a priori*. (As von Foerster puts it, teachers do not teach but students can learn.)

The subject matter of education is not in fact what we learn that is new but how we learn and know. The pupils come to "commission" their education through the capacity to negotiate and define the stages within the process. Teaching therefore becomes "performative" rather than informative. There is no presentation of an already organised package. Teaching is not understood as an accumulation of knowledge but rather as the construction/organisation of information, the supply of suggestions about pathways to find answers through the use of a relational process involving both pupils and teachers. In other words, the possibility of asking questions that are "right and consistent" with one's needs, attention to the process and the pathway.

Let us now outline the Italian dialogue on this theme.

Donata Fabbri and **Alberto Munari** (1984) have long been involved in organising workshops of operative epistemology for adults and adolescents as an educational strategy consistent with their proposal of a cultural psychology making it possible to reflect on and experience emotions connected with the process of learning and knowing.

Duccio Demetrio takes the common metaphor of narration as a point of reference in putting forward an educational pathway based on consideration of the subject's biography. This involves developing a number of narratives about oneself and focusing on the past and the future so as to open up new possibilities and thus move beyond the constraints of personal history.

The model of education put forward by Carli and by Pagliarani is based on combining the relationships of those taking part in the educational action with their knowledge, theories and ideas. Pagliarani and his group create the motivational and relational conditions needed to give meaning and form to the educational process, which is always developed at the group level. The process takes place through juxtaposition of the group relational game and one's object of work understood as a co-evolutionary process "shaping" the world as invented-experienced by the subjects in the various contexts.

Moving beyond the differences between education and clinical intervention, Renzo Carli identifies two different levels, one organisational and based on explicit objectives and conscious purposes of the system, and the other emotive-implicit (the "*fantasmatico*" or imaginary level). He interprets education as consisting in the creation of a continuous process of reflection on the implicit emotive dynamics shared by the group, which determine its organisation in such way as to trigger a continuous process of development and self-organisation.

The question of training for adult personnel involves a whole range of spheres including permanent education and training courses in sectors as far apart as health care and business.

Mention must also be made of clinical training, a widely debated subject in the 1990s (see Malagoli, Togliatti and Cotugno, 1995) due to the fact that psychotherapy training schools are systems with a history of their own and increasingly close connections with other educational structures such as universities.

SYSTEMIC METAPHORS FOR MEDICINE

While it would be a truly herculean task to identify all the changes taking place in medicine as a result of the paradigm shift, it should be noted this field has also seen changes in connection with the systemic revolution, the holistic approach and a pluralistic view of evolution.
While positivism increased the importance of specialisation and differentiated the areas of operation (with priority accorded to surgery and drugs), there has also been an attempt to introduce an evolutionary approach into medicine and the last few years have seen a broadening and humanisation of practice as well as diversification of the spheres of research and explanation.
One of the first supporters of contact between medicine and the spheres of contemporary science and culture was **Ludwik Fleck**, a theorist of the epistemological aspects of medical praxis, who published a critique of the theory of knowledge drawing, among other things, upon an analysis of the social construction of the concept of syphilis in Switzerland in 1935. The book found few readers, probably because it proved too innovative for the period. It puts forward an image of the physician that embraces not only the sciences of nature but also those of the psyche and develops a painstaking psychosocial analysis of how theories about illnesses evolve and become established.
The historian of medicine Grmek suggests that the concept of illness is connected with different criteria of evaluation at the objective level (the sicker the individual, the less he can work), the subjective level (which considers the subject's physical and mental suffering) and the socio-cultural level (linking illness with collective moral judgements).
There has been change as regards both the explanations of illness, from a single cause to many, and its image: regarded no longer as an entity but as a process-like event; no longer as an event that alters the homeostatic mechanisms of the organism (C. Bernard) but as the result of incongruity between the individual organism and some internal or external environmental aspect (B. Childs). The very concept of illness as a typical entity has given way to a focus on individual cases. Medicine appears in any case to be increasingly interwoven with social theories and involved with various types of ethical choice. (See among other things the debate in Italy on artificial insemination, the new law on hospices and care for the terminally ill.)
The science of non-linear dynamics has led increasingly in recent years to a change in the view of the dynamics implicit in the processes of health and illness and to a weakening of this dichotomy. The psychology of health, derived in northern Europe from behavioural medicine, thus puts forward an idea of health understood not as the absence of illness (the incommensurability of health and illness was taken for granted up to the post-war period) but as the capacity, also when sick, to improve the quality of one's everyday life.
To give a still more specific example of the application of the new theories, **A. Goldberger** applies the fractal concept not only to the macroscopic world and the large scale but also at the sub-cellular and molecular levels, arguing that the nucleic sequences of certain long chains of DNA are fractally organised. The author also detects a fractal pattern in many physiological processes that fluctuate over a variety of temporal scales ranging from a second to days (e.g. the variation of the heartbeat over time, in which connection the author claims that its rhythm does not become more chaotic with the accentuation of heart disease but displays less complex variability). The aging process also involves a "de-complexification" of responses to internal and external stimuli that narrows the range of possible reactions. The author regards a decrease in variability as highly negative and argues that while healthy functions are characterised by variability of a complex and chaotic type, aging processes and illnesses are often accompanied by a loss of complexity.
The new epistemological theories have brought changes in conceptualization as regards the human dimension, communication, interaction and knowledge. The human being is no longer seen as a tabula rasa, a robot passively organised by external stimuli, but as an individual bombarded with stimuli and capable of choosing which to admit and which to reject. The function of language is no longer seen as

