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Donato Bergandi *Editor*

The Structural Links between Ecology, Evolution and Ethics

The Virtuous Epistemic Circle

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Contents

Chapter 1

Ecology, Evolution, Ethics: In Search of a Meta-paradigm – An Introduction

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Abstract Evolutionary, ecological and ethical studies are, at the same time, specific scientific disciplines and, from an historical point of view, structurally linked domains of research.

In a context of environmental crisis, the need is increasingly emerging for a connecting epistemological framework able to express a common or convergent tendency of thought and practice aimed at building, among other things, an environmental policy management respectful of the planet's biodiversity and its evolutionary potential.

Evolutionary biology, ecology and ethics: at first glance, three different objects of research, three different worldviews and three different scientific communities. In reality, there are both structural and historical links between these disciplines. First, some topics are obviously common across the board. Second, the emerging need for environmental policy management has gradually but radically changed the relationship between these disciplines. Over the last decades in particular, there has emerged a need for an interconnecting meta-paradigm that integrates more strictly evolutionary studies, biodiversity studies and the ethical frameworks that are most appropriate for allowing a lasting co-evolution between natural and social systems. Today such a need is more than a mere luxury, it is an epistemological and practical necessity.

In short, the authors of this volume address some of the foundational themes that interconnect evolutionary studies, ecology and ethics. Here they have chosen to analyze a topic using one of these specific disciplines as a kind of epistemological platform with specific links to topics from one or both of the remaining disciplines. Michael Ruse's chapter, for instance, elucidates some of the structural links between Darwinism and ethics. Ruse analyzes the Evolutionism vs. Creationism debate, emphasizing the risks run by scientists when they ideologize the scientific content of their studies. In the case of the contributions of Jean Gayon and Jean-Marc Drouin, which respectively deal with the disciplines of evolutionary biology and ecology, some central connections have been developed between these two disciplines, while reserving the option to consider in detail their topic in order to discover essential features or meanings. Gayon analyzes the multilayered meanings of "chance" in evolutionary studies and the methodological implications that accompany such disparate meanings. From a similar analytical perspective, Drouin's contribution focuses on the identification and critical evaluation of the different conceptions of time in ecology. Chance and time, factors of evolution in species and ecological systems, play a very important function in both disciplines, and these chapters help to capture their polysemous structure and development. Bryan Norton's chapter, on adaptive environmental management, is set within an epistemological context where the Darwinian paradigm, ecological knowledge and ethical frameworks meet to give rise to practical, conservationist policies. In his contribution, Patrick Blandin pleads for the necessity of an eco-evolutionary ethics capable of fully encompassing humanity's responsibility in the future determination of the biosphere's evolutionary paths. Our value systems must recognize the predominant place that humanity has taken in the evolutionary history of the planet, and integrate the ethical ramifications of scientific advances in evolutionary and ecological studies.

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The chapter by J. Baird Callicott introduces us to a metaphorical ecological reversion with direct consequences for our moral conduct. If ecology showed that ecosystems are not organisms, recognizing organisms as a kind of ecosystem could be the basis for a new post-modern ecological ethics that lays the foundation for a better moral integration of humans with the environment. The contributions of Robin Attfield and Tom Regan delve into some of the classical issues in environmental ethics, situating them within a broader ecological and evolutionary context. Attfield's chapter tackles the confrontation between individualistic and ecologically holistic perspectives, their different approaches to the issue of intrinsic value, and their tangled relation to monism and pluralism. Regan's contribution ponders the criteria that allow individual beings, human and non-human, to own moral rights, the role of the struggle for existence in the relationship between species, and the logical difficulties involved in attributing intrinsic value to collective entities (species, ecosystems). Catherine Larrère's chapter discusses the opposition between two environmental and ethical worldviews with very different philosophical centers of gravity: nature and technology. These opposing perspectives have direct consequences not only for the perception of the problems at hand and for what entities are deemed morally significant, but also for the proposed solutions.

To set out some foundational events in the history of evolutionary biology, ecology and environmental ethics is a first necessary step towards a clarification of their major epistemological orientations. On the basis of this inevitably non exhaustive history, it will be possible to better position the work of the different contributors, and to build a meta-paradigm, i.e. a connecting epistemological framework resulting from one common or convergent tendency of thought and practice shared by different disciplines.

1.1 Some Landmarks of an Interweaved History of Ecology, Evolution and Ethics

From the beginning, with Ernst Haeckel (1834–1919), ecology showed an integrative tendency. Unlike biology, which is fundamentally interested in the structures and functions of organisms, ecology examines the conditions of existence of organisms as they are integrated into their environments. As the discipline developed, controversy arose over the fundamental units of nature that should be the focus of ecological research. In plant ecology, for example, an epistemological rivalry began between organicistic and individualistic perspectives. Frederic Edward Clements (1874–1945) considered the plant formation and successively the biome – the plant-animal formation or community – as a unit composed of individuals that are closely interdependent (1905, 199; 1916, 106, 124–125; 1935, 342–343;Clements and Shelford 1939, 20–24; see also Phillips 1931, 19). On the other side, Henry Allan Gleason (1882–1975), postulated a continuing variation in space and time of the plant association. He maintained that a fixed and definite vegetational structure does not exist and that the plant association was a fortuitous juxtaposition of individuals, a coincidence resulting from environmental selection of the available immigrant species (Gleason 1917, 464, 467, 480; 1926, 15–16, 23–26). In the midst of this epistemological battle for hegemony in the discipline, Arthur George Tansley (1871–1955) introduced the concept of the ecosystem. From the point of view of the ecologist, the ecosystem was conceived as "the basic unit of nature," and, as this methodological abstraction was more integrative and systemic than the entities that had preceded it, Tansley's concept enabled modern ecology to flourish (1935, 299; see: Bergandi 2011).

In animal ecology, with Alfred James Lotka (1880–1949), Vito Volterra (1860–1940), Charles Sutherland Elton (1900–1991), Georgii Frantsevich Gause (1910–1986), Umberto D'Ancona (1896–1964), and in limnology with Raymond Laurel Lindeman (1915–1942), ecology ceased to be an exploratory and descriptive discipline and became a modern experimental science focused on the various functions of the ecological systems at different

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levels of complexity. Elton (1927) identified some basic principles of organization of animal communities, stressing the importance of the size and numbers of the animals, and of the flow of matter and energy through different levels of consumption (food-chains, food cycles, pyramid of numbers, niche: for the concept of the niche, see Grinnell 1917; Whittaker and Levin 1975). Lotka (1925), Volterra (1926), Gause (1934), Volterra and D'Ancona (1935), D'Ancona (1939) developed mathematical models to study the struggle for existence among animals and to establish laws describing the multiplication of organisms. These models proposed a mechanistic view of the effects of individual organisms on the population aggregate (see Chap. 4 by Drouin, in this volume). Upon the basis of Elton's principles and Tansley's concept of the ecosystem, Lindeman, focusing on food-cycle relationships and his concept of "dynamic ecology," proposed a generalization of thermodynamics based on the exchange of energy between living beings at various trophic levels of an ecosystem (1942, 399–400, 409, 415; see also 1941). Subsequently, Herbert George Andrewartha (1907–1992) and Louis Charles Birch (1918–2009) proposed a functional concept of the environment centered around the ecological web, where an animal's environment consists of everything, living and non-living, that might directly or indirectly influence its chance to survive and reproduce (1954, 17–24; 1984, 3–18).

