

Chapter 2

Environmental History as Sustainability Science

2.1 History and the Crisis of Modern Civilization

There is no doubt about the profound crisis currently experienced by the industrial civilization that has exerted global dominium during the nineteenth and twentieth centuries, its foremost myths gradually collapsing one by one. The industrial growth has failed to visibly close the gap between the rich and the poor countries, thus clearly revealing the lack of connections made between economic growth, industrialization, and development. Neither were social inequalities abolished, although they dimmed during the peak of *Fordism*, currently reappearing with a particular virulence that is reaching to even a growing sector of the population of the rich countries (Milanovic 2003, 2006; Acemoglu and Robinson 2012). The feeling of deprivation of the myriads of commodities offered by the markets—now boosted by globalization—spreads throughout the world. This deprivation becomes a powerful motivation that—contrasting with misery and violence—thrusts migratory movements that *endanger* the *positional* privileges of the affluent countries. The modes of political organization of the nineteenth and 20th centuries, which accompanied industrial capitalism, show unequivocal signs of exhaustion in front of the constant transference to transnational decision domains of important shares of sovereignty, at the same time that small cultural communities regain their political identities in reaction to the process of globalization. The orthodox paradigms of science—together with its hegemonic core of scientific-technological rationality—have for some time sinking into an irreversible crisis. Crisis also regarding many dominant values, while others appear that some have labeled as *postmaterialistic*, but that are maybe only expressing the need for a *new modernity*—as claimed by Beck (1998). But it is the ecological crisis what perhaps better depicts the civilization crisis, its severity and its planetary dimension, and what will surely force the adoption of highly relevant changes in the conformation of society. The greenhouse effect, the gap in the ozone layer, the exhaustion of mineral resources and fossil fuels, deforestation, overexploitation, the depletion of water resources, atmospheric pollution, acid rain, erosion and desertification, among others, are tightly linked with the modes of production and consumption brought about by economic growth and industrialization.

However, most discourses regarding the past continue to maintain the same values, and to proclaim the virtues of a single social model that an increasingly fewer sector continue to consider as viable: the industrial society. Indeed, it is discouraging to observe that among most historians the concept of nature occupies a marginal place, being only invoked by the modest minority of the environmentalist historians. Once the ambition for a Total History claimed scientism—and its pretension of the past serving as a powerful impulse for the future, which would trigger social change—have been overcome, the historical discourse has diversified in its objectives, its contents, and its theoretical and methodological orientations. No more is there a Universal History integrated by the sum of National histories, or by the aggregation of the different social classes, but a multiplicity of histories—some of which are too small and insubstantial—in which the sense of social usefulness has vanished. The crumbling propitiated by *post-modern* critical historiography has deconstructed the solid foundations of the Total History, one of the late forms of understanding the past of the industrial civilization.

But deconstruction was incomplete. *Postmodern* historiography continues to neglect nature, the discourses it produces remaining inside a material vacuum without physical or biological references, nor a relation to the laws of nature making social practices become possible or impossible. Thus, most present historiographical currents are tributaries of the *metaphysical illusion* that enraptured modernity, and that segregated human beings from nature, engendering an anthropocentric fiction that refuses to die. That is why some accounts of the past are frequently turned into a mere instrument for legitimizing the present. We are then in a strange situation in which the challenges to be faced cannot find a backup in social memory. The continually dominant discourse of our historiography conserves an ancillary axiomatic based on values and objectives belonging to an obsolete modernity, displaying a notorious abandonment of reality, being condemned to remain as a simple archaeological exercise or museum knowledge that is almost devoid of a connection with the surroundings, and which in reality is only useful for legitimizing a society in crisis, thus delaying the consciousness of change. It is thus urgent to recover the needed unity that must exist in the collective memory and in social demands: a recovery that transits through the necessity of reconciling society with nature. The following pages are devoted to support such a necessity by means of an attempt for relocating the accounts of the past within the *human knowledges* that can provide us with a clear and palpable social utility.

2.2 Environmental History, a Hybrid Discipline

As other fields of knowledge, Environmental History was born as a response to the limited capacity of conventional disciplines for understanding the increasingly complex reality of the present. In his devastating critic to contemporaneous

science, Morin (2001) found that the main limitation of the predominant style of scientific research lays in the *simplifying paradigm*, which is a way for organizing knowledge while reducing the growing complexity of contemporaneous reality. The need for surpassing such *fragmented objectivity* by means of a multidimensional or integrating explanation has already motivated the appearance of new epistemological and methodological proposals.

Two noticeable contributions are, undoubtedly, the principle of complexity of Morin (2001), and what García (2000, 2006) has termed as the study of complex systems: “With the principle of complexity it is intended to overcome the knowledge in separate worlds characteristic of ‘classical science,’ [where] ... not even human sciences have consciousness of the physical and biological character of human phenomena, nor natural sciences have consciousness of their inclusion within a culture, a society, a history, nor of the hidden principles orienting its constructs” (Morin 1984, p. 43). Thus, a *science with consciousness* as Morin calls it, would be that which achieves to transcend (without their abolition) the different fields of specialties. Anyways, many of the problems to be solved by researchers are present in reality unclassified regarding scientific disciplines.

García (2000) recognizes that certain situations in which multiple processes merge (e.g., of the physical-biological environment, production, technology, demography, and social organization) conform the structure of a system functioning as an organized whole, which he calls complex systems, and that is only analyzable from an interdisciplinary approach. The above obliges to propose a research strategy that cannot be limited to the simple *summation* of the partial approaches of a diversity of specialists, but build a truly systemic interpretation leading towards an integrated diagnosis.

Beyond the thoughts of the above-cited and other scholars, such as Funtowicz and Ravetz (2000) or Holling (2001), who propose a *science for sustainability*, the rupture of cognitive parceling has not occurred as a self-conscious and generalized process, but as a *spontaneous*, multipolar, and asynchronous trend, i.e., it has appeared in different time periods, and in the different domains of knowledge there where the problems to be solved have induced the creation of new integrating approaches.

The most illustrative example of the above-described methodological process is that of so called *environmental problems*. As time passes, it has been discovered that these environmental issues can be fully described, interpreted, and above all, solved, only through a comprehensive approach. Environmental or ecological issues are today maybe the most challenging of problems for contemporaneous science, not only because it urgently demands new approaches capable of offering reliable and comprehensive information for solving numerous problems, but specifically because these issues already represent a colossal threat to the survival of life and human societies in the planet. In that regards, the birth of a *science of sustainability* can be understood as a result of *evolutionary convergence* brought about by environmental pressures over the divergent branches of science.

2.3 Sustainability Science

Despite its youth, sustainable science has become a field of science that has experienced an unusual expansion. The volume of literature produced by sustainability science—which despite its diversity has given rise to a more unified scientific practice—is impressive: over thirty seven thousand authors from one hundred and seventy four countries had produced over twenty thousand papers by the year 2010 (Bettencourt and Kaurc 2011, p. 19541).

Sustainability science, as described by the PNAS website, is “... an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenge of sustainability: meeting the needs of present and future generations while substantially reducing poverty and conserving the planet’s life support systems (quoted in Kates 2011, p. 19449).”

At present, sustainability science “is usually understood as research providing the necessary insights to make the normative concept of sustainability operational, and the means to plan and implement adequate steps towards this end (Spangenberg 2011, p. 276).” It is, hence, a predominantly practical or applied science: “sustainability science is a different kind of science that is primarily use-inspired, as are agricultural and health sciences, with significant fundamental and applied knowledge components, and commitment to moving such knowledge into societal action (Kates 2011, p. 19450).” It pursues “real-world solutions to sustainability problems (Spangenberg 2011, p. 275).”

Sustainability science is not a subtopic of other sciences, or a transversal topic, or merely a new discipline. Despite that the term encompasses several theories, methods, and orientations (Kastenhofer et al. 2011), it has emerged as a research field defined by the problems of unsustainability rather than by the disciplines it recurs to (Clark 2007; Kajikawa et al. 2007). Beyond possible semantic differences, sustainability science must include both the *science for sustainability*, and the *science of sustainability*.

According to Spangenberg (2011, p. 276), sustainability science is characterized by three constitutive features, over which some consensus seems to exist: it may be basic or applied research, but it must be linked to a defined objective; the approach to the complex scientific and technological topics is based on integrated analyses and evaluations, understood as iterative participatory processes of reflection and discussion in that knowledge (science) is coupled with action (politics); the participation in it of scientists, decision makers, and stakeholders is essential. Finally, it is indispensable that sustainability science is multidisciplinary, or as stated by Clark and Levin (2010, p. 6), “extraordinarily multidisciplinary.”