the transmission of information or the description of "reality" but as the creation of consensus on meanings and the coordination of actions between human beings. Like every other linguistic activity, verbal communication becomes a special form of interaction, namely the process through which individuals can create one another and help one another to become people of one type or another. Importance attaches to the ability to distinguish two different phases of human knowledge: a linguistic, analytical and disjunctive phase in which contextual logic and the implicit definition of the object of knowledge predominate, and another characterised by the primacy of implication, relation and pre-verbal, metaphorical sensation. All these changes have led to a change in medical praxis, including greater attention to relations, the healthy aspects of individuals, compliance (understood as the doctor's ability to obtain what he asks for and what the patient needs), and the transparency of the diagnostic process and the treatment plan. The new theoretical approach has introduced the need for informed consent, the loss of power based on role in favour of power based on professional skill and capacity, and the need – explicitly stated in the new ethical code – for cost/benefit analysis of the treatment offered. Many European countries have thus seen a change in medical training involving not only greater exposure to individual cases (rather than a long grounding in theory) but also greater attention to the healthy and psychological aspects of humans as well as awareness of the epistemological models employed and their pragmatic implications (hence the abandonment of a single model of training and the tacit understanding of behaviour as in any case neutral).

COMPLEXITY IN ANTHROPOLOGY

By Vincenzo Padiglione

From the standpoint of the interpretive and reflective school of anthropology to I belong, there is no language that does not have an allegorical or metaphorical dimension. Metaphor has come to be regarded increasingly in this perspective not so much as approximate and abstract knowledge but as a necessary form (and means) of knowledge in general and anthropological knowledge in particular. Anthropologists were forced in the second half of the 20th century to abandon any idea of being able to approach the study of the various cultures through a "neutral" and objective language and hence to change their view of metaphors (and metaphorical thought), regarded no longer as a limitation of their approach but as a possible resource, as one of the few tools for reflection on the symbols and practices of a different culture. As used in the field of anthropology, metaphor does not therefore represent only a "natural" language capable of describing or classifying "others" but encapsulates an effort at interpretation. In other words, it can be understood as a resource for use not only at the analytical-descriptive level but also in the field of the actual experience. This premise is indispensable to any discussion of metaphors of anthropology and for anthropology. It was as early as 1936, in his introduction to *Naven*, that Gregory Bateson examined the question of the "expressive" tools to be used in his ethnographic work, and metaphorical language is still one of the central and most debated issues in the so-called postmodern anthropology of today. Metaphor can therefore be seen as a possibility, as an instrument capable of condensing knowledge around a central nucleus, both explicitly and implicitly.

A brief outline of the history of anthropology can be given in terms of the key metaphors expressed by the different authors in the different periods.

From the "evolutionary" anthropology of the discipline's "birth" at the beginning of the 19th century up to the 1850s, the dominant metaphor used to describe cultural studies was of humanity as a "great

laboratory" in which authentic "experiments" (albeit "unique" and not susceptible of manipulation) are developed in the interaction between the different cultures. The anthropologists of the period thus thought above all in terms of scientific and academic knowledge even though it was impossible for them to use the practices and techniques of scientists. The dominant metaphor in the "structural-functionalist" anthropology (Radcliffe-Brown) was instead the organism. Society was thus an organism with connected parts and a defined structure, like the human body (a metaphor stretching all the way back to ancient Greece and even earlier). This metaphor enables the anthropologist to pinpoint the interconnections and interdependence between the parts of society. The author does not speak of a body in the broad sense but specifically of an "organism", almost as though to draw upon the medical knowledge of the time.