These are some of the epistemological cornerstones of three major orientations in ecology: population and community ecology, evolutionary ecology and ecosystem ecology (for global and landscape ecology see Bergandi 2000). As far back as the 1940s, ecologists were looking for a new paradigm that unified evolution and ecology. Warder Clyde Allee (1885–1955), Orlando Park (1901–1969), Alfred Edwards Emerson (1896–1976), Thomas Park (1908–1992), and Karl Patterson Schmidt (1890–1957), traditionally identified as the Chicago School of ecology, dealt with the problem of aggregation and animal cooperation on different phylogenetic levels. Their work focused on the connection between ecology and the theory of Darwinian selection, and the link between ecology and genetics was clearly represented as the foundational element of future research in evolutionary ecology. Their proposition, grounded on a population-system approach and on a predilection for group selection considered as the fundamental engine of evolution, anticipated what has come to be known as the units of selection issue (1949, 5, 6, 8, V sect.). Some decades later, this would take the form of a harsh scientific and epistemological confrontation between proponents of group (Wynne-Edwards1962) and individual selection (Williams 1966).

George Evelyn Hutchinson (1903–1991) made another remarkable attempt to durably connect evolution and ecology when he asked: "Why are there so many kinds of animals?" Anticipating the present issue of biodiversity, his answer connected ecological and evolutionary considerations and pointed out that the genetic variability of a small population of a species will necessarily be lower than in a larger one. He concluded that a diversified community would be better able than an undiversified group to seize new evolutionary opportunities (1959, 155). However, only relatively recently have ecology and evolution merged into a productive scientific field, evolutionary ecology – an ecology that makes explicit what was implicit in *On the Origin of Species*, i.e., the acknowledgement that natural selection is deeply rooted in ecological processes. George Christopher Williams's epistemological campaign against group selection, interpreted as a more onerous hypothesis than individual selection, for a long time largely contributed to the shaping of evolutionary biology. Instead, evolutionary ecology, from the beginning, had a more nuanced position in regard to group selection. In the wake of Allee and his colleagues, Vero Copner Wynne-Edwards (1906–1997), and above all, Lewontin (1970), with his critique of selection units, and in consonance with the interdemic group selection model (Wilson 1975, 1983; see also later: Sober and Wilson 1998) Pianka, considered that group selection actually occurs, even if less frequently than individual selection (Pianka

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1974, 13; see also: Emlen 1973, 38–42; Wilson 2001; for the marginality of group selection and the preponderance of kin selection see Hamilton 1964; Maynard-Smith 1964, 1976, 1998).

Phenomenologically speaking, modern population and community ecology built themselves on overcoming the organismic Clementsian idea of community. They harnessed an individualistic Gleasonian perspective on the plant association, and showed that species associations vary, constantly and continuously, in space and in time (Whittaker 1956; Strong et al. 1984; Roughgarden and Diamond 1986). However, the Clements-Gleason epistemological confrontation also had a deeper significance, as both perspectives anticipated structural aspects of certain tendencies in the development of ecology. One current of development essentially focused on the general patterns and functions of ecological systems, while another was structured around analytical, merological-mechanistic models that define the analyzed system with equations so as to make predictions about its behavior, or at least, to explain its structure and dynamics. The latter mechanism-oriented current considers the attributes of communities as resulting from the study of their component populations as well as individuals and their interactions. In other words, the community system is decomposed into lower-level components as populations and individuals in a search for concepts and considerations that belong to the behavioral, physiological or morphological levels (Hutchinson 1965, 110; Price 1986, 3–4; Schoener 1986, 99–100; Inchausti 1994, 213 ff.; see also Kingsland 1985, 50 ff.). The former macro-level pattern-oriented current, Odum's systems ecology, is predominantly interested in focusing on the functional characteristics of ecological systems, using cybernetics models that describe energy flows and nutrient cycles, i.e., energy and materials transfer between the various trophic levels of the ecosystem (Simberloff 1982, 87; McIntosh 1980, 204–205; 1985, 203–208; 1987, 321, 334–336; Hagen 1992, 136–138; Bergandi 1995, 154–168).

During the same period in which the population view of evolution represented the epistemological reference point in evolutionary ecology (Allee *et al.* 1949), Ronald Aylmer Fisher (1890–1962) worked on constructing a theoretical and methodological link between Darwinism and Mendelism. Mendelian inheritance, which involves the segregation of factors and not their blending, holds that individual genes pass from generation to generation entire and unchanged (1924, 202), and that they constantly tend to create genetic situations favourable to their survival (1930, 95). In a similar vein, Williams later argued that natural selection ultimately arises from reproductive competition among the genes (1966, 251). This was the epistemological groundwork upon which Richard Dawkins proposed his gene's-eye view of evolutionary processes, with its corollary of the "selfish gene" theory. His "genes-replicators" are competing directly with their alleles for survival, are able to create copies of themselves, and program organisms as survival machines to safeguard their existence (1989, 2, 15, 19, 35, 36, 98 [1976]). David Hull recognized the validity of Dawkins's concept of the replicator, but considered that natural selection results from the necessary interplay of the processes of replication and interaction. He thus proposed the concept of the "interactor" to accompany the replicator. The interactor was meant to be a cohesive entity interacting with its environment so that replication is differential (1980, 318, 1998, 150; 2001, 22, 38 [1988]).

The gene-centered worldview of evolution has been firmly contested by many scholars, among them Susan Oyama. Her developmental system theory refuses the informational gene concept, according to which the genes intrinsically contain programs, plans with a predetermined formative power that generate specific organism traits. More particularly, Oyama points out that the genetic imperialism dominant in developmental and evolutionary studies involves an asymmetric dichotomy between the causal values of genes and the environment. The organism environment complex renders impossible any attempt to argue that in phylogeny and ontogeny the genes represent the primary causal factors (2000, 67–68, 107, 197–198 [1985]; for critiques of the Dawkins gene-centered evolutionary worldview see: Hull

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2001, 32 [1988]; Lewontin 1991, 48; Griffiths and Gray 1997, 487; Godfrey-Smith 2000, 411–412; Morange 2001, 159–163, 167; Okasha 2006, 166–172).