Thus, this new field of scientific practice has been created as a response to the challenges derived from the ecological crisis, encompassing within it several *hybrid disciplines* that operate as particular reactions to the general process of excessive compartmentalization and specialization, and as expressions of a sort of *salvage science* seeking for information to stop and revert the environmental crisis. This phenomenon presents two main characteristics: First, it has had its main

infectious focus in Ecology, the discipline that has achieved an original synthesis—of knowledges from other Earth and Biological Sciences, including Physics and Chemistry—that crystalized in the proposal, rigorousness and decantation of the concept of ecosystem: its object of study.

Second, it has been a multipolar process in which, on one side, there has been a gradual overcoming of the resistance of ecologists who insist in circumscribing their approach to the study of phenomena whose nature is conceived as a pure, pristine, or untouched entity, and in the other side, the impermeable barriers of disciplinary purity have been removed from at least nine areas of knowledge. As a result, nearly twenty *hybrid disciplines* have arisen (Fig. 2.1), which can be seen as interdisciplinary modes of approaching reality based on the integration of the synthetic study of nature (Ecology), with different applications on the study of the social or human universe.

Heterogeneity has been the main feature of this reciprocal fertilization, such that all attempts for considering these hybrid disciplines as fractions of a supposed *metascience* becomes premature, if not illusive. Nevertheless, interdisciplinarity requires at least the use of a common language. Examples of this can be found at present in many fields of study, as are the cases of the Integrated History and Future of People on Earth (IHOPE), for whose participants “one of the major challenge for reaching this goal is developing ‘workable’ terminology that can be accepted by scholars of all disciplines (Costanza et al. 2012, p. 106),” and in the more ambitious proposal of Gintis (2009, p. 225) of extending History as a science studying human behavior in the past, regarding which he stated: “In fact all four [disciplines] (Economics, Anthropology, Sociology and Psychology) are flawed but can be modified to produce a unified framework for modeling choice and strategic interaction for all of the behavioral sciences.”

From the sociological perspective, the triggering factors of all these new hybrid disciplines have undoubtedly been the process of globalization of the human phenomenon, the development of specialized knowledge itself, the deployment of new technologies, and, in the center of all this, the appearance and aggravation of the so called environmental or ecological crisis, which is today present at the global scale and that during the past decades has become more frequent, severe and extended. In sum, Environmental History has surged in parallel with other areas of knowledge, among which the most conspicuous are Ecological Economics, Political Ecology, Environmental Education, or Agroecology, among others.

2.4 What is Environmental History, and What Are Its Goals

Certain academic groups also designate Environmental History as Ecological History, which should not be confused with Historical Ecology. Historical Ecology is the subdiscipline of Ecology that deals with the study of ecosystems in the past.

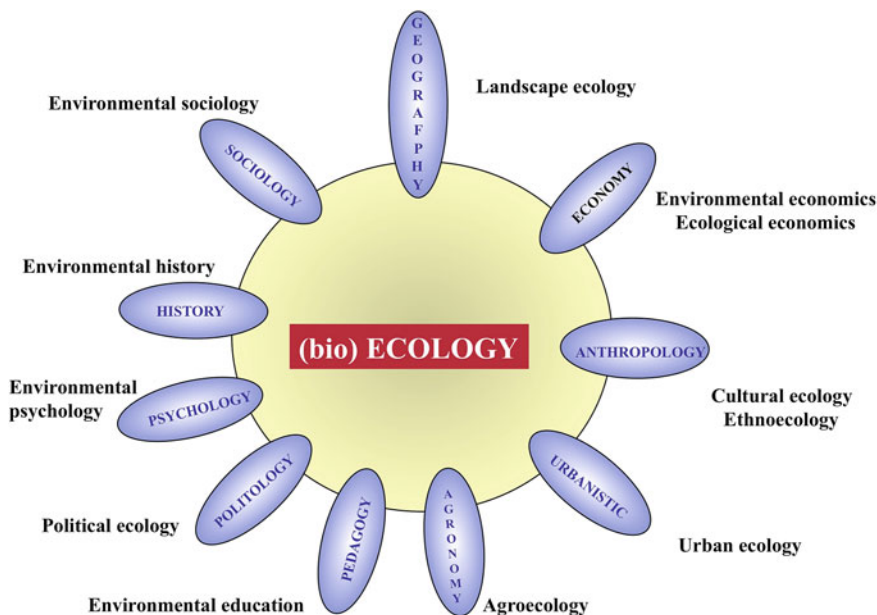


Fig. 2.1 Diagram showing the birth of at least 12 hybrid disciplines resulting from the integration of biological ecology with other areas of knowledge (See text)

Although its origins go back to the 18th century, it was until the 1950s that it became defined (Rackham 2003). History has interested ecologists for a long time (for example, see Peterken 1981; McDonnell and Pickett 1993; Worster 1993; Russell 1997; Meine 1999; Bowman 2001; Egan and Howell 2001; Foster et al. 2003; Rackham 2003; Verheyen et al. 2004; Crumley 2007; Dietl and Flessa 2009). That interest arises because: it aids to understand the present processes involving nature, it favors both decision making and the implementation of better supported modes of management of ecosystems (Newell and Wasson 2002; Thompson et al. 2009) and, finally, because History as a discipline places Ecology in a more consequent interdisciplinary context (Bürgi and Gimmi 2007).

During its onsets, Historical Ecology shared topics and some methodologies with Environmental History, but during the last decades it has oriented more towards Ecology, in particular, to the conservation of natural resources. There is no consensus among ecologists defining themselves as historical ecologists regarding the definition of Historical Ecology (Rackham 1986, 1998, 2003; Crumley 1994, 2007; Russell 1997; Egan and Howell 2001; Balée 2006; Bürgi and Gimmi 2007). However, given human beings have become one of the main factors explaining the dynamics of ecosystems, there is an agreement about its main object of study: the interactions of humans and nature in the past. Side by side with the main stream of ecologists that conceive human activity over the environment as a *stressing agent*, a new conception is gaining terrain which considers human activity as an agent of *change*, and thus of the environmental dynamics (Dearing

2007, p. 31). In other words, the impossibility of analyzing nature and culture in a separate way is becoming clearer each day (Szabó 2010, p. 381). The terms Ecology and History as fields of study was defined by Crumley (2007, p. 27) as the former including humans, and the latter, the planetary system and the physical and social past of the human species.

Historical ecologists are more oriented towards studying the large fluctuations of the physical and biological cycles, particularly those of climate, and their repercussions on human societies and their capacity for reaction (resilience). Their view of the past is rather *naturalistic*, from the perspective of its functional rules contemplating society as separate from nature and reacting differentially in response to environmental pressures. Instead, Environmental History obeys to the growing concern of the community and historians for the environment, having a more *social* view. As a part of History, the human past remains to be the focus, but regarding material interactions, it remains to be engaged in studying the various past and extant societies as human ecosystems, or as subsystems of the more inclusive system of nature.

If the objective of study of Historical Ecology is the ecosystem—in a broad sense including anthropized ecosystems—that of Environmental History is the material part of the functioning of societies in the past. A priori, there should be no distinction between Historical Ecology and Environmental History, given that both attempt to build “a science of the past (Cornell et al. 2010; Costanza et al. 2012, p. 112).” Lets examine the example of Agroecology. An agroecosystem is an anthropized ecosystem that would be unapproachable without taking into account the energy supplied by human beings. The only possible Historical Agroecology is that of the Environmental History of agroecosystems. Thus Historical Agroecology and Environmental History have one and the same object of study and are the same thing. The ideal situation would be that both disciplines merge into one when considering the level of human intervention in the environment. To achieve this unification a language, and a theoretical and methodological framework need to be developed, which tends to be common within its diversity or to the very least, to facilitate an interdisciplinary dialogue. In this regard, the interactions between the academic communities are intense, and the border between both disciplines is being increasingly blurred.

Donald Hughes tried to establish a more precise conceptual perception of Environmental History: “The idea of environment as something separate from the human, and offering merely a set—ting for human history, is misleading. The living connections of humans to the communities of which they are part must be integral components of the historical account. Whatever humans have done to the rest of the community has inevitably affected themselves. To a very large extent, ecosystems have influenced the patterns of human events. We have, in turn, have to an impressive degree made them what they are today. That is, humans and the rest of the community of life have been engaged in a process of coevolution that did not end with the origin of the human species, but has continued to the present day. Historical writing should not ignore the importance and complexity of that process (Hughes 2002, p. 25)”.