The field of anthropology has always been distinguished by its great "output" of metaphors and owes a great deal of its interest to the effervescence of the metaphors it has "invented". (Suffice it to recall the myths, traditions and customs of the different societies that have influenced our culture, sciences and arts). Writers, psychoanalysts and "intellectuals" in general have in fact always drawn metaphorical resources from anthropological studies in order to see their own society through the myths and rituals of other cultures and thus to inhabit and alter it (to find it different). Anthropology has therefore always been a great reservoir of metaphors later "used" and reinvented in the sciences and the arts (suffice it to recall the Symbolists and the avant-garde literary movements of the 20th century). The greatest advocate of the abandonment of scientific and biological metaphors in favour of humanistic metaphors is Clifford Geertz, whose *Blurred Genres* describes the radical change of direction in the social sciences, initially interested in the metaphors born in the field of science (the so-called "hard sciences") but now capable of producing and offering to science metaphors shedding light also on other fields of knowledge. Geertz lists three fundamental metaphors developed in anthropology since the 1960s that have made great progress possible in the understanding of social action: "life is a game" (introduced by Irving Goffman), where the strategic and reflective action of the subject in the social context is emphasised; "life is a play" (introduced by Victor Turner), which focuses on the idea of "social drama" and the performance of social actions in the social ritual as one of society's ways of handling conflicts, reflecting on itself and transforming itself; "culture is a text" (Geertz), which is indebted to semiotic and hermeneutic studies. What Geertz means by the latter metaphor is that if culture is a text, then it must be interpreted by a community of interpreters. It is a text that is worked, an action that is interpreted, "deposited" and codified like a written text but always open to a range of interpretations.

Systemic keywords

The following are the significant keywords we have considered and explained in the Italian dictionary "Sistemica"; they are key constructs for an epistemological complex way of thinking and they all influence practice :

Abduction
Adaptation
Ambifinality
Autonomy
Autopoiesis-allopoiesis
Biosphere…, ecosphere…noosphere
Brain/mind
Catastrophe theory
Chance/necessity
Change/homeostasis
Chaos, chaotic attractors
Causality/circularity
Communication
Complexity
Computation
Constructivism,/constructionism / deconstructionism
Context
Contingency
Continuity-discontinuity
Conversation
Cybernetics
Data-capta
Description/explanation
Difference
Ecology of the mind
Education /learning
Entropy
Epistemology
Equifinality
Ethics
Evolution-coevolution
Exaptation
Expectations
Explanation
Feedback
Fractal object
Fuzzy sets, fuzzy logic
Hermeneutics/semantics
Hierarchy, hierarchical organization
Holism/reductionism
Hypertext
Hypothesis/hypothization
Knowledge/cognition
Identity, dis-identity
Individual/ environment
Information, difference
Interaction-relational frame

Language
Map-territory
Meaning
Memory
Mind/body
Mindscapes
Narration
Noise
Observer/subject
Order/disorder
Organization
Possibility/constraint
Prejudices
Prevedibility o foreseeness
Processuality
Punctuation
Purpose, aim or end
Reflexivity, recursivity
Responsibility
Reversibility/irreversibility
Self-organization
Self reference
Self-value
Science-systemics
Structural coupling
System
Theory
Time, imprevedibility
Understanding
Universe/ pluriverse
Value
Viability

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BIBLIOGRAPHY

. AA.VV., 1989, *Terapia Familiare*. N° 31.

. Accame F., 2002, *La funzione ideologica delle teorie della conoscenza*. Spirali, Milano.

. Ampère A.M., 1843, *Essai Sur La Philosophie Des Sciences*. Kissinger Legacy Reprint, N.Y.

. Anderson H., Goolishian H.A, 1988, Human Systems as Language Systems. *Family Process*, vol. 17.

. Angyal A., (1941). *Foundations for a Science of Personality*. Harvard University Press, Cambridge.

. Arthur B., 1997, The Economy as an Evolving Complex System II. edited with Steven Durlauf and David Lane. Addison-Wesley, Reading, MA, Series in the Sciences of Complexity.

. Ashby W.R., 1956, *An introduction to cybernetics.* John Wiley & Sons, New York, 1957.

. Atlan H.,1972, *L'Organisation Biologique et la Théorie de l'Information*. Herman, Paris.

. Atlan H.,1979, **Between** the **Crystal** and the **smoke**. Threshold edition, New York.

. Bateson G., 1936, *Naven*. The University Press, Cambridge UK.

. Bateson, G.,1960, The group dynamics of schizophrenia. In L. Appleby, J. M. Scher, & J. Cumming (Eds.), *Chronic schizophrenia: Explorations in theory and treatment* (pp. 90–105).

. Bateson G., 1972, *Steps to an Ecology of Mind: Collected Essays*. Chandler Publishing Company, Oxford.

. Bateson G., 1979, *Mind and Nature: A Necessary Unity*. Wildwood House, London.

. Bateson G. ,1991, *Sacred Unity : Further Steps to an Ecology of Mind.* Cornelia & Michael Bessie Book, New York.

. Bateson G., Jackson, D.D., Weakland J.H., Haley J., 1956, *Towards a theory of Schizofrenia.* Behavioral science,•Wiley Online Library.

. Beebe B., Lachmann F., 2002, Organizing principles of interaction from infant research and the lifespan prediction of attachment: Application to adult treatment. *Journal of Infant, Child, and Adolescent Psychotherapy*, (4):61-89.

. Beer S., 1959, *Cybernetics and Management*. English Universities Press, London.

. Beer S., 1972, *Brain of the Firm*. The Penguin Press, London.