In moral philosophy, the meeting between evolutionary and ecological thinking set off a major revolution in ethics: the recognition of an ontological continuity between humans and nature and the concern for an ethics capable of integrating this new perception of humanity's place in the world. A new ethical domain has arisen: environmental ethics. What are the limits of moral community? What entities are worthy of being recognized as bearing intrinsic value? Or to put it differently, do we have ethical duties only to humans or do we also have direct duties to environmental entities? The intrinsic value issue plays a paramount role in channeling analysis about the different types of human relationships to the rest of nature. In a very propaedeutic way, there are at least three accepted meanings of the syntagma "intrinsic value," i.e. non-relational, non-instrumental, and objectivist meanings. We can judge an entity to be endowed with intrinsic value when its value is dependent solely on some inherent properties belonging to the entity in question, or when its value depends solely on the intrinsic nature of the entity (Moore 1922, 260). We can consider an entity as having intrinsic value when it is an end in itself, or when we recognize it solely for its own sake and not as a means to an end (Kant 1990, 45–46 [1785]; see below on Kant's ethics). Finally, we can say that an entity has intrinsic value when its value is not dependent on the observer's perception, appreciation or evaluation, or when its properties or qualities belong to it independently of its being valued (Dewey 1944, 452; O'Neill 1992, 120).

Presently, in Western cultures, according to our ethical and juridical norms, the environment is not judged to have intrinsic value or directly to possess moral, or legal, rights. The environment can be protected only indirectly through the exercise of the rights of human beings or with specific legislation that freezes, in a conservationist sense, the traditional relation that people have with the environment. This traditional relation is primarily economic, and expresses itself in the exercise of property rights. Nowadays, this legal perspective is grounded in a secular hierarchical ethical framework. Hierarchicalism, the origins of which are religious, maintains that things and norms are ordered along a scale of good, with higher and lower norms. One of the central principles of the Great Chain of Being framework is the following: "persons are more valuable than things" (Geisler 1971, 115). Self-awareness, self-determination, and inter-subjectivity (the power to relate to others) are specific characteristics of the human species, and these consciousness and reason-oriented specificities are at the foundation of Western ethics.

Human-centered ethical perspectives consider that humans alone deserve moral respect. People are the only beings that can have interests, actually or potentially, and thus moral rights (McCloskey 1965, 126–127). ". . . What is good for humans is, in many respects, good for penguins and pine trees." Humanity must strive to find a balanced cost-benefit approach to the problems of pollution and resource exploitation (Baxter 1974, 5–6, 8–9). The ecological links between people and other components of the ecosystem certainly form a community, but not a "moral community" established on mutual obligations, common interests, and shared rights: "the idea of 'rights' is simply not applicable to what is non-human" (Passmore 1974, 116).

A softer anthropocentric option maintains that wild species and ecological systems, even if not endowed with intrinsic value, have "transformative value." Their existence allows the emergence in humanity of a higher level of consciousness, of a perceptual and conceptual shift in ethical worldview that involves less consumptive and destructive habits (Norton 1987, 10–14, 233–239; 2003, Chap. 2, particularly, 32–33; 2005, Chap. 6). Others hold that to cope with the environmental crisis no new ethics is needed, and that it is sufficient to follow an ecologically-updated version of secular, or religious, stewardship traditions. Humans are

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stewards of nature, where any entity that has a good of its own has moral standing, but not necessarily intrinsic value, and equal moral significance in case of a conflict of interests. This is an ethics marked by caution towards anthropogenic transformation and the use of nature (Attfield 1983, Chap. 2, 154; 1999, 39–40; see Chap. 9, in this volume).

Nonetheless, other ethics are possible. A sentience-oriented ethics uses the capacity for suffering, enjoyment, and having interests as the basis for being considered a moral entity. This approach maintains that a non-human life deserves moral consideration in itself and not merely as a function of satisfying human needs (Singer 1977, 8–9, 215). An animal rights ethics is grounded on the capacity to be an experiential subject-of-a-life, a capacity shared by both humans and animals, and considers both to be equally endowed with inherent value and moral rights (Regan 1983, 235–250; 1985, 14, 21–23; see Chap. 8 by Regan, in this volume). There is also a biocentric ethics, where animal and plants – with a good of their own that can be promoted or damaged by human moral agents – are considered as bearers of moral and legal rights (Taylor 1986, 222).

There are even some "ethics of the unthinkable" – those which overcome the traditional anthropocentric ethical standards. Such ecological ethics hold that all the biotic and abiotic components of the natural environment have moral and legal rights on their own account (Stone 1972, 456, 501), and that humans have the duty of protecting the integrity of species *in* the ecosystems, and defending the forms of life that generate and sustain the ecosystems of which they are a part and an expression (Rolston 1985, 724; 1988, Chaps. 4 and 5). Aldo Leopold (1887–1948), an ecologically and philosophically enlightened forester, was the forerunner who opened the door to this kind of "extension of ethics" that involves stepping beyond the traditional instrumental relationships that humans have with the rest of nature. With an accent reminiscent of Thomas Henry Huxley's (1825–1895) worldview (see below), Leopold maintained that if ethics, basically, prescribes conducts that restrict freedom of action in the struggle for existence, thanks to which groups evolve towards cooperation, humanity now needs to recognize itself as part of a larger moral community involving both the biotic and abiotic components of natural systems. He claimed that an ethics of respect for non-human components of the ecosystem is the necessary product of social evolution. This would mean a society where humanity no longer considers itself as the "conquerors" of nature, but as "members" of a an enlarged community, where economics no longer determined all the uses of ecological systems that are uncritically considered as simple "natural resources" (1966, 217–220 [1949]). For this kind of non-anthropocentric ethics, the persistence of the intrinsically valuable biosphere, with its integrity, complexity and dynamic stability, depends on the preservation of species and ecosystems. (Callicott 1989, 142).

1.2 Looking for an Epistemic and Practical Meta-paradigm: The Transactional Framework

In science as in the rest of life, everybody wants to rule the world. But the specific beauty of science is that at one moment the ideal dimension, the theoretical systems, cease to be autonomous and unrelated to empirical reality, at one moment they cope with the reality of experience. A transactional worldview is not necessarily or intrinsically more representative of ontological reality than other views. But it can be an epistemological and methodological tool that allows us to take into consideration some aspects of reality that previous models have not been able to take on board.

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Scientific knowledge is structurally based on the use of epistemic fictions that allow us to come nearer to ontological reality, whatever that reality is. But some of them are both more fruitful and more corroborated than others, or rather, they will potentially help us more than others to discover new aspects of this reality. In other words, if the process of scientific knowledge is a kind of asymptotic process, in the sense that the sciences continuously approach ontological reality, up to infinity, without ever fully reaching it, some of these theoretical tools allow us to grasp specific aspects of the reality better than others do.