In consequence, and while the needed unification in a single field of knowledge, the objective of Environmental History is not the study of the (natural) environment, but of human beings within environment, i.e., of the relations between society and nature through time. In terms of McNeill (2005, p. 13) one of the better-known environmental historians, Environmental History deals with the reciprocal relations between the human species and the rest of nature. In the latter definition, and to which we adhere, human beings are not an external and differentiated entity, but form a part of nature together with all other living species, something we will reexamine below. Such a definition suggests a number of questions centered in the tasks of Environmental History. Worster (2004, p. 126) stated that: “all the range of human interactions, both intellectual and material, with the natural world are assumed. This concept questions how natural or anthropogenic forces have transformed the landscape and how these changes have affected human life. It concentrates in the technological power that humans have accumulated and asks how has that power affected the natural world. The new environmental history also takes care of how humans have perceived the natural world and how they have reflected about their relation with this more than human world (Worster 2004, p. 126)”.

Environmental History is thus *a part of the history of humanity* throughout its evolution in the planet. It does not pretend to build a new narrative of human evolution that replaces contemporaneous theories such as Marxism or Functionalism, among others: such a pretension was buried by the crisis of modernity. But Environmental History is neither a new historiographical specialty to be added to those already existing—Economic, Agrarian, Political, and Social History, or that regarding mentality of social movements—nor does it operate independently from them. It is just one of the *crumbs* in which historical research disintegrated in present times of postmodernity. Environmental History uses theories, methods, and constructs narrations that are part of Economic History, Political History or Social History. Thus, the knowledge it provides is transversal across existing disciplines, as transversal is its position regarding many of the ongoing historiographical debates from which it nourishes.

Neither does Environmental History pretend to become a specific field of knowledge dominated by Natural Sciences, and aiming at providing environment with an explicative capability of human practices—a capacity that it, obviously, lacks. Hence, it does not pretend to understand all from the environmental perspective, legitimizing the intrusion of Natural Sciences in History, giving preference to natural over social scientists. Such a defensive reaction is common among many historians that see their status threatened by a specialized knowledge needed by the practice of Environmental History that is apparently outside of the humanistic approach (e.g., Fontana 1992, p. 65), and for which they are usually not prepared. The separation between social and natural sciences has long ago been left behind by the development of human knowledge, committed with transdiscipline (Khagram 2010). What Environmental History does pretend is to reject and overcome the traditional division—and even the confrontation—between society and nature that has characterized the narrative of modern historiography. In consequence,

presuming that Environmental History be a mere translation to the historiographical field of concepts and schemes from the Natural Sciences is unwarranted, as would also be presuming History to be substituted by Ethology or Biology. Furthermore, the simplistic view placing Ecology—with which Environmental History shares many of its theoretical and epistemological postulates—in the realms of Natural Sciences, understood as disciplines exclusively in charge of the animal, physical, and biological realities, becomes terribly unfair and restrictive.

Environmental History is thus far from any *imperialistic* attitude regarding its methods and its theories, as is believed to be by some historians who hold that historical knowledge should be reserved to the exclusive and unpolluted realm of *pure* Social Science; it does not claim that all historical phenomena have an environmental explanation, even when this is necessary a part of the explanations given to a historical event. Many historical facts can be explained taking into account variables of an environmental nature, but many others can definitively not be such accounted for. Although environmental variables provide much more coherent explanations to certain trends and historical phenomena, Environmental History resigns to explain it all with the environmental prism, or to build a new meta-narrative in which the environment is the *deus ex machina* providing the key for understanding.

Environmental History is an *alternative* way of understanding evolution of human beings, which requires of a radical change in focus. To the same extend that History studies human societies and their past evolution, Environmental History attempts to understand the strategic relations established by human beings—both between themselves and with nature—in order to organize their subsistence. The historical account must consider the relations of humans with the communities of organisms to which they belong, and account for the fact that any effect over the former will affect the latter (Hughes 2002, p. 26). For that reason, History needs to be also Environmental History; it must be an inseparable part of historiographical discourse, which is therefore ecologized.

Environmental History is thus a narrative about human past that contributes to constructing and making more coherent a more general account of the evolution of the human species on Earth. The separation between Environmental History and History is useful above all for emphasizing the relevance of environment in explaining the course followed by humanity, clearly revealing the connection that History must have with Ecology in a series of common features—both of epistemological as ontological nature—that form part of the new ecological paradigm. For example, the inter- and multidiscipline in front of the analytical spirit; integrality of the knowledge it generates instead of its fragmentariness; centrality of the rational opposed to the substance of mechanicism; the importance of the temporal dimension; and the biocentric perspective, among others. All this key-notes assume a rupture with the so far dominant forms of historiographical discourses, a fact that must righteously be emphasized. The moment of Environmental History is, in addition, a constitutive period in the sense of Kuhn (1975), amidst the crisis of traditional historiographies, and it is convenient to clearly distinguish between them.

Environmental History essentially deals with the material base of social relations. In that sense, it is consequently materialistic and naturalistic (Prices 2011). Such a qualification does not, however, imply that it chooses a materialistic and objectivist theoretical over an idealistic standpoint, as artificially suggested by the dichotomy in the social sciences during modernity. Naturalism, as materiality refers here to the object of Environmental History, the flows of energy, materials, and information to which all human practice can be reduced, but also to material nature of any cultural dimension of human practice. Materialism must mean not believe that cultural forms of production and consumption are determined by the by the forces of environment, only the cultural behavior occurs within a material world whose properties limit what is possible and determine the environmental consequences of that behavior. In other words we need to support both the specificity of cultural motivations such as the universality of material laws (Hornborg 2007). As will be seen below, all individual—this including social groups or an entire society—consumes a given amount of energy and materials to feed and sustain its organism, to commute from one place to another, to dress, warm-up, and even to perform immaterial actions such as cultural and scientific activities. In this process, the individual establishes relations with nature and with other individuals that are relevant for Environmental History. However, to explain these relations is not a task corresponding exclusively to Thermodynamics, Chemistry, Physics, or Biology, but also to Sociology, Economy, Anthropology, and of course, also to History. Even the ideas and representations of nature and how to manage it—belonging to an immaterial realm—is a fundamental object of study of Environmental History. Definitively, Environmental History is materialistic because it attempts to study the manner in which the flows of energy, materials, and information have been organized through history according to the changing needs of the endosomatic and exosomatic social metabolism.

For that reason, the knowledge produced by Environmental History requires the support of theories, methods, and techniques both from the Natural and the Social Sciences with a of trans-disciplinary vocation. But Environmental History does not seek to study it all, but only the parts and the connections emerging from these parts through theoretical-methodological mediations to reduce the complexity of reality—the significant historical fact for Environmental History—allowing for its explanation. In consequence, a distinction must be made between the globalizing ambitions, the recognition of the existence of a multiplicity of possible explanations, with the totalitarian ambition of modern historiography. Behind the pretension of a Total History hid the pretension of building a normative meta-narrative to govern the historical fact, fitting it within a preconceived interpretative framework of structuring and evolution of social relations.

2.5 Is Environmental History Anachronic or Ephemeral?

Some historians have raised several questions about placing nature at the base of human practice, judging it as one more of the ephemeral fashions of postmodern

historiography: Is it only the consequence of present environmental concerns? Would this make historical discourse to be a form of *Presentism*, or to be anachronic? Would it legitimize blaming nature for past environmental concerns that were then inexistent? But Environmental History is free from such a risk provided the required abandonment of the ethnocentric idea of environmental concerns being only expressed in conventional scientific terms, and that only scientists express them—or at the most, occidental ecologists; what this means is that after a careful analysis of the economic and social worries of cultures other than the occidental, rooted in the Enlightenment and motor of modernity (but as mentioned, ill with a metaphysical illusion), it will be apparent that worrying about natural resources, the environment, and even for the *sustainability* of social relations in regards to environment has always been habitual, albeit obviously such concerns were stated in different terms.

Human beings have always cared for the relation of society with nature. Before the anthropocentrism of our culture became established, and even in current oriental societies, nature was and is indissoluble from culture. Enough be to recall the nearly generalized organismic conceptions of cultures that through sacralization of space or resources, and the ritualization of main productive activities, attempt to have a *harmonic* relation with nature, among other reasons, because its survival as cultures depend on it. As rightly said by Hornborg et al. (2007), the interphase between the human and not-human spheres has always been an omnipresent theme for reflection and cosmological explanation, from the ancient written documents from Mesopotamia and China, to the myths and metaphors of contemporaneous indigenous people.

Also in the literate occidental culture an environmental reflection was present since early periods, frequently expressed through science, which rarely gained relevance in the history of ideas due to they went against the tide. Grove (2002), among many other historians, dealt with this fact considering a common fallacy to conceive environmental concerns to be new, beginning after World War II. Environmentalist reactions to changes induced by human beings originated early in the well-read culture, of which Grove (2002) provides multiple examples occurring from the 15th century to the present.

Each society has had its own perception of its environment and of the process of its metabolism with nature. Environment is not only a physical space defined by complexity and entropy, but also a social construct, which throws a shadow upon the assumed universality and uniqueness of the categories *nature* and *culture*, and on their artificial separation caused by modernity (Redclift and Woodgate 2005). Indeed, such a conceptual differentiation between nature and culture is lacking in non-western cultures and the society vs. nature antagonism so evident nowadays is in reality an *ethno-epistemological* construct of Western culture that is poor suited for accounting the ways in which other peoples or cultures speak about or interact with their physical environment (Toledo and Barrera Bassols 2008).