. Beer S., 1974, Managing Modern Complexity. In *von Foerster* 1974.

. Bertalanffy L. (von), 1968, *General Systems Theory*, *Foundations, Development, Applications*. George Braziller New York.

. Bertalanffy L. (von), 1950, An outline of general system theory. *British Journal for the Philosophy of Science*, 1, 134–165.

. Bertalanffy L., (von), 1968, *A system's view of man*. Routledge, London.

. Bezoari M., Ferro A., 1992 Percorsi bi personali dell'analisi. Dal gioco delle parti alle trasformazioni di coppia. In L.Nissim Momigliano, A.Robutti (a cura di), *L'esperienza condivisa*. Cortina, Milano.

. Biggiero L.,1990, Managerial Action and Observation. A View of Relational Complexity. In U. Telfener, L. Casadio 2003.

. Biggiero L., Laise D., 1998 a, Determinismo e intenzionalità in economia e managment. In M. Cini *Caso, libertà, necessità*. Cuen, Napoli.

. Biggiero L., Laise D., 1998 b, Economia politica ed economia aziendale: un confronto inter-teorico. Economia politica index. Vol 97, 79-126.

. Bocchi G. e Ceruti M.,1980, *La sfida della complessità*. Feltrinelli, Milano.

. Boscolo L., Bertrando P., 1996, *Systemic Therapy with Individuals*. Karnac, London.

. Broadbent ,1958, *Perception and Communication*. Pergamon press, London.

. Bruner J., 1990, *Acts of meaning*. Harvard University Press, Cambridge.

. Buber, M. 1958, *I and thou*. Scribner, New York, 2000.

. Bucci W., 1997, **Psicoanalisi** e Scienza Cognitiva. Fioriti Editore, Milano 1999.

. Cadenotti B., 1996, *Metodi Matematici in Complessita Computazionale.* Springer, New York.
. Carli R.,1993, *L'analisi della domanda in psicologia clinica*, Giuffré, Milano.
. Carmagnola F., 1999, Teorie della mente. Una mappa tra biologia, scienze della cognizione e scienze dell'uomo. *Pluriverso* N°1-2.
. Carugati F., Mugny G., 1985, *La théorie du conflit socio-cognitif.* Giuffré, Milano

. Casadio L., Telfener U., 2003, *Sistemica, voci e percorsi nella complessità*. Bollati Boiringhieri, Torino.
. Ceccato S.,1966, *Un tecnico tra i filosofi*. Marsilio, Padova.
. Ceruti, M., 1996, *Constraints and Possibilities*. Gordon and Breach, New York.
. Cerruti M., Pievani T., 1998, Il Sistema dell'evoluzione e l'evoluzione dei sistemi. *Connessioni,* N°3.
. Chomsky N.,1957, *Syntactic Structures*. Mouton and Company, Chicago, Ill..
. Clausius R.,1851, On the Moving Force of Heat, and the Laws regarding the Nature of Heat itself which are deducible therefrom. London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science. 4th. 2 (VIII): 1–21, 102–119.
. Conserva R., 1996, *La stupidità non è necessaria. G.Bateson, la natura e l'educazione*. La Nuova Italia, Firenze.
. Couffignal L., 1956, *The art of ensuring the efficacy of action*. The Technology Press, Cambridge, Mass.
. Cronen V.E., Pearce B.W., 1980, Communication, Action and Meaning. Praeger, New York.
. Cronen V., Johnson K.M., Lannaman J.W., 1982, Paradoxes, Double Binds and Reflexive Circuits. *Family Process*, March;21(1):91-112.
. Damasio A., 1994, *Descartes' Error: Emotion, Reason, and the Human Brain*. Penguin Publishing Books, New York
. Darwin C., 1972, *The Expression of the Emotions in Man and Animals*. Cambridge Library Collection, Cambridge 2009.
. Deleuze G., Guattari F.,1972, *Anti Oedipus, Capitalism and Skizophrenia*. Penguin Clasics, London.
. Demetrio D., 1996, *Raccontarsi. L'autobiografia come cura di sé*. Raffaello Cortina, Milano.
. D'Eramo M., 1970, *Gli ordini del caos*. Manifestolibri.
Storia delle esposizioni universali: meraviglie, infamie e declino. Tratto da Micromega.
. Derrida J.,1967, Interview with Henri Ronse. Republished in *Positions*, University of Chicago Press, Chicago 1981.
. Doise W., Mugny G., 1981, *Le développement social de l'intelligence*. Interéditions, Paris.
. Eagle M.N., 1984, *From Classical To Contemporary Psychoanalysis: A Critique and Integration*. Routledge, London 2011.
. Edelman G.M.,1992, *Bright air, brilliant fire: On the matter of the mind*. Basic Books, N.Y..
. Einstein A., 1921, *Relativity: The Special and the General Theory*. Methuen, London.
. Emery F., 1969, *Open Systems Theory*. Wiley, New York.
. Fabbri D.,1990, *La memoria della regina*. Guerini, Milano.
. Fabbri D., Munari A., 1984, *Strategie del Sapere*. Dedalo, Bari.
. Farmer J.D., 1990 A Rosetta stone for connectionism. *Physica D: Nonlinear Phenomena*,Vol. 42, Issues 1–3, June, Pages 153-187
. Ferraris M., 1998, *L'ermeneutica*. Laterza, Roma.
. Ferro A., 1999, *La psicoanalisi come letteratura e terapia*. Cortina Editore, Milano.
. Fleck L.,1935, *Genesis and Development of a Scientific Fact*. The University of Cicago Press, Cicago.
. Foerster H. (von), 1974, *Cybernetics of Cybernetics.* Biological Computer Laboratory, Univ of Illinois, Urbana.
. Foerster H. (von), 1980, Epistemology of Communication. In K.Woodland (Ed.), *The Myths of Information: Technology and Postindustrial Culture*. Coda Press, Madison, 18-27.