This paper places an epistemological wager on the transactional worldview, which is considered as one of these useful fictions that can help us to deal with some convergent aspects underlying the research in ecology, evolutionary studies and moral philosophy. What is clearly emerging from these studies is that the environment is acquiring new senses and values. First, the dichotomy between organisms and the environment is tending to disappear. Second, some elements emerging from the analysis of ecological, evolutionary and moral studies are converging with respect to the processes of co-determination between organisms and the environment. The environment is ceasing to be a simple "filter" or "background" to biotic dynamics and becoming a real, concrete protagonist on the ecological, evolutionary and ethical scenes.

John Dewey (1859–1952), in collaboration with Arthur Fisher Bentley (1870–1957), wrote a book, *Knowing and the Known* (1949), in which some of the foundational ideas that he had already sketched out in previous books and papers reached maturity. Key to this was a historical-evolutionary analysis of the forms that have characterized scientific inquiry and correlated types of knowledge.

Three procedures or levels of inquiry historically follow one another, based on "self-action," "inter-action," and "trans-action"[1]. A self-actional procedure considers things as possessing powers of their own and as acting under their own power (1989, 66, 101 [1949]). More precisely, self-action is a "Pre-scientific presentation in terms of presumptively independent 'actors,' 'souls,' 'minds,' 'selves,' 'powers' or 'forces,' taken as activating events" (*Ibid.* 71). An interactional procedure, instead, happens where thing is balanced against thing in causal interconnection (*Ibid.* 101), where there is a presentation of particles or objects organized as operating upon one another (*Ibid.* 71). Dewey and Bentley eliminate any ambiguities between "inter" and "trans," confining the prefix "inter" where "in between" is dominant, and employing the prefix "trans" where the mutual and reciprocal are intended (Ibid. 264–265; see also Ratner and Altman 1964, 125). The transactional level of inquiry occurs:

> . . . where systems of description and naming are employed to deal with aspects and phases of action, without final attribution to "elements" or other presumptively detachable or independent "entities," "essences," or "realities," and without isolation of presumptively detachable "relations" from such detachable "elements" (Dewey and Bentley 1989, 101–102).

A transactional perspective is used when it is not possible to describe either component of the system adequately without implying the others (Ratner and Altman 1964, 301). The transactional formulation can be a useful method of posing and analyzing problems in quantum physics (1989, 107–109; Ratner and Altman1964, 631), and in embryological, evolutionary and ecological domains where the historical component is prevalent and where such a procedure becomes an epistemic necessity (1989, 97, 120; Ratner and Altman 1964, 527).

Therefore, from a transactional viewpoint, any observation of totalities, parts, elements and relations is nothing but a methodological abstraction. In other words, the transactional approach

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adopts as a reference entity the "whole" of the events –including the relation between the knower and the known – without identifying the eventual entities and the surrounding environment as *substantiae*, i.e., things that are ontologically separated and subsequently are found to have relationships. At the same time, a structural transactional network or "web" is presupposed to be the "logical" primary reference (for the relation between ontology and logic, see: Dewey and Bentley 1989, 287).

Looking through the tangled history of ecological, evolutionary and ethical studies, it is possible to catch a glimpse of an ever-lasting underlying tendency. These scientific disciplines are crisscrossed by an integrative, inclusive, monistic and systemic tendency towards the complete overcoming of the dichotomy between organism and environment. Once we become aware of the existence of such a convergence, it is possible to establish a meta-paradigm, a connecting epistemological framework built on this common orientation. Furthermore, a transactional framework is better adapted than other frameworks to convey this common, shared epistemological ground.

In fact, assuming a transactional framework, the following positions, among others, acquire a clearer and more univocal meaning. Tansley's concept of the ecosystem definitively settled the split between the biotic and abiotic environments and between the different biotic compartments (plant and animal communities). Odum's systems ecology was proposed as a new approach that apprehended the specificities of the ecosystem as an emergent whole that was not reducible to its biotic and abiotic components. Andrewartha and Birch explained population dynamics based on the reciprocal action and reaction between organisms, constituting local populations, and the environment. Oyama's developmental system theory claimed that non-genetic factors, both biotic and abiotic environmental factors, participate causally in ontogenetic development and evolution. Genes as prime movers of evolutionary processes cease to exist. What exists, and what has developmental and evolutionary significance, is the organism-environment system, with its many levels of organization and causality. Biological and behavioural structures and functions of the organism result from the developmental and evolutionary interdependence of organism and environment. Finally, in moral philosophy, Leopold, Rolston and Callicott proposed a new environmental ethics grounded on the extension of the moral community to non-human living and non-living components of the ecosystem.

Ultimately, with regard more specifically to the evolutionary explicative concepts of "replicator" and "interactor," it is worth noticing that using the epistemological trilogy of Dewey and Bentley, Dawkins's replicator proposition can be interpreted as pre-scientific, i.e., the self-actional character attributed to the genes is an element in constructing a fiction that passes over all the gene-complexes, developmental and environmental determinisms (see also the anticipatory critique by Dewey and Bentley of the gene concept, 1989, 118–119; Morange 2001, 88–90, 159–163). David Hull recognizes that ". . . the distinction between an organism and its environment is . . . artificial" (1979, 429; see also Sober 1984, 87). In any case, in the development of his interactor concept this distinction is a central assumption. The interactor is an "individual" – the genes, and all the remaining levels of organization, with the exception of the communities and ecosystems – that interacts with the environment, understood as structurally separated and external with respect to it: "Genes of course, can also function as interactors. They interact directly with their cellular environment, but they interact only indirectly with more inclusive environments via the interactors of which they are part" (Hull 1981, 34; but see also El-Hani 2007;Meyer et al. 2011).

As a complement to the replicator and interactor concepts in an evolutionary and ecological context, the "transactor" is proposed here with the aim of taking into consideration the permanent, mutual, reciprocal relationships between the environment and the entity under selection. In contrast to an interactional framework, where the environment/entity are viewed

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as in a causal relationship, but as definitely separate. Such a separation ordinarily confers causal preeminence on the inward biological factors over the environmental ones (Bergandi 2007):

– The transactor identifies a functionally cohesive, coherent, complex, and relatively independent (or autonomous), environmental-organic entity[2];

– The transactor is a methodological construct that integrates into the definition of an evolutionary entity those environmental factors that have selective value for its existence;

– The transactor is part of a transactional web with other entities of similar, lower and higher levels of complexity;

– The identification of such an entity implies the attribution of specific emergent properties that may express specific adaptations or ecological properties;

– The need to take into consideration the upper transactor is revealed when the differential frequency of the proliferation of an entity (gene, organism, deme, population, species) is sensitive to, or depends on, its "context."