But even in epistemological terms such a flaw is unacceptable. As a social and therefore historical construct, History could hardly be kept unpolluted from current concerns. The historical discourse is more than compilation of a story it also

involves collective *recalling* in which past events are selectively recovered under present stimuli. The historian disentangles the past through methods and theories that necessarily need to be expressed in current terms. This method differs little from that used by individuals to tolerate the mere fact of remembering. Many facts are discarded, be it consciously or unconsciously, as many others we deliberately decide to remark (Gaddis 2002, p. 176).

A demonstration of the above is seen in the mere existence of history as a professional discipline institutionalized during the construction of the nation states of the nineteenth century. History fashioned stories projecting to the past the existence of the nation, accentuating all that could create a sense of national unity since the beginning of times. But such unity obviously could neither have risen, nor could it have rose before the nation itself had been born. In a similar way have methodologies belonging to neoclassical economic history of the nineteenth and 20th centuries been blatantly applied to societies for which the notion of growth was unknown. Many more examples could be brought forward to illustrate the frequency with which even the more reputed historiography relapses into Presentism. A risk that, as seen above, Environmental History is free from as judged from the common expression of past societies of a concern for nature, or what is the same, for their own survival.

2.6 The Theoretical Foundations of Environmental History

Knowing that Environmental History deals with the material part of social relations causes a radical Copernican revolution of historiographical accounts by bridging between the social and the natural worlds. But including environmental variables is not enough given that not all of the theories incorporating the physical and biological world are convenient for the purposes of Environmental History, whose theoretical foundations lay on the adequate understanding of the relations between society and nature. Rejecting any form of determinism seems obvious at first sight, in particular that rooted in the nineteenth century and geographically originated in Europe, which pretended to compare the different cultures and the *geniality* of nations through their habitat. Environmental History opposes any form of unidirectionality in the relation between the physical and biological environment such that human behavior can be explained in terms of the relation between society and nature. The natural laws in the physical and biological environment constraints the actions of human beings, but nothing more or less than that. This clarification becomes essential, because Environmental History is frequently disqualified as *deterministic*, a pejorative adjective whose use precludes any serious and well-supported rebuttal of argumentations.

But yet another more modern version of determinism equally threatens the scientific coherence of Environmental History: the pretension of some social ecologists of understanding the dynamics of societies by means of theoretical assumptions from Ethology or Population Ecology. By thinking that there are laws that rule human behavior which do not substantially differ from those for other

species, History becomes Natural History and Sociobiology (Wilson 1980), its theoretical framework. Pretending that ecological laws could explain the dynamics of human societies would be as preposterous as thinking it could be explained without the influence of such laws. Variations of this environmental reductionism can also be found in the attempts made for explaining human evolution in energetic terms (Odum 1972), or in the fatalism advocating the mechanical application of the Law of Entropy (Rifkins 1990).

Neither is there any pity for the pretensions of Environmental History coming from the attempts of Cultural Anthropology to explain the conformation of society as an adaptive response of human groups to corresponding their environments, such as the historiographical schools derived from Steward's (1955, 1977) Cultural Ecology, and from neofunctionalistic Ecology of Vayda (1969) and Rappaport (1968, 1971; also Vayda and Rappaport 1968; Vayda and Mackay 1975, 1977). In this same trend is *Cultural Materialism: the Struggle for a Science of Culture* of Harris (1977, 1983, 1985) and his Anthropology school that was so successful among environmental historians in the U.S. Harris is an adept of *functionalist* explanations of relations between humans and their environment, attempting to explain facts for their beneficial effect for the reproduction of the social system—for example, war is useful for lowering the growth rate of the population, which guarantees the reproduction of the ecological niche and thus, of the community. The fact that an event is useful does not imply that such usefulness explains the event: war cannot be explained by its consequences. A similar argumentation would be valid for the Ecological Anthropology of Hardesty (1979).

Many and very important achievements were reached within these currents that guided not few researches in the field of Environmental History, or even in that of Ecological Anthropology, although currently practiced with a less unilateral approach. Making Environmental History only relying on the theoretical arsenal and the methodological instrumentation of Ecology would be both too easy and simplifying. Social practices—because that is what History deals with—cannot be reduced in their whole complexity to environmental analysis. It is nonsense to claim that social relations move in response to physical constraints or by adaptation to them. As clearly stated by Georgescu-Roegen (1990a) regarding the second law of Thermodynamics, entropy has sets limits to the material life of humans throughout their history, but does not determine it (Georgescu-Roegen 1990b, p. 307).

2.7 Environmental History and the Coevolution Between Nature and Society

More recently, it has been proposed to understand the relation between nature and societies as a process of coevolution in which both interact along time, being thus impossible to understand them separately. Although this approach enjoys

popularity among social scientists, maybe because it does not introduce new questions but adds a new variable to the conventional analysis of society in the form of an essential principle: the double determination of both worlds—conceived as separate from each other—which can be separately explained by social and by natural sciences. Undoubtedly nature establishes limits to human behavior, to which it sometimes reacts adaptively, other times developing solutions that change the scale or disappear. It is also certain that society generates diverse impacts on nature. Thus, the relations between society and nature are ruled by a mutual determinism (Deléage 1993, pp. 275–300). Society and nature coevolve indivisible throughout history: changes in the dynamics of the ecosystems set global limitations that by social mediation induce changes in social organization; conversely, societies have triggered more or less definitive changes that have modified even the dynamics of ecosystems (Margalef 1979; Norgaard 1987; Worster 1988, pp. 289–308). But the recognition of this reciprocity does not imply that both be considered as separate worlds having their own dynamic and interacting through time. It is a way of seeing things that improves our comprehension of human relation with the natural world, but it does not implicate a fundamental shift regarding traditional conceptions.

Environmental History is hence supported on the principle of *social and ecological coevolution*. The work of Norgaard (1994)—to whom the foundation as a principle of Environmental History is due—emphasizes that people's activities transform ecosystems and these in turn, set scenarios for individual and social acts. Thus, Environmental History considers society *within* nature, with which human beings establish material relationships of exchange of energy, materials, and information. The concept of *social metabolism* has been adopted to refer to this multiple determinant relation, as we will see below. It thus attends to the relation between society and nature in an integrated way, meaning it rises from considering the social system as one more part of the natural systems (Berkes and Folke 1998), or societies as *subsystems of the biosphere*, denying exceptionalism, as was demonstrated by Catton and Dunlap (1978), being and continuing to be the dominant paradigm of social sciences. Barbara Adam expressed it bluntly as the inexistence of a nature-culture duality: we are natural and our actions are natural, although we establish conditions in an evolutionary, historical process (Adam 1997, p. 171).

However, human societies have an immaterial dimension differentiating humans from other species. Human societies thus can be conceived as a *hybrid* between culture, communication, and the material world (Fischer-Kowalski and Haberl 2007, pp. 8–10). In that measure, the cultural or symbolic moiety is subject to a dynamic not belonging to the natural environment. But all human actions, including the symbolic part, can be analyzed in material terms: for example, a music concert that is seen as the paradigm of a cultural practice subject to non material rules, can also be evaluated by calculation of the endosomatic cost of energy invested by musicians during the performance and in previous rehearsals, but above all, in the exosomatic cost of transportation, instrument manufacture, illumination and maintenance of the concert hall, and so on. Even thinking implies

exosomatic and endosomatic metabolic costs whenever thought is transmitted in a book, television, or a newspaper, etc. All human activities, although not belonging to the *material* world may have a cost in terms of energy and materials, and a quantifiable impact on the natural world. That is precisely what Environmental History deals with.

Agreeing to the an initial assumption of social systems forming part of nature, it becomes clearer why Environmental History cannot be limited to the simple account of environmental damages triggered by human activity. This version of Environmental History has been, as seen above, the most frequent and widespread: by means of a historical reconstruction of the undesired and unintentional consequences (or negative externalities) of human activity acting upon natural systems. This modality of Environmental History that Sieferle (2001) has ironically called *hygienist*, and McNeill (2005, p. 19) *decadentist*, has been marked by the consciousness of the ecological crisis. Many examples can be found, from pioneer works about the *smoke* caused by the Industrial Revolution, to many works about deforestation (Brimblecombe 1987; Brüggemeier 1990; Kiss 1990; Totman 1989; Gadgil 1990), and many, many others. Environmental History must be something more than the history of the negative externalities, it must also be the history of the *ecological rationality* in broad sense of each human society, both from the perspective of its productive models, as from its ideas about nature and the impacts over it from physical-biological changes (Worster 1988, p. 2002).