. Foerster H. (von), 1982, *Observing Systems*. Intersystems, Ca.
. Foerster H. (von), 1985, Cibernetica ed epistemologia: storia e prospettive. In Bocchi G., Ceruti M. 1985.
. Foerster H. (von), 1990, Understanding Understanding. Methodologia, 7, 7-22.
. Foerster H. (von), 1992, Ethics and Second Order Cybernetics. C*ybernetics and Human Knowing*, 1, 1, 9-20.
. Foucault M., 1972, *The Archaeology of Knowledge & The Discourse on Language*. Pantheon Books, New York.
. Fruggeri L., 1992, Therapeutic Process as the Social Construction of Change. in S. McNamee, K. Gergen, op cit.
. Gadamer H. G., 1960, *Truth and Method.* Sheed and Ward, London.
. Geertz C.,1980, Blurred Genres, The Refiguration of Social Thought. *The American Scholar* Vol. 49, No. 2 (Spring), pp. 165-179.
. Gergen K.J., 1985, The Social Construcionist Movement in Modern Psychology. *Am Psychol*., vol 40, 266-75.
. Gergen, K. J., & Gergen, M. M.,1988, Narrative and the self as relationship. *Advances in experimental social psychology*, Vol. 21, pp. 17-56. Academic Press.
. Ghiselin M.F., 1981, Categories, life, and thinking. *The Behavioral and Brain Sciences*. 4(2), 269–313.
. Gill M.M., 2000, *Psychoanalysis in Transition: A Personal View*. Karnac Books, London.
. Glasersfeld E. (von), 1977, *Radical Constructivism: A Way of Knowing and Learning*. The Falmer Press London, 1995.
. Glasersfeld E. (von), 1985, Reconstructing the concept of Knowledge. Archives de Psychologie, vol.53, N° 204, 91-101.
. Glasersfeld E. (von), 1987, *The Construction of Knowledge: Contributions to Conceptual Semantics*. Intersystems Publications: Seaside, California
. Gofman I., 1956, *The Presentation of Self in Everyday Life*. The Edinburgh Edition. Penguin Books London, 2022.
. Goldberger A.,1987, Physiology in Fractal Dimensions. *American Scientist*, Vol. 75, No. 4 (July-August), pp. 354-365
. Goolishian, H., & Anderson, H. (1987). Language systems and therapy: an evolving idea. *Psychotherapy*, 24, 529-538.
. Gould S.J., 1980, *The Panda's Thumb: More Reflections in Natural History*, Cambridge University Press, New York.
. Gould S.J., Eldredge N., 1977, Punctuated Equilibria: The Tempo and Mode of Evolution Reconsidered. *Paleobiology*, Vol. 3, No. 2. (Spring), pp. 115-151.
. Gould S.J.,Vrba E.,1982, Exaptation, a Missing Term in the Scientific Forum. *Paleobiology*, vol.8, N°1.
. Greenberg J.R., Mitchell S.A., 1983, *Object Relations in Psychoanalytic Theory*. Harvard University Press, Cambridge, Massachusetts.
. Guidano V., 1987, *Cognitive Processes and Life Span Development*. Guildford, New York.
. Haken H., 1983, *Synergetic*. Springer Berlin, Heidelberg.
. Haley, J., 1959, The family of the schizophrenic: A model system. *Journal of Nervous and Mental Disease*, 129, 357–374.
. Haley J., 1971, *Changing Families*, Psychol Corp., New York.
. Harré R., 1986, The Social Construction of Emotions. Basil Blackwell, Oxford.
. Harré R., Gillett G., 1994, *The discursive mind*, Sage, London.
. Heidegger M., 1927, *Being and Time*, Blackwell Pub, 1978.
. Hoffman L., 1971, Deviation Amplyfying Processes in Natural Groups, In J.Haley (ed), Op Cit.
. Hoffman L.,1992, A reflexive point of view. in S. McNamee, K. Gergen, *Op.Cit.*