In an evolutionary perspective, at least from the gene level, any level can be considered as an environmental-organic or transactional totality. The transactor, indeed, integrates into the definition of an entity those environmental factors that have selective value for its existence. This concerns what Brandon identifies as the "ecological environment," and the "selective environment" (1988, 57; 1990, 47, 49; 1992, 81–86). The theoretical core of this transactional perspective is the idea that there is a permanent functional connection "in" the transactor between the entity selected and the ecological-selective environment.

For instance, the genome is the immediate environment of the single gene, or of a complex of genes, and the ontogenetic and evolutionary values of a gene are determined to be an integral part of such an entity. Similarly, as far as the other organizational levels are concerned, they will be organic-environmental entities, like transactors. The biotic and abiotic components of ecosystems that have selective values for the transactor in question must be considered parts of the evolutionary and ecological connotations of the individual organisms, the populations, and the species.

Finally, a direct and fundamental consequence of this methodological proposition is support for a legitimate explicative pluralism, until proved otherwise (see Sober and Wilson 1998; Okasha 2006). *A priori* every transactor, or transactional level, legitimately has a possible causal role in the determination of adaptations and other evolutionary, and ecological, processes that can be generated in the whole range of biological organizational levels. On the other hand, ecology can be perceived as the scientific transactional discipline par excellence. From population and community ecology to ecosystem ecology the theoretical and experimental models grasp at different levels the intrinsic interdependence of biotic and abiotic components of the ecological systems. Such a transactional framework could play a structuring role in conservation biology, where the need for interdependence is extended beyond natural systems so as to integrate human society as one major component of what is becoming the "planetary socio-ecosystem."

In a moral philosophy context, if the experimental method were adopted in the conduct of ethical and social affairs, as Dewey reminds us, a transactional perspective would be one of the possible ontological frameworks. It would not be taken as rigidly established prior to and independent of scientific inquiry, but rather as a hypothesis, the consequences of which should be tested. In fact, it could be one possible basis for an extension of ethics, for a more integrative

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moral ontology, i.e., the enlargement of the moral community to the biotic and abiotic components of the ecological systems.

Once the experimental method in ethics was adopted, principles, rules and beliefs "…would be recognized to be hypotheses. Instead of being rigidly fixed, they would be treated as intellectual instruments to be tested and confirmed – and altered – through consequences effected by acting upon them. They would lose all pretence of finality – the ulterior source of dogmatism" (Dewey 1984, 221 [1929]; for a similar position on the development of environmental ethics and the necessity of an environmental pragmatism, see: Norton 2005, 2007; see Chap. 6 by Blandin, in this volume). This link between the experimental method and ethics would open up possibilities for setting a new epistemological course based on the merger of ecological, evolutionary, and ethical studies and issues, in a virtuous epistemic and practical circle.

1.3 Evolution between Ethics and Creationism

The Darwinian evolutionary paradigm has not only revolutionized the biological sciences, having become the explicative epistemological background for all biological phenomena, but it has also had obvious consequences on ethical and social constructs.

Thomas Henry Huxley (1920 [1894]), the most influential supporter of Darwin, recognized that human social life is both a part and a product of the cosmic process determined by the struggle for existence, i.e., by the selection and survival of those forms of life that are best adapted to the environmental conditions. At the same time, Huxley's reading of the evolutionary process, which was largely influenced by Herbert Spencer (1820–1903) (see Chap. 2 by Ruse, in this volume), implies that a "progressive" development from uniformity to complexity has been the deep rule driving the occurrence of natural events. In Huxley's view, the notion of progressive development applies not only to the history of the cosmic process, but also to human social contexts. In the highest and most complex stages of social development, the emergence of cooperative behaviors gains the upper hand over the struggle for existence, which is the agent of the selective process in the state of nature. The fundamental reason advanced by Huxley to explain this inescapable feature of social development is the following: the progressive limitation of the struggle for existence between the members of society leads to increasing efficiency as regards outside competition, either with the state of nature, or with the members of other societies. This would be the only relational context that allows for the preservation of the bonds that hold members of a society together (1920, 34–37, 51–53, 79–83). Finally, in human society the "ethics of evolution" implies a distancing from instinctual, compulsory self-assertion and an embracing of self-restraint. That is, it involves repudiating a gladiatorial vision of existence, so as to escape from the animal kingdom and establish a kingdom of man ruled by the principle of moral evolution, where "social life is embodied morality" (Huxley 1907, CCLXXV [C.E., ix, 204]).

It is definitely enriching to look back at John Dewey's criticism of Huxley's *Romanes Lectures* on evolution and ethics, where he points out Huxley's oxymoronic structure of thinking (1898). According to Dewey, there is no reason to oppose the natural process and the ethical process on the basis of a supposed identity between the struggle for existence and self-assertion and an arbitrary attribution to the latter of unscrupulous, gladiatorial traits. Some positive behavioural traits such as benevolence, self-sacrifice and cooperation can also be considered as part of self-affirmation and, therefore, of the struggle for existence. The Deweyan unified vision of biological and ethical evolution is grounded on the refusal of the Huxleyan dualism between cosmic and ethical processes (on the continuity between ethical and evolutionary processes, see Ruse 2009, xxiv–xxvii), and on the idea that natural selection is

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still operating in the same way in human social life. The main differences between humans and non-humans have to do with the fact that the range of uses for the environment is wider in human societies than for other species, and the selected functions differ: to be fit among animals does not mean the same thing as to be fit among humans (Dewey 1898, 41, 45–49, 52–53, see also: Kropotkin, below). Dewey's position finds some meaningful echoes in the way that the present-day defense of evolutionary ethics looks to the biological origins and basis of human morality: "Our moral sense is an adaptation helping us in the struggle for existence and reproduction, not less than hands and eyes, teeth and feet. It is a cost-effective way of getting us to cooperate, which avoids both the pitfalls of blind action and the expense of a super-brain of pure rationality" (Ruse 1995, 97).