In consequence with what has been said, Environmental History must be a field in which natural and social sciences merge with a multidisciplinary vocation. The historian must be familiarized with theories, categories, and methods of both sciences, stemming from a holistic and systemic approach. The advances of science themselves have surpassed the cognitive virtuousness of the Newtonian paradox believing in the possibility of the compartmentalized study of specific phenomena, disconnected from their universe of relations, latter to be linked with others in a kind of pure causal relation. In our world all phenomena are connected through a vast and complex network of mutual relations that turn them in independent within the context of a dynamic process of constant evolution. Environmental History studies *social processes with environmental significance*, in a system in which, through complex relations, the physical, social, economic, and political factors intertwine.

The protagonist role of the relation between nature and society obliges taking into account the different time scales in which both operate, and how they interact between them. There is an ecological time that differs from the political, economic, and cultural times. This matter can be more clearly appreciated when comparing the duration of the large physical-biological processes with that of the social processes, either regarding natural resources as socially appropriated chunks of nature, be it because of the influence of environmental fluctuations on defining the ecological limits of development of societies, or referring to the disturbances of entropic changes on the dynamic of the ecosystem. As stated by Deléage (1993), the duration of the biophysical processes largely exceeds the actual experience of individuals and even of civilizations, such that these have only been aware and

used the phenomenological manifestations of such biophysical processes. What characterizes the ecological time periods is the immensely brevity or length of its processes, therefore the impression of stability held by generations until the present.

The analysis of consumption of natural resources is an excellent example regarding the confrontation of the time needed for their consumption with the length of time invested by Nature in their production, or what Puntí (1988) has termed the *production time*. The annual rate of destruction of tropical forests currently exceeds $1 < 5$ of its total coverage, but 400 years are required for its total recovery; at the present rate of consumption, oil is predicted to be depleted by the end of the present century, but Nature invested millions of years in its production; the thin ozone layer needed two thousand millions of years to consolidate, but remains to be threatened by the use of certain gaseous compounds (Comoner 1992). Conclusively, from the human perspective, the cycles of regeneration and production of materials and energy, and the productive capacity of ecosystems is determined in the long term, and always depending on the presence of a certain measure of stability.

These long physic-biological cycles condition the performance of societies, the more characteristic example of which is climate fluctuations object of research since the late fifties (Wigley et al. 1981; Pfister 1988; and more recently, Pfister 2007; Brázdil et al. 2010; McCormick et al. 2012). Le Roy Ladurie (1967) showed that continued rainfalls between 1646 and 1651 were coincident with profound economic and social problems eventually leading to the Fronde confrontation, and although no causal relation between climate and the insurrection exists the climatic alteration generated a critical scenario. Earth has witnessed climatic periods related to modifications of the zonal flow of air masses. The first land clearings that ended Prehistory were made in a favorable temperature climatic phase; the following cooler phase had an opposite effect, favoring the growth of forests and natural vegetation; again between the ninth and twelfth centuries, a temperate phase was coincident with the peaking of agriculture in Western Europe; and subsequently therefore. An even more spectacular case is the colonization by Vikings of Greenland in the late tenth century, thus called by them for its vegetation due to mild climatic conditions; since centuries ago, Greenland was covered by snow becoming a hostile territory for human presence, which undoubtedly cooperated to the failure of the Viking colonization from the fourteenth century. Less prolonged climatic fluctuations also have had a significant effect on the evolution of agricultural activities, as exemplified by the high correlation found by Pfister (1988) between meteorological variables and the prices of cereals in the continental Europe lasting until the diffusion of railroad transportation and the integration of the national markets.

A recent meta-analysis made by of Hsiang et al. (2013) of 60 studies based on 45 databases about conflicts taking place during the last ten thousand years in the world has demonstrated a considerable influence of climatic events and human conflicts. The deviations from normal precipitation and temperature levels systematically raised the risk of conflict, sometimes substantially so. In the period

from the second half of the twentieth century to the present, climate has a definite, statistically highly significant influence on contemporaneous conflicts. The authors do not mean to say that climate is the only factor when analyzing the magnitude of conflicts, but they conclude that in the eventuality of large climatic fluctuations substantial effects are produced in terms of the impact produced by conflicts (Hsiang et al. 2013).

In contrast, the changes induced by humans are abrupt and occur in a short time period relative to evolutionary trends spanning hundreds, thousands, or millions of years. For example, the desertification of Africa was favored and accelerated after World War II by erosive processes from deforestation, overgrazing, or agricultural mismanagement. Environmental History must encompass the social and the ecological timetables, which requires the coining of new—and perhaps proprietary—periods differing from those of conventional History, as for example the period of *Great Acceleration* characterized by the high increases in the rates of consumption of energy and materials occurred immediately after World War II, but coinciding in essential hiatuses such as the Neolithic Revolution or the Industrial Revolution, among others.

2.8 Sustainability, the New Meaning of History

In the beginning of this chapter we mentioned the Copernican revolution implied in substitution of conventional historiography for Environmental History. Certainly, History does not have to have a *meaning*. The project of the modern historiography was founded from the laic interpretation of the Christian *meaning of history*, and incarnated through the construct of progressive reasoning (Arostegui 1995; Hernández Sandoica 2004). History happened along a single line calculated by science and its applications, and hence guided by reason. The mission of modern man was to accelerate the evolutionary mechanism aided by Nature itself to achieve the maximum level of wellbeing. Progress therefore materialized as abundance brought about by science and technology.

This perspective explains the preponderance enjoyed by Economic History not only because it accounted the material advances made towards human progress in the form of technological achievements, but also because it did this by using Mathematics, the science most approaching Natural Sciences. Social History, second in importance, found its meaning in the corroboration of an evolutionary process towards evermore complex social models as an expression of the progressive social division of labor linked to economic growth and the material welfare of societies. Complexity was, henceforth, an expression of the growing rationalization of social organization. Political History was assigned to a secondary role consisting in measure the degree of political modernization of societies based on an abstract model concocted from the past experiences of the more affluent Occidental societies in which democracy and National states had been enthroned as the most efficient political organizations. Surely enough, most

orthodox Marxist historiographies identified the modern ideal with Socialism and Communism, and with internationalist forms of territorial organization, but all social historiographies converged in preferring to study the social change towards complexity and the empire of reason, be it as a Communist society or as a Western democracy; a change performed by social classes, or by their expression through social movements.

Any economic, social, political, or ideological behavior not fitting into this general theory of modernity were condemned to an otherness in which were mixed their characterization as pre-modern or exotic, their moral rejection, and public curiosity. The pre-modern repertoire included peasants, indigenous peoples, poor countries, and not Western cultures, whose presence measured the degree in which these would, sooner or later, enter the route towards progress.

History does not have to have a definite meaning, nor the historical discourse needs a finalistic or teleological evolutionary logic. However, Environmental History finds it *meaning* in the elaboration of a discourse centered on the concerns for sustainability, in coherence with its materialistic vocation. This does not mean that it only deals with the physical and biological worlds, or of the environmental constraints to human actions. We have already rejected such a deterministic position, as we also rejected analyzing society with the tools of natural sciences, and considering Ecology as the main objective of Environmental History. The definitive contribution of the environmental approach is the concern for sustainability. In doing such, it becomes a science that is committed with the uncountable social and political movements struggling throughout the world for constructing a new *sustainable society* (Toledo 2003).

2.9 Epistemological Foundations of Environmental History

The proposal herein made of Environmental History is thus tightly linked to the ecological paradigm that arises from the confrontation with the world vision of industrial modernity. It shares most of the assumptions of the *paradigm of complexity* (see Tyrantia 2008). It is thus the result of the efforts of criticism and of search for alternatives. Its construction was forged from diverse materials provided by criticism, but also by new scientific disciplines such as Ecology, Thermodynamics, and Systems Theory. From Ecology, it has borrowed the relevance of interactions between parts, or components of the natural and social worlds, the recognition of the complexity of reality, evolution, change, and others. From Thermodynamics, it adopted the conception that physical and biological processes in terms of finiteness, irreversibility, entropy—and simultaneously, of negentropy and order (Prigogine 1971; Adams 1975; Bailey 1990), i.e., of sustainability. From Systems Theory (Bertalanffy 1976; Luhmann 1996) were taken the holistic and systemic approach allowing for articulating concepts and theoretical constructs from Ecology, Thermodynamics, and Evolutionary Theory. In that regard, Bateson (1993) and Luhmann (1996) contributed to form an ecological theory of the

symbolic systems (language, mind, communication, culture, and so on), while Morin (1984) laid the foundations for a new method, a *conscious science* centered in relation and complexity, a field in which the contributions of Rolando García (2006) are also worthy of mention, and finally, Adams (1975), Capra (1998), Tyrtania (2009), among other researchers, have aided to the construction of a general ecological theory of the living beings, including the social ones, in an expression of the articulated synthesis of the natural and the social sciences.