. Hoffman L., 2001, *Family Therapy: An Intimate History*. W W Norton & Co Inc, New York.
. Hull D.L., 1974, *The Philosophy of Biological Sciences*. La philosophie contemporaine/Contemporary philosophy: Chroniques nouvelles/A new survey,1981: 281-316.
. Jantash E.,1980, *The Self-Organizing Universe*. Pergamon, Oxford.
. Jackson D., 1957, The Question of Family Homeostasis. *Psychiatr Quarterly Suppl*. 31,79-90.
. Jackson D., 1960, *The Aetiology of Schizophrenia*. Basic Books, New York.
. Israel G., 1986, The two faces of mathematical modelling: Objectivism vs subjectivism, simplicity vs Complexity. Springer-Verlag, London.
. Keeney B., 1985, *Aesthetics of Change*. Guildford Press, New York.
. Kelly, G.A. (1955)*The psychology of personal constructs*. (2 Vols.).Norton Books, New York.
. Kenny A., 1973, *Wittgenstein*. Wiley-Blackwell, Hoboken, New Jersey.
. Kinman C., 2000, *The rhizome Way: a New Beachhead for Systemic Practice*. Conference in Calgary.
. Koestler A., 1964, Beyond Atomism and Holism, the Concept of Holon*. Perspectives in Biology and Medicine,* Vol.13, n°2, 131-154.
. Krippendorff K., 1986, A Dictionary of Cybernetics. Univ of Pennsilvania Press, USA.
. Kuhn T., 1962, *The structure of scientific revolutions*. Chicago University Press, Chicago.
. Lange O., 1965, *Wholes and Parts: A General Theory of System Behaviour*. Pergamon Press, USA.
. Laszlo E., 1972, *Introduction to systems Philosophy*. Gordon & Breach, New York.
. Lewontin R.C., 1978, "Adaptation". *Scientific American*, vol. 239, 212-228.
. Lorenz E.,1963, Deterministic Non-periodic Flow. *Jurn Atomo Science*, 20.
. Lowrence P.R., Lorsch J., 1967, Organization and Environment. *Administrative Science Quarterly* 1-47.
. Lovelock J.E.,1979, *Gaia. A New Look at Life on Earth*. Oxford University Press. New York.
. Lewin K.,1935, *Dynamic Theory of Personality*. McGraw-Hill, New York.
. Luhman N., 1989, *Ecological Communication*. University of Cicago Press, USA.
. Luhman N., 1990, *Theory of Society*. Cambridge University Press
. Lyotard J.F.,1984, *The post Modern Condition*. The Univ. of Minnesota Press.
. Madonna G., 2003, *La psicoterapia attraverso Bateson*. Bollati Boringhieri, Torino.
. Malagoli Togliatti M., Cotugno A., 1996, *Psicodinamica delle relazioni familiari*. Il Mulino, Bologna.
. Malagoli Togliatti M., Telfener U., 1983, *La terapia sistemica*. Astrolabio, Roma.
. Mandelbrot B.B., 1982, The Fractal Geometry of Nature. Freeman ed., London.
. March J.G., Simon H.A., 1958, *Organizations*. Wiley, New York.
. Maruyama M., 1963, The Second Cybernetics Deviation Amplifying Mutual Causal Processes. American Scientist, 51.
. Maturana 1978, Biology of Language: The Epistemology of Reality. In G.A. Miller, E. Lenneberg (Eds.) *Psychology and Biology of Language and Thought: Essays in Honor of Eric Lenneberg,* Academic Press, New York, pp. 27-63.
. Maturana H., 1990, *Self-organization: Portrait of a scientific revolution*. Dordrecht: Springer Netherlands, 12-35.
. Maturana, H., Varela, F., 1980, *Autopoiesis and Cognition. The realization of the living*. Reidel, Dordrecht.
. Maturana H., Varela F., 1984, *Tree of Knowledge: The Biological Roots of Human Understanding*. Shambhala/New Science Library, Boston.
. McCarthy, John, Hayes P.J., 1969, Some Philosophical Problems from the Standpoint of Artificial Intelligence. *Machine Intelligence*, Volume 4.
. McCulloch W.,1965, *Embodiments of Mind*. The Mit Press, Cambridge, Ma.