Certainly, the meeting between evolutionary thinking and ethics has generated antithetical interpretations that navigate perilously between the Scylla of dogmatic religion-based morals, emanating from an intangible divine power, and the Charybdis of the naturalistic fallacy, which implies the refutation of any inference of moral rules from propositions about natural occurrences (Moore 1903). In fact, the naturalistic struggle for life that once was applied to human society took the form of an ethics of "rational egoism," whereby society as a whole was held to benefit from the competition among individuals struggling for the acquisition of the means of subsistence (Spencer 1892, 1st vol., 199). On the other hand, Peter Kropotkin (1842–1921), in *Mutual Aid* (1972 [1902]), proposed a more cooperative interpretation of the relationships between individuals and groups in nature. The direct consequence of such a conception is an ethical worldview based on cooperation, which shares some similarities with Thomas Henry Huxley's position – a worldview grounded on the idea that in human society, as well as in nature, "the fittest" are not those who are continuously fighting each other, but those who support one another. Mutual aid and mutual struggle are laws of Nature, but mutual support would be a major factor in evolution because it allows individuals to flourish, to rear their progeny and to develop to the best of their potential. While under certain circumstances, individual qualities such as force, swiftness and cunning certainly allowed individuals to be fittest, nevertheless " . . . under *any* circumstances sociability is the greatest advantage in the struggle for life" (Kropotkin 1972, 68; italics in original). Herbert Spencer, Thomas Henry Huxley, and Peter Kropotkin ethicized evolution, grounding it on the implicit idea that the underlying deep structure, sense and purpose of natural, and social, reality was an enhancing progressive tendency towards complexification and cooperation.

Here are presented some aspects of the scientific and philosophical background that underlies Michael Ruse's chapter, "Evolution versus Creation: A Sibling Rivalry?". Ruse provides points of reference for understanding the conflictual relationships between evolutionary biology and the religious creationist worldview. Basically, evolutionary studies from Darwin until today have proposed an approach to understanding the past and present and the variety of all living beings on Earth: in the great and complex battle for life, organisms result from a long, slow and gradual natural process in which the primary causative factor is natural selection based on a struggle for existence. From the beginning, such a scientific construct inevitably challenged the world depicted by religious thinking. Nevertheless, according to Ruse, the Darwinian scientific paradigm has been hijacked and twisted by its epigones, particularly Thomas Henry Huxley. In the hands of Huxley, what was a scientific approach to nature became a secular religion without revelation. Another protagonist of this hijacking has been Herbert Spencer. The idea that significantly structured Spencer's metaphysical conception of evolution as the progressive complexification of all natural and social processes has been the keystone of a major misrepresentation of Darwinism. Even recently, Edward O. Wilson metamorphosed evolutionism into the cornerstone of a scientific materialist worldview of nature and society. Such a distortion of evolutionary thinking takes upon itself the definitive power to explain even the reasons for the emergence of religious thinking and to deprive theology of meaning and

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strength. Finally, Ruse reminds us, mixing science and ideology risks becoming explosive. The outcome can be very negative for the persistence of the scientific, evolutionary view of life in schools and in the rest of society. At present, creationists can wield this misuse of evolutionism to argue that scientists are the vehicles of a "secular religion," and use that as justification to impose their will on and against science.

1.4 Chance and Time between Evolution and Ecology

"All-over progress, and particularly progress toward any goal or fixed point, can no longer be considered as characteristic of evolution or even as inherent to it" – George Gaylord Simpson (1902–1984) thus summarizes his evolutionary conception grounded on purposeless, materialistic and random processes (1949, 343). Progression, in the sense of a succession of phases of a process, and not progress, certainly exists in evolution, but the occurrence of environmental and genetic events based on chance and randomness makes any kind of oriented, progressive evolutionary change impossible. Such a class of events introduces us to an epistemological domain where determinism and the causality principle are confronted by chance and random processes that have causes, but that remain substantially unpredictable, or that can be treated only stochastically. For Darwin, variations were due to chance, the causes were unknown, but they were natural causes and did not require any mysterious source (on the role and the meaning of chance in Darwin, see Morgan 1910; Ruse 2008).

Does chance exist? "Though there be no such thing as *Chance* in the world, our ignorance of the real cause of any event has the same influence on understanding, and begets a like species of belief or opinion" (Hume 2007, VI, 41, 1 [1748]; italics in original). Is the term 'chance' merely a negative word, veiling our ignorance of the real causes underlying the occurrence of the phenomena, and leveling the specific contribution of the various events contributing to the occurrence (*Ibid.* VIII, 69, 25)? What is the relationship between cause, purpose and chance? Is chance a relative notion that is contrary to purpose, but not to cause? (see: Katz 1944). In evolutionary studies, what role is there for: (a) the statistical meaning of chance, resulting from the confluence of an ignorance-based interpretation of chance (dating back to Hume and Laplace) and the idea that a chance event is determined by the intersection of independent causal chains of events (for the latter conception of chance, see Chap. 3 by Gayon, in this volume, and Warren 1916), and (b) the evolutionary meaning of chance, arising from the idea that events are independent of an organism's needs and of any directionality provided by natural selection in adaptive processes (Eble 1999)?

To begin to answer these questions, it is necessary to identify several of the partially overlapping meanings that are attributed to the word 'chance' in evolutionary studies. Jean Gayon, in his analytical essay "Chance and Evolution," identifies these meanings (luck, randomness and contingency) as well as the contexts (mutations, random genetic drift, genetic revolutions, ecosystems and macro-evolutionary events) in which the word 'chance' appears.

The author reminds us that when genetic mutations emerge randomly, "by chance," biologists tell us that they are "fortuitous" or "unexpected." One could say that advantageous mutations are like jewels that a gardener "chances" to find while working in his garden. In the case of random genetic drift, the process is random in the sense that it allows certain alleles to fix stochastically in a specific locus in a Mendelian population, following the laws of probability. As in roulette or a game of dice, we do not know precisely the initial conditions, and we can say only that there are several possibilities, without being able to predict precisely which allele will ultimately be fixed.

At the level of the genome, genetic drift in isolated populations contributes to determining "genetic revolutions" that involve a different kind of chance, one that directly concerns the

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theoretical system. As a consequence of the complexity of the interactions between genes – and with the environment – genetic revolutions are fortuitous in the sense that they are not predictable for contingent reasons. Gayon points out that these reasons can be: (a) it is not within the range of the theory to predict such events; (b) the initial conditions are not sufficiently known; or (c) the complexity of the phenomena precludes prediction. This last reason is also the cause of the unpredictability of fortuitous interactions (between organisms, and between organisms and the environment) peculiar to the ecosystem level.

At the macro-evolutionary level, when the "contingency" of evolution is addressed, two meanings of "chance" are put forward. Firstly, due to the contingency and complexity of the history of life, our paleobiological theories will never be able to retrace exactly what has happened. Secondly, the survival or extinction of some species is contingent because of accidental occurrences (such as a swift, drastic change of environmental conditions, for example) and not because of their specific capacity for adaptation. Finally, Gayon ends his essay with a cross-reference to Antoine-Augustin Cournot (1801–1877, 1843), who proposed a specific sense of chance that could be of use in evolutionary studies.