Complexity is thus one of the main constitutive principles of the ecological paradigm, maybe contrasting more than any other with the traditional epistemology. In face of the exclusion mania of mechanistic science, it reintroduces the local and the singular to the explanation of phenomena. In front of the reversibility of time permeating through mechanistic science, it states time as an irreversible process, endowing knowledge with historicity. By that means, it contradicts the so frequent vision of human sciences depriving social relations of its temporal dimension to singularize the *structure* that rules them. “While the simplifying thought eliminates time, or conceives but one time (that of progress or that of corruption), the complex thought confront not only time, but the problem of multi temporality in which repetition, progress, and decadence appear as linked (Morin [1999] 2007, p. 61).”

Facing the idea the reality can be reduced to its ultimate dimension, or to elementary units that conform it, it reassures the latest advances of science emphasizing more the interactions than particles themselves; it is in that way that the whole is more than the sum of its parts. In front of the idea of the universe being an ordered entity with no room for randomness, chaos, or dispersion, the ecological paradigm vindicates the insufficiency of laws determining its structure and function, and the need—as a complement to the stochastic component of processes—for its improbability. Confronting the idea that all consequences have a cause, it proposes multicausality as a reflection of the complexity of reality, where consequences contribute to configure the causes. This principle of recursion is what allows for understanding that the emergent properties of any organization will end up interacting with its components. That is particularly adequate when the forms of social organization are to be understood: “... interactions between individuals make society (...). However, society itself produces individuals, or at least consummates humanity by providing it with education, culture, and language (Morin [1999] 2007, p. 68).” Answering to the dilemma between object and environment, subject and object that is typical of the traditional scientific thought, it reintroduces the observer within the observation (Woodgate and Redclift 1998). And finally, opposing the supposed capacity of the scientific method for generating true knowledge by means of empirical verification and mathematical demonstration, it vindicates paradox in which contradiction is not a synonym of error, but a reflection of the existence of deep or unknown dimensions of reality.

From the epistemological point of view, Environmental History must be settled upon ecological epistemology, at the point of confluence between structuralism and naturalism (Blackburn et al. 2013). *Subjective naturalism* in the sense of Price (2011); which assigns to Environmental History the task of making the surrounding

world comprehensible. Pragmatism in the sense of Putnam (1995), by recognizing that Environmental History—being a science—will not produce absolute truths, but partial, provisional, knowledge that will change along time, and whose relevance will be proportional to its usefulness (Sini 1999). And finally, structuralism as defined by Moulines (2006) when postulating a *structural conception of scientific theories*. Because no theory can function with exactness, the Environmental History we propose seeks for approximations to the physical reality of societies. The theoretical development of Environmental History we pursue in this book must assemble the same conditions demanded by Moulines from his structuralist typology of the theoretical development of empirical sciences: to be intuitively plausible, to be formally precise, and to be uniform and systematic; i.e., that it proposes a general scheme useful for attaching to it the diverse evolutionary forms, and that it can be applied to reconstruct concrete cases (Moulines 2011, p. 12).

Also behind the ecological paradigm are a new set of axioms and a new model of social organization based on sustainability: an objective whose achievement depends on the orchestration of several sciences, among which are the social sciences, cooperating to the proposal of sustainable modes of interacting with nature; which is the reason for which the new paradigm is obliged to be trans-disciplinarity. These and other constitutional elements of the ecological paradigm does not try to be an alternative to science, but an equally scientific way of conceiving and practicing it; also, it does not pretend to rival with other existing paradigms, but aspires to integrate them and cooperate with them. It questions itself about the social utility of the knowledge it generates, such that its quality would not be the result of measurements made by scientists themselves following their own scientific logic, but also an evaluation from the whole of society in function of ethical criteria (Funtowicz and Ravetz 2000). This integration between ethics and epistemology shows the normal *modus operandi* of the ecological paradigm, which together with social movements, and in particular with the environmentalist movement, is collaborating in the quest for answers to the present civilizing crisis.

2.10 History as a Post-normal Science

Post-normal science, being aware of the uncertainty of scientific knowledge, and of the sometimes unpredictable consequences of the same *discoveries* it produces, is cautious of talking the appropriate steps to guarantee that the decisions made, and the control of scientific and technological development itself, be socially shared. Funtowicz and Ravetz (2000) propose epistemological changes—i.e., modifying the relation between facts and values, promoting axiological and strategic pluralism, introducing uncertainty and chaotic processes, adopting the systemic approach, articulating qualitative and quantitative methods, an others—and, in the social plane, the introduction of a qualitative criterion for socially evaluating the scientific and technological activities. “Post-normal science is dynamic,

systemic, and pragmatic, and because of that, it demands new methodology and social organization of labor. (...) The principle of quality allows us to handle irreducible uncertainties and ethical complexities that are central to the solution of problems in this new style of science (Funtowicz and Ravetz 2000, p. 58).”

In that sense, the place of ethics and its functionality is similar to that occupied by instincts and conditioned learning in animal species evolutionary related to humans, such as higher mammals. An ethics founded upon valuing criteria that are properly ecological and oriented towards stimulation of behaviors and ecological actions, i.e., actions that generate social and environmental benefits. An ethics that in order to be consequent with its nature, requires to expand the limits of the moral community to include all living beings, whose ecosystemic organization makes life possible, given that their contribution is fundamental for maintaining human life. In this manner, the ecological paradigm adopts a biocentric perspective opposing to the anthropocentric ontology that subordinates the whole of nature to the human being, and which is responsible for behaviors leading to the ecological crisis. The ecological paradigm is thus founded upon an alternative axiology built over an ethics that is conscious both of the ecological limitations to freedom, and of equity—comprising intergenerational and interspecific equity—being one of its main values. Finally, the ecological paradigm rests on the principle of prudence or precaution. Confronting the old axiom, particularly operational in science, that all that can be made must be made, the ecological paradigm forces to reflection before action, and to questioning the social and environmental utility of science. Such symbiosis between epistemology (post-normal science) and ethics (principle of responsibility) in the construction and use of the principle of precaution is another expression of the integrative mode of operation of the ecological paradigm.

2.11 Environmental History and the Ecological Paradigm

Environmental History adapts its *modus operandi* according to this new way of generating knowledge, not pursuing—as did the old positivistic and neo-positivistic historiographies—to arrive to *the truth about what happened*, but to produce a knowledge with quality, i.e., defined by its social usefulness. The intellectual quest for knowing other past cultures and even to learn from their experience is legitimate, but in doing so we would only be making the history of the past that is useful only to scholars and the curious. The environmental crisis demands immediate solutions in which search Environmental History must contribute. Environmental History must make historical accounts of the past, but a more urgent task is to make the history of the present, i.e., to search for the historical roots of the greatest environmental problems in the present. Because the usefulness of historical knowledge cannot rest on the unreachable ambition of accounting all that happened, but on provision of an adequate *genealogy of the present*, looking for explanations and experiences that give significance to reality, allow for its understanding, and to think about a future with minimal physical and social

entropy. Castel (2001, p. 69) stated: “The objective is not to tell it all, in case telling it all was a requirement of historical methodology, but it is about choosing well.” in that sense, the historical discourse, as useful knowledge, must be at the service of the seemingly more urgent objective from the standpoint of humanity—and not of a country or a social class—is the reversal of the environmental crisis.

To contemplate history from the perspective of the ecological paradigm implies to make a radical shift in the historiographical discourse, paraphrasing Rorty (1990), a necessary *environmental shift*. That, in turn, implies to reconcile society with nature, to place nature back where it should have never been moved from, inside the historiographical discourse from where it was removed by modern historiography. But it also requires abandoning the totalitarian and scientist pretensions of Marxist historiography, or the total history of the *Annals*, but without resigning to the aspirations of globalism, or to the consideration of its full equality with other social sciences. As righteously written by Cronon (1993), Environmental History is totally comprehensive, it is the only truly *general* or universal history.

Environmental History avoids fragmentation in multiple disciplines and topics, not uncommonly becoming closed upon themselves, in occasions becoming isolated from the global study of society, becoming the framed territory of a scientific practice pretending to be autonomous. It eludes the atomization in micro-sectorial histories sometimes precluding—necessarily—the view of human beings in their entirety, and of their relations with nature. In front of that, according to Fontana (1992), it is increasingly necessary to never again assume the cause of *Globalization*, but pursue a different globalization built from the integration of the fragments of such minced stories with the objective of offering a more unified view of human beings in all its dimensions, from their nurture to their dreams, and in all its relations, between its fellows and with Nature itself.