. McCulloch W., Pitts W., 1943, A logical calculus of the Ideas Immanent in Nervous Activity, Bullettin Math Biophysics, 5.
. McGregor D., *Theory X and Theory Y*. Archive.is.
. McNamee, S., Gergen, K.J. (Eds.), 1992, *Therapy as social construction*. Sage. London, UK.
. Miller J.,1965, Living systems: Basic concepts. *Behavioural Science*, Vol.10, Issue3.
. Miller G., Galanter E., Pribram K.,1960, *Plans and the Stucture of Behaviour*. Holt, New York.
. Mitchell S.A., 1988, *Relational Concepts in Psychoanalysis* - an Intergration. Harvard University Press
. Modell A.H., 1990, *Other Times, Other Realities, Towards a Theory of Psychoanalitic Treatment*. Harvard Univ. Press, Mass.
. Morelli U., Weber C., 1996, *Passione e apprendimento*. Cortina, Milano.
. Morgan G., 1996, *Organizational Methaphores*. Taylor & Francis, New York.
. Morin E., 1977, *Method: Towards a Study of Humankind : The Nature of Nature*. Peter Lang Editions, London.
. Morin E., 1983, *La Méthode 2: La Vie de la vie*. Seuil, Paris.
. Morin E., 1985, *La Méthode 3: La Connaissance de la connaissance*. Seuil, Paris.
. Moscovici S., 1961, *Le rappresentazioni sociali*. Il Mulino, Bologna 2005.
. Mugny G., Perez J.A.,1989, *The social Psychology of Minority Influence*. Cambridge Univ. Press, Mass.
. Munari A.,1993, *Il sapere ritrovato*. Guerini e Ass. Milano.
. Neisser U., 1967, *Cognitive Psychology*. Prentice Hall, New Jersey.
. Neisser U., 1976, *Cognition and Reality*. Freeman,
. Neumann J. (von) e Morgenstein O., 1953, *Theory of Games and Economic Behavior*. Princeton University Press, New York.
. Ogden T.H., 1993, *The Matrix of the Mind*. Jason Aronson, Inc.N.Y.
. Oliverio A., 1996, La mente e le emozioni, *Le Scienze*, Quaderni 91, Settembre.
. Pagliarani L., 1985, *Il coraggio di Venere*, Cortina, Milano.
. Papert S., cibernetica
. Pask G., 1961, *An Approach to cybernetics*,. Harper and Brothers, New York.
. Pearce B.W.,1989, *Communication and Human Condition*. Southern Illinois Univ. Press, USA.
. Perticari P., 1992, *Conoscenza come educazione*. Angeli, Milano.
. Perticari P., 1996, *Attesi imprevisti*. Bollati Boringhieri, Torino.
. Piaget J., 1936, *La construction du reel chez l'enfan*. Delachaux et Niestlé, Paris.
. Piaget, J. (ed.), 1967, *Logique et connaissance scientifique*. Gallimard, Paris.
. Piaget J.,1973, Introduction a l'épistemologie Genetique. PUF, Paris.
. Planck M., 1901, Ueber das Gesetz der Energieverteilung im Normalspektrum. *Annalen der Physik*, 309 (3): 553–563
. Poincarré H., 1903, *Science et Méthode*. Flammarion, Paris.
. Pribram K.H., 1971, *Languages of the Brain: Experimental Paradoxes and Principles in Neuropsychology*. Brandon House, New York.
. Prigogine I.,1967, *Introduction to Thermodynamics of Irreverence Processes*. Wiley, New York.
. Prigogine, I., Stengers I., 1979, *La nouvelle alliance*. Gallimard, Paris; Eng. trans. Order Out of Chaos: Man's New Dialogue with Nature. Flamingo, London 1984.
. Radcliffe Brown A., 1935, Structure and Function in primitive society, *American Anthropologist*, Vol. XXXVII.
. Rapaport, 1962, The Use and Misuse of Game Theory. *Scient. American*, vol 207, N°6.
. Rebitzer J.B.,1995, The consequences of minimum wage laws some new theoretical ideas. *Journal of Public Economics*, Vol. 56, N°2, pp.245-255.