Chance, in its various forms, contributes to shaping evolutionary and ecological processes at many levels of organization, from genes to ecosystems, according to evolutionary and ecological time scales. Evolutionary time deals with time scales that allow for gene frequency changes in populations that can lead to speciation and evolutionary adaptation. Ecological time deals instead with a shorter time span and concerns essentially species dispersal and the complex web of relationships that populations establish with their immediate environmental factors (Pianka 2005). Evolutionary and ecological systems are definitely and inextricably intertwined, as are evolutionary and ecological times. The study of the ecological outcomes of evolution – the properties of biotic populations and communities resulting from the natural selection of their components – and the speciation processes ensuing from ecological pressure over geological time, involves taking into consideration these two types of time span. It is noteworthy that, in both evolutionary and ecological contexts, there is room for another type of time, totally different from the classical chronological time, which follows a sequential series of moments. This other time is kairological (from καιρός : *kairos*; the Greek god of a non-sequential, non-chronological time: a propitious, opportune, right time). This is a time of contingency, a time of right or adapted behavior, at the proper time involving, in the struggle for life, the difference between the life and death of the organisms, with all the ensuing consequences for the evolution of the populations (for an analysis of kairological time and contingency, see respectively Gault 1995; Gould 1999).

In his chapter "Some Conceptions of Time in Ecology," Jean-Marc Drouin analyzes the succession of different concepts of time that have characterized the development of ecology from the end of the eighteenth century until modern times. Geology dismissed the short biblical chronology and made it possible for a long term history of the Earth to become the scientific basis for all natural sciences. Ecology, while a historical science like geology, is also a science of processes, like physiology. This specificity determines some of its peculiar characteristics. Fundamentally, ecological processes have been described according to three different paradigms based on the ideas of cycle, growth, and chaos, the latter entailing unpredictability. The different conceptions of time underlying these paradigms can sometimes be intertwined, as in the case of climactic conceptions of plant ecology (cycle and growth) or mathematical models of population ecology (cycle and chaos).

A cyclical conception of time, already present in botanical geography (Alexander von Humboldt (1769–1859)), was adopted by the pioneers of plant ecology. Henry Chandler Cowles (1869–1939) and Frederick Clements, using the notion of "climax," proposed a conception of the succession of vegetational stages over time that culminated with a "peak" specific to a given geographic region. In this case, the ideas of cycle and growth coexist: a

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forest, as an organism, develops and dies, always following the same successional structure. Later, the works of Lotka, Volterra, and Umberto d'Ancona contributed to applying mathematical models to the prediction of cyclical fluctuations in prey and predator populations, which are dephased over time. Finally, Drouin reminds us, Robert May has shown, under some circumstances the dynamics of populations can be unpredictable over time. In the case of populations where growth takes place at discrete intervals, as in some insect species with non-overlapping generations, and where rates of growth are highly variable, the dynamics of these populations are chaotic and, hence, unpredictable.

1.5 Ethics between Ecology and Evolution

The Darwinian theory of evolution and the emergence of an ecological, scientific way of thinking are the latest stages in a gradual process of our understanding of how humanity is integrated into nature. Some previous steps in this process included, during the Renaissance, the recuperation of the naturalistic knowledge of the ancient Greeks and Romans, and the Copernican revolution. The new worldviews emerging from these developments have decentralized man's place in the universe. Ethically speaking, however, the process of man's integration in nature, with the concomitant changes in perception and practical conduct, is relatively recent. The Kantian moral perspective of the *Foundations of the Metaphysics of Morals* attributed to any entity not provided with rationality a relative value as means: therefore all sorts of natural non-rational entities are, uniquely and unambiguously, means. The self-evidence of the ethical axiom according to which rational beings exist as ends in themselves supported an anthropocentric, coherent and legitimate moral system. In the philosophical backyard of the Universal Declaration of Human Rights, in good company with Aristotle and Locke, Kant played a fundamental role in maintaining that rational human beings were morally autonomous and equal. Nowadays, our ethical assumptions are still embedded in a moral world structured around this postulate (Kant 1990, 45–46 [1785]; see also: 1963, 120 [1775–1780]).

The way relationships between humans and their natural environment are modeled gives practical expression to a system of values and beliefs. Nevertheless, we must be reminded that value systems as well as species are selected by the environment. And, in our times, the global environmental crisis has helped to push us to reassess the ethical foundations of our societies. In fact, some environmental indicators are telling us that our current value system is most likely no longer adequate to deal with economic globalization and its environmental challenges.

Moral adjustments are necessary as we become increasingly aware that we are living on a kind of "spaceship" where our reservoirs of resources are not unlimited (Boulding 1966, 9–10). Humans need to become aware that, as Walter Penn Taylor (1888–1972) affirmed in 1936 – referring to Henry Agard Wallace (1988–1965), who had pointed out the need for a Declaration of Interdependence to resolve political and economical international problems – "There is . . . equal need for a declaration of interdependence among plants, animals, and their environment. Such a declaration may well be the preamble of the ecological constitution" (335). Such an ecological constitution would set out that humans solemnly recognize being part of the same co-evolutionary system as other species, all of which must be preserved and respected.

As a matter of fact, the human species and the environment subsist in a coevolutionary relationship. So Bryan Norton reminds us in the chapter where he explores the potential for a system of adaptive management of the environmental crisis built upon the Darwinian selectionist paradigm. This kind of approach, combining an evolutionary perspective, experimentalism and pragmatism, has the merit of overcoming the classic intrinsic value issue, with its constantly shifting borders of moral considerability. In this case, the core of the issue no longer concerns the entities that are acknowledged as having intrinsic value (humans, non-

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human world), but rather the relationships between descriptive and prescriptive assertions, "facts" and "values," environmental sciences and environmental ethics.

The foundational background of this Darwinian adaptive management is a commitment to naturalism, linked to a social context that provides for experimental confrontation of the beliefs and values involved in a given environmental problem. This enables a gradual re-configuration of the perception of the factual elements that constitute the environmental problem. In this way, a new conservationist consciousness emerges and the spatio-temporal model of the situation is broadened with respect to both natural and sociological entities and processes. Norton applies this approach to the way in which the residents of the Chesapeake Bay in the US became aware of the causes of the pollution in their area, and shows that only by taking into consideration a space-time model on a larger scale was it possible to change the ethical commitments of the social communities involved. In fact, the perception and the policy actions of the Bay residents changed only when they radically transformed their worldview (scientific and ethical). A change in the model used to think about the problem of pollution in the Bay led to a new watershed system model, which largely surpassed the geographical limits of the Bay, thus involving neighboring regions and establishing active cross-state cooperation.