As stated above, Environmental History does not signify an attempt to reify a totalitarian history, but does have a globalizing vocation in which the particular and the global complement each other, such as is expressed by the classical environmentalist adagio: think globally, act locally. In fact, globalization is an essential condition of the discourse of Environmental History, and of its connatural methodology: systems theory, forbidding the parceling and segmentation of the historical knowledge no matter how limited or specialized may its range of study be. Environmental History cannot thus believe in the atomized specialization of knowledge, rather it believes in the inexistence of a proprietary method that is different from that adopted by any other social sciences: the distinctions are always temporal and instrumental. This does not mean that it vindicates the unity of the scientific method, but the indissoluble unity of social and natural sciences in a multidisciplinary quest.

Environmental History resigns to the unitary and totalitarian project of modern historiography, hence, it recognizes the existence of several histories within each society, varying in their scale, purpose, content, and organization. For example, there are individual and family histories, church histories, ethnic group histories, and often, a master narrative promoted by the State. There should also be an Environmental History. Furthermore, Environmental History recognizes the possibility of several accounts about the relation between society and nature through

time, without this implying to fall into relativism. The compilation of History is a social process consistent in a differential retention, either active or passive, of historical facts, and their organization in the group's memory (Hassan 2007, p. 172). The historical discourse, as in the case of a map, is a *representation* of reality, but not reality itself. As stated by Gaddis (2002, p. 176), "it is a pitiful approximation to a reality which, despite the skill of the historian, would seem very strange to anyone having actually lived through it." The goal is to generate a narrative having a beginning, a plot, and an end or moral bottom line. It is not about telling what happened, which would be preposterous, given the time needed for such an intrinsically impossible task. It is about building a narrative that simplifies and makes understandable what happened, a story subject to future interpretations, and above all, devoid of any causality relation typical of more conventional historiographies. A plurality of causes can be argued in order not to define the historical event, but to explain it.

Environmental History is aware that it generates a radically distinct historiographical knowledge. Paraphrasing Funtowicz and Ravetz (2000, p. 23), it can be said that historical knowledge does not progress but evolves. Such a claim was already made during the 1950s, Collingwood, in his *The idea of History* wrote: "Each new generation must rewrite history in their own way, each new historian, not content with giving new answers to old questions, you should review the questions themselves, and—since the historical thinking is a river in which no one can enter twice—to the same historian who works on the same subject for some time may, in trying to rethink an old question find that the question itself has changed." This feature approaches Environmental History with historicism, however it is parted from it when admitting the possibility of regularities, or explanatory theories without any ontological pretension (Collingwood 1956, p. 248, quoted in Gaddis 2002, p. 140)."

In consequence with all what was exposed above, Environmental History does not pretend to be the unique form of building history from a proprietary theory and methodology, which is alternative to all other historiographical orientations. In coherence with its pluralistic vocation, it considers that there are useful constructs in other paradigms and theories, given that it is not at all obsessed with exclusivity. In fact, there may be several possible forms in which Environmental History can be conceived and operated. The common aspects are reduced to the restitution of nature and all this implies inside the historical discourse, and to the founding of an alternative axiomatic—as will be seen below, a new epistemology, new theories of historical change, and new methodologies which, among other things, brake apart from the typical parceling of traditional scientific knowledge. In that regards, Environmental History resigns to reconstruct the old historiographical project of modernity, adapting it to the new times with a varnish of environmentalism. Quite on the contrary, Environmental History pretends to produce a new discourse that, simultaneously, aids in finding a way out of the ecological and civilizing crisis by providing historical discourse with the material basis it lacks of.

2.12 Entropy and Environmental History

The Environmental History we propose has at its core an entropic conception of historical time, i.e., irreversible, which establishes an uncertainty regarding the *final outcome*, but with room for negentropy. The main consequence of the fundamental laws of nature, in particular of the Second Law of Thermodynamics, is irreversibility, given that the evolutionary process marches from order to an increasing disorder. In laying the foundations of Ecological Economy, Georgescu-Roegen (1990b) had already discovered such a process applied to all human practices. However, this does not imply admitting the degradative conception of History held by the Greeks and the Romans. Human beings may invert—in given space-time conditions—entropy to negentropy, creating order although at considerable energetic expenses. Thus, Environmental History makes a radical vindication of evolutionism in which humans interact with the environment, generating the facts on which History nourishes. That implies, on one end, giving an ontological status to the change-continuity dialectics, and placing nature in the center of the analysis of the human beings, thus eradicating anthropocentrism.

The genealogy of this entropic conception of Environmental History is rooted in the consideration of human societies as complex adaptive systems displaying emerging properties that are not analytically derived from the components of the system (Gintis 2009, p. 245). Human societies also reflect a fundamental characteristic derived from the theory of complexity: *emergentism* (Laughlin 2005; Bunge 2012). By that, our proposal for an Environmental History is non reductionist materialism focused not only on parts, but in their collective organization, assuming such organization exhibits novel properties in components themselves. Being human societies complex systems, they are determined by *stable complex organization structures* that are the main actors of historical dynamics. As stated by Laughlin's (2005, p. 106–107), our word view is changing from a deconstructive approach to that of an understanding of nature's functioning.

In this organization structures order is inseparable from disorder, its processes being accompanied by random events and disorganization, which gives place to an *organized diversity* (Morin 1980, p. 418) that transforms, produces, unites, and maintains (Morin 1977, p. 126) society. Randomness and indetermination becomes a basic ingredient of organized diversity as dictated by quantum mechanics and the Uncertainty Principle of Heisenberg. Social systems are non-linear systems in which quantic uncertainty can be *amplified by chaos*, and randomness acquires an extraordinary relevance thanks to the limitations of human knowledge. Societies are complex because they stand amid the ordered and the random, between order and chaos (Pagels 1988, p. 15).

The thermodynamic conception of complexity is of special interest in this book, as stated by Prigogine (1979, p. 201), Thermodynamics is the science of complex systems. Applying dissipative system theory to social phenomena would result in substantial advances in the field (García 2006, p. 60) and would require to consider complexity as the state of an unbalanced physical system in the verge of chaos and

indetermination (Tyrtania 2008, p. 41). Complexity characterizes a system that *exists* by dissipating energy in an unbalanced regime. As a result, it at the same time produces order and disorder (Tyrtania 2008, p. 44). The more complex a system is, the farther away it is from thermodynamic equilibrium. This implies that entropy is the motor of evolution.

Our proposal agrees with what was before set forward from Anthropology by Adams (1975), and from Sociology by Bailey (1990), it sees human societies as adaptive complex systems based on entropy, or dissipative systems compiling with the *thermodynamics of irreversible processes* Prigogine (1947, 1971). Human societies are thermodynamically open systems exchanging with environment flows of energy, materials, and information that are used to increase their internal organization. Such process requires of a given amount of energy, i.e., its dissipation. Based on this fact, Prigogine conceives social structures as *dissipative structures* generated by means of self-organization processes. Thus, it can be said that energetic processes are the physical (material) foundation of all abiotic, biological and social processes.

But societies are not only structures, or said different, structures are nothing but groups of relations with a certain degree of stability. It is social relations, as held by Luhman (1996), what builds societies. Social relations can be classified in two main classes: relations occurring inside the social group, and relations established by societies with the environment. From this perspective, the functioning of societies throughout history is in this book seen from an entropic and at the same time negentropic perspective: human societies are an organized ensemble whose main emergent property is consumption (dissipation) of energy and materials in a larger amount than the sum of the individuals that integrate it.

Considering societies as adaptive complex dissipative systems erases any artificial difference between society and nature. Human societies are natural to the same extent in which they exchange with the environment energy, materials, and information. Thus, our proposal of Environmental History assumes that all human societies are self-organized (autopoietic) systems that occur as some form of stable organization in space and time, but given its configuration and maintenance, require of a continual input of energy, materials, and information from the environment, an inflow which increases entropy in the environment, thus generating dynamically adaptive processes that lead the course of evolution.

Seen from that angle, historical evolution has but increased the magnitude of the exchanges, expanding both exosomatic consumption, and social complexity. Being open systems, social systems are dynamic, their properties changing over time in a way that impedes predicting the outcome, when, nor the direction of the evolutionary process. Not all is explained by thermodynamics, it only dictates the reason for existence and evolutionary transformation (Georgescu-Roegen 1971). Evolution does not always lead to progress—complexity is not progress, but marked by uncertainty and risk, a reflection of entropic indetermination. The objective of Environmental History as conceived by us is the study of the evolution of societies from this entropic point of view. Among the social relations, we are most interested in are those in which societies exchange energy, materials, and

information with their environment. These kind of relations can be called *socio-ecological* because the rise from the relation of humans with nature. The organized ensemble of socio-ecological relations can be called *socio-ecological systems* (Ostrom and Cox 2010), which throughout history have displayed varied forms according to their space-time coordinates. We propose to study socio-ecological systems by means of the theoretical and methodological tool of Social Metabolism.