. Riziello S., 1996, The Economics of the Mind. Edward Elgar Pub. 1999.
. Rizzolatti G., Gallese V., 2001, Neurophysiological mechanisms underlying the understanding and imitation of action. In *Nature reviews neuroscience*, 2.9, 661-670.
. Rosenbleuth A., Wiener N., Bigelow, 1943, Behavior, Purpose and Teleology. *Philosophy of Science* Vol. 10, No. 1 (Jan.), pp. 18-24.
. Rossimonti M.,Vitale S., 1980, Dall'analisi esistenziale alla teoria dei sistemi. Feltrinelli, Milano.
. Ruelle D., Takens F., 1971, On the Nature of Turbolence. *Commun Math Phsy*, 20, 167-92.
. Saussure F.,1922, *Course in General Linguistics*. Bloombsbury Publishing, London 2013.
. Sbisà M., 1975, *Wittgenstein*. Ubaldini, Roma.
. Searle G.R., 1990; *The mystery of Consciousness*. New York Review Books, USA.
. Selvini Palazzoli M.,1970, Contesto e meta-contesto nella terapia della famiglia. *Archivi di Psico., Neurol. e Psichiatria*, 31.
. Selvini Palazzoli M., Boscolo L., Cecchin G., Prata G., 1980, Hypotesizing, Circularity and Neutrality, three guidelines for the Conductor of the Session. *Family Process*, Mar, 19(1),3-12.
. Shannon, C. & Weaver, W., 1949, **The mathematical theory of communication**. University of Illinois Press, Urbana, Il.
. Schmid G.B., 1996, *Caos*. In M. Turno, E. Liotta, F. Orsucci (eds), *Fra Ordine e Caos*, Teda, Roma.
. Simon H.A., 1997, *An Empirical Based Microeconomics*. Cambridge Univ Press, Cambridge.
. Stengers I., 1985, *Les Généalogies de l'auto-organization*. Cahier CREA, vol. 8.
. Stern D., 1985, *The Interpersonal World of the Infant: A View from Psychoanalysis and Developmental Psychology.* Basic Books, New York.
. Telfener U., 1983, Dal modello omeostatico al modello evolutivo. In M. Malagoli Togliatti, U. Telfener 1983.
. Telfener U.,2000, La psicologia clinica come pratica culturale, *Pluriverso*, N°1. pp. 219-230. culture (cambiare pg 71)
. Telfener U., 2008, Riflessioni sulla terapia individuale sistemica, in Connessioni, N° 20, marzo 2008, pp. 28-52.
. Telfener U., Cingolani S., 1987, Riflessioni sui problemi epistemologici in psicoterapia. Psicobbiettivo N° 1.
. Thom R.,1975, *Structural Stability and Morphogenesis*. W. A. Benjamin, Inc., Reading, Massachussett.
. Thompson W.I.,(Ed), 1967, *Ecology and Autonomy, the New Biology*. Feltrinelli Milano.
. Turing A.M.,1937, On Computable Numbers, with an Application to the Entscheidungs Problem. In von Foerster 1974, *Op Cit*.
. Ulrich H., Probst G.J, 1984, *Self-Organization and Management of Social Systems*. Springer, New York.
. Ugazio V., 1984, Ipotizzazone e processo terapeutico. *Terapia Familiare*, N°16.
. Ugazio V., 1985, Oltre la scatola nera. *Terapia Familiare*, N°19.
. Vaccarino G.,1984, *La mente vista in operazioni*. G.D'Anna, Messina.
. Varela F.,1979, *Principles of Biological Autonomy*. North Holland, Amsterdam.
. Varela F., 1985, Complessità del cervello ed autonomia del vivente. In G.Bocchi e M. Ceruti, *Op Cit*.
. Varela F., 1987, The science and technology of cognition: Emergent directions, Technical Report for Shell Int.Co., London.
. Varela F., 1997, Patterns of Life: Intertwining identity and cognition. *Brain Cognition* 34:72-87
. Varela, F., Maturana H., Uribe R., 1974, Autopoiesis: The organization of living systems, its characterization and a model. *Biosystems* 5.4, 187-196.
.Varela, F., Thompson, E., Rosch, E., 1991, *The Embodied Mind: Cognitive Sciences and Human Experience*. MIT Press, Cambridge, Ma.

. Vrba E.,Eldrege N., 1984, Individuals, Hierarchies and Processes: Towards a more Complete Evolutionary Theory. *Paleobiology*, 10.
.Vattimo G., 1994, *Oltre l'interpretazione*. Laterza, Roma.
.Vattimo G., Rovatti P.,1983, (eds), *Il pensiero debole*. Feltrinelli, Milano.
. Veca S., 1997, Dell'incertezza. Feltrinelli, Milano.
. Waldrop M.M., 1987, *Complexity*. Simon & Shuster, New York, 1992.
.Watzlawick, P., Beavin, J.H., & Jackson, D.D.,1967, *Pragmatics of human communication.* Norton, New York.
. Watts A., 1951, *The Wisdom of Insecurity*. Vintage Books, New York.
. Weaver W., 1947, *Science and Complexity*. in Foerster H. (von) 1974, *Op.Cit*.
. Weick K.E., 1969, *The Social Psychology of Organizing*. McGraw Hill.
. Weick K.E.,1995, *Sensemaking in Organizations*. Sage, California.
. Weiss J., Sampson H., 1986, *The Psychoanalytic Process: Theory, Clinical Observation, & Empirical Research*. Guildford Press, New York.
. White M.,1992, *La terapia come narrazione*. edited by U. Telfener, Astrolabio, Roma.
. Whitehead A.N., Russel B., 2010, *Principia Matematica.* University of Michigan Historical Math Collection. Ill.
.Wiener, N.,1948, *Cybernetics*. MIT Press, Cambridge, Mass.
.Wittgenstein L.,1922, *Tractatus Logico-Philosophicus*. Routledge, London.
.Wittgenstein, L.,1953, *Philosophical investigations*. New York
. Zanarini G., 1990, *Diario di viaggio*. Guerini, Milano.
. Zeeman E.C., 1965, Topology of the Brain in Mathematics and Computer Science. *Biology and Medicine*, Stationery Office, London.