Furthermore, the type of management proposed in Norton's chapter is "adaptive" and "Darwinian." The epistemological ground is a stripped-down version of natural selection: a source of variations in a population, a means of coding, and the survival of variation in the population. In the context of an environmental crisis, a community or culture will survive only if it plays an adaptive game with regard to its environment. On the one hand, individuals must survive to reproduce and contribute to the gene pool. On the other hand, the group or community must "select" and accept a sense of responsibility and stewardship for resources and the integrity of natural systems. This is achieved by setting aside forms of individual or group wellbeing that are grounded in short-term economic choices. Only in such a way will a community – whose goal is multigenerational sustainability – be able to survive, proliferate and develop, preserving a viable range of choices for future generations. A sustainable society structured around this type of selective adaptive management would be a clear expression of a concrete and fruitful meeting of ethics and the evolutionary paradigm.

Evolutionary ethics considers the possibility that moral norms contribute to humanity's success within the biosphere, and that at least the capacity to behave ethically should have been shaped by evolutionary processes. In his chapter, Patrick Blandin explores the hypothesis that some environmental ethics views, inspired by ecological knowledge, are attempts to increase mankind's adaptability. He first recalls some fundamental points in the history of ecology and nature conservation. Clearly, from the end of the nineteenth century to the second part of the twentieth, ecology constructed a view of the natural world as an "equilibrium world" (disturbed only by human activity), a process culminating with the elaboration of the ecosystem paradigm. During the first part of the twentieth Century, ecology did not have a strong influence on ideas about nature conservation, but it played a very important role in Aldo Leopold's way of thinking. Leopold's Land Ethic was explicitly inspired by current ecological ideas, and his ideal was to preserve the stability of natural communities. Equivalent ideas were at the core of the conference organized in 1949 by the International Union for the Protection of Nature, which had been created in 1948. There the "balance of nature" idea played a paradigmatic role, later reinforced by the development of ecosystem cybernetics, which supported the idea that ecosystems are normally in a dynamic equilibrium state, allowing a cyclical functioning. Furthermore, Darwin's theory has been used by ecologists to support the idea that natural communities reach an equilibrium through natural selection: evolutionary change should produce ecological stability. But, during the last decades, an important paradigm shift has been taking place. Ecological systems appear to be changing through time, along trajectories that are unique and chaotic, and thus unpredictable, even if the processes are deterministic: ecology

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meets evolution, understood as a global process of change. Blandin proposes viewing the biosphere as a "transactional web," (see previously 1.2) where interacting entities are "co-changing": a "co-change paradigm" is taking the place of the "ecosystem equilibrium paradigm." Consequently, there is a need for an eco-evolutionary ethics, as a new step in the development of environmental ethics. Recalling Julian Sorell Huxley (1887–1975), Otto Herzberg Frankel (1900–1998) and Michael Soulé who advocated human responsibility for the future of evolution, Blandin argues that the aim of conservation is to maintain the biosphere's adaptability. He therefore focuses on the problem of biodiversity conservation, raising thorny questions about the uniqueness of living entities – which is connected with the intrinsic value issue – the evolutionary meaning of diversity, and the substitutability between species presumed to be functionally redundant. An "eco-evo-ethics" must assume that we are living in a changing, transactional web, and provide relevant principles and guidelines. But, at the same time, it must assume that values may also change, through permanent transactions between eco-evolutionary science and environmental ethics.

Moreover, ecology can serve as a metaphorical ground for new moral forms that allow more integrative, ecological ethical conducts. The contribution by J. Baird Callicott, "Ecology and Moral Ontology," analyzes the important role played, during several decades, by the organicistic paradigm in the history of ecology. According to Callicott, pre-energetic Clementsian ecology is more indebted to the biological conceptions of his time than to extra-scientific philosophy and sociology (in particular, German idealism and Durkheim's sociological functionalism). Clements, via analogical reasoning, structured ecology along similar lines with biology, merging ecology with physiology and looking for precise knowledge about the conditions of the life of plants, about the external factors in the environment in which the plants live and about the activities that these factors determine (Clements 1907, 1). This eco-physiological approach replaced the study of the functional interrelations of organs in organismal biology with the study of the functional interrelations of species in organicistic ecology. Likewise, the study of organismal development, in the context of Clementsian ecology, was replaced by the study of the successional development of the plant formation. With the arrival of the ecosystem paradigm, the organicistic framework underpinning ecology up to then gradually but inexorably faded from the scene. Some specific characteristics of the natural systems clearly emerged: successions are not directional and predictable, species populations are not in a steady-state equilibrium and ecosystems are not superorganisms.

Callicott prefers to reverse the metaphor, recognizing the organisms as "superecosystems," in the sense that the organisms "magnify" the characteristics of the ecosystems, and exhibit in a superior way the characteristics attributed to the ecosystems: the organisms as the ecosystems are hierarchical, constituted by many different types of subsystems, self-regulating and open to environmental energies and relationships. For example, the author reminds us, the metabolic processes of the organisms are carried out by a multiform variety of species populations of the internal microbial community (on this topic see also: Palka-Santini and Palka 1997).

From a moral point of view, the modern, traditional, Cartesian moral ontology, grounded on the dichotomy between subject and object, between thinking and not thinking entities, considers that moral thinking monads could have moral relationships only with other entities possessing the same moral essence. According to Callicott, on the contrary, the organism-as-superecosystem metaphor represents the core knowledge concept needed to construct a post-modern ecological moral ontology that departs significantly from the Cartesian perspective. This core allows the recognition of the ontological continuity between our own self and our biotic, and abiotic, surroundings. One's self is a "nexus" in a flux of relationships connecting internal and external organisms to one's superecosystem. And above all, our existence as nexus, and not as monadic self, allows us to imagine, and practice, a very nuanced, hierarchical system of ethics based on the proximity (cultural, historical, geographical) with people, institutions,

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things and environments, an "inclusive ethics of care and concern for those people, institutions, places, and things that define oneself and give meaning to one's life."

At present, the phylogenetic continuity between man and other living beings maintained by evolutionary studies and the inescapable structural embeddedness of human species in ecological systems have been clearly integrated into more recent moral philosophy, promoting an enlargement of the boundaries of the ethical community. However, even at the end of the nineteenth century, Henry Stephens Salt (1851–1939), who already supported the recognition of animal rights against human supremacy, was directly referring to the ethical arguments of Jeremy Bentham (1748–1832, 1789) and John Stuart Mill (1806–1873, 1848) against cruelty to animals. Salt argued that modern science recognized as a fact that between man and the other animals there was only a difference of degree and not a difference of kind, and on that basis proposed an enlargement of the moral community based on the extension of the idea of "humanity" to the other animals. This philosophy of rights pushed for an ethical reform grounded in "the recognition of the rights of animals, as of men, to be exempt from any unnecessary suffering or serfdom, the right to live a natural life of 'restricted freedom,' subject to the real, not supposed or pretended, requirements of the general community" (1894, 85). Salt reminds us that in the past such an extension was made to "savages" and slaves, and that if humanism does not wish to