2.13 The New Axiology

In the same way as science cannot be reduced to scientific knowledge, history is neither an account of past events. As a social activity, it is ruled by a plurality of values giving meaning to scientific praxis. The classical separation of facts and values is now obsolete. Scientific activity and, hence, its theories, are deeply influenced by several value systems needing to be analyzed and elucidated (Echeverría 1995, p. 73). In that sense, the dominant paradigms of social science were founded upon axioms magnifying progress and putting science at the service of production, providing technological progress with self-referenced autonomy. In Economy, it was economic growth; in Sociology, social modernization with its sequels of urbanization and complex labor division; in Anthropology, reinsuring of the industrial I over the otherness of primitive peoples. Social sciences became subordinated to the common objective of modernization of societies, i.e., the expansion of the way of life created by the Industrial Revolution. The modern historiographical discourse shared all these preconceived ideas thus becoming an instrument of legitimization of National States and industrialism.

Providing historical discourse with a new axiology is an essential task in which Environmental History can decidedly contribute because it encompasses a thematic in that facts answer to most of the *metascientific assumptions* underlying most syntheses and manuals of history, and even in a large part of research found in monographs and journal papers. Among these assumptions, some *provide character*, being intimately associated to industrial civilization with which they were born and became consolidated, and of which they have been blamed as an accessory to the crisis: anthropocentrism, unlimited progress, ethnocentrism, preponderance of the economic and material, and others. It is not infrequent to continue finding comments about the need to dominate nature in order to achieve development and human wellbeing, or the superiority of Western culture over other cultures—seen as incapable of achieving a minimum of civilization—being either assumed or openly recognized, linking democratic conquests or scientific advancements to this statement, and shamelessly defending an ethnocentric conception of history.

The notion of unlimited progress is perhaps that most difficult to eradicate from history books, maybe because it confers the meaning introduced by religion in the study of time when theology was in charge of it. Thus, the idea of time incarnated

in a lineal and progressive conception continues to be translated into the unquestioned principle of the accumulation of material richness as an expression of progress. The same dynamic of economic growth, its trend to incrementing its physical base of the economy, the need for expanding consumption for its own existence and materialization in a form of wellbeing identified with the possession of material commodities, have converted the idea of progress in a social evidence beyond question. However, the ecological crisis, or the nuclear threat, the incapability for generating wellbeing for all the human species, the recession rather than development experienced by most third world countries during the past decades, and the skepticism regarding humanity going in the right direction (if such existed), have reinforced the rejection not only of linear evolutionism characteristic of many *rational utopias* of modernity, but also of many sociological, economical and, of course, historical theories. That progress is the product of the evolution of nature to higher grades of complexity, or that social complexity automatically assumes the rationality of which Weber spoke.

Any renewed historical discourse that is consequently reconciled with nature must restate those objectives that remained until today in historiography: the creation of wealth, economic growth and technological development of nations, and social equity. While these are legitimate aspirations, environmental historiography must also deal with questioning if the achievement of these goals was achieved without endangering the long-term survival of society, i.e., its sustainability. Precisely so, an Environmental History that is coherent with the entropic approach herein proposed and the rejection of excessively naturalistic or anthropocentric perspectives of nature, remains centered in human societies, but within the context of its environment. In that way, sustainability becomes one of the main criteria of analysis. It does not, however pretend to merely substitute old for new objectives, what truly distinguishes Environmental History is the attention it gives to the material base of society, whatever be the cultural criteria by which it is judged. An example of this can be seen in the change being experimented in the approach made by historians of the logical aspirations of the human species of improving its situation, which are no longer limited to the increase of wealth of a country or of its individuals. From inside the United Nations, and from certain academic circles, the concept of human development has been proposed as an alternative conception emphasizing the factors of life quality, while not relegating the economic factors. It seems logical to think that concepts such as this and the needed modifications made to them in the future, will guide historians as criterion for evaluating societies, such as was distributive justice in the immediate past, and that will reasonably be expected to be so in the future. Environmental History assumes these and other innovations always from the perspective of their physical feasibility.

2.14 A New Social Function for History: The Species Memory

The philosophers of science are well aware that scientific activities and interventions in the world have as an objective more than improving scientific knowledge, but that it also modifies and transforms reality, given it attempts to know in order to modify or even radically transform that what is being known. Science has stopped being a *pure* philosophy to become a *practical* one (Echeverría 1995, p. 39). In that sense, the historical discourse has an unquestionable social utility; it makes the past to be accessible. As a modeler of the future, it is not a mere literature exercise, but has both pedagogical and a practical significances. With this reifying dimension of a *modest and prudent scientism*, history preserves its practical, hence emancipatory, its aspiration for change. The historical discourse must not only help to understand the present but also to explain it, and explain to change things and correct their courses. Explanation is the principle of understanding, thus allowing the development of learning, therefore its pedagogical function that is the same of social memory.

In consequence, Environmental History promotes a significant change in the social function of the past and of the discourses constructed about it. This new function resembles that in traditional cultures: to conform the collective memory of the group, in which is stored the knowledge useful for confronting the present. In that sense, the historical discourse is the same as the memory of a social collective and functions in a similar way as the individual memory. The experiences had, the perception of time and space, the consciousness of change, and the social dynamic are accumulated in this memory. From there, molded by the dominant ideological constructs and values, spring the ideas that guide behavior. The successful or disastrous experiences guide practice. Obviously, History as a discourse about the past goes beyond the social memory of a human group, storing forgotten aspects not remembered or having contradictory meaning for its members. But the historical discourse must *also* accomplish that task without falling in an apparently objective position beyond social demands. That is for us one, if not the main, tasks to be assumed by Environmental History.

The collective memory contains not only the experience of one or several generations, but of all not present anymore. Memory is selective, and this selective process of recovery of information is activated or materialized in front of situations or issue imposed by the present. That is why the historical discourse must retain a strong connection with the concerns of the present, a connection largely broken by conventional history. Memory is the decisive mechanism making the individual conscious of its own identity, but it is also the tool that through the resources of life experience aids its decisions when facing alternative options. The same can be said about the collective memory of the group.

As demonstrated by many mythological stories of ethnic nationalism, even the most idealized discourse about the past is adequate for satisfying the need of identity. But for historical discourse to act as group memory it is essential that the

theoretical and methodological instruments with which recalls are constructed be as close to reality as possible. In that sense, most hegemonic social theories of historiography and social sciences keep the old segregation of human beings from nature. The mutual relation between society and nature was absent from most theories rooted in the Illustration such as Liberalism, Marxism, or Anarchism, among others, because of which they could be considered as idealistic. An example of this can be seen in the notion of *economic system* in one way or another shared by all these theories, and that place economy in an ideal world in which resources are endless, and environmental services are never degraded. As stated by Naredo (1987) in his splendid and enlightening book, *Economy in Evolution: History and Perspectives of the Basic Categories of Economic Thought*, such notion is supported by the “mythology of *production and growth* ... by assuming the dogma of the permanent, and at no extra cost, replacement of ‘production factors’, based on a technolatriy that has little to do with scientific rationality (Naredo 1987).” This example is significant because economy deals with the way society is reproduced in material terms.

Worster (2004) enumerated some of the contributions that Environmental History can provide. It can contribute to the development of environmental consciousness both inside of scientific disciplines as in society. Due in part to the book reading Cronon (*Changes in the Land. Indians, Colonists, and the Ecology of New England*, 1983), Worster says, scientists have changed their thinking about forest ecology. Now they are much more willing than twenty years ago to see the role of the human hand in the formation of forest processes from the Ice Age, to see the forest as a historical process and even as a historical artifact. Hughes (2002, p. 24) gives a similar example showing the usefulness of the knowledge provided by Environmental History for adequate management of current environmental problems. The Canadian Department of Environment ran into a strange phenomenon of pollution of the turbots of lake Laberge, north of Whitehouse in the Yukon. Only historical research was able to discover the cause of the black mud polluting the fish’s liver, which originated during the 1920s from the exploitation of lead and silver in the middle Yukon River—used for transportation. The lengthy process of thawing that slowed down the exploitation and transportation of ore was accelerated by application of a mixture of sod, used motor oil, and diesel oil. Company files showed this practice to have been common in the middle 1940s.

Environment History must preponderantly, but not exclusively, play the role of a species memory in which is stored the useful experiences accumulated by humanity along its history of relation with environment. Its social utility is undoubted (Margalef 1995; Hughes 2002) in a moment like the present in which both the social and the natural sciences are required to contribute to the reversion of the ecological crisis. In that same measure, history acquires a certainly practical dimension: it seeks for building a narrative that is part of the flows of information that revert the high degree of entropy brought about by the industrial metabolism in both our environment and in the functioning of our society.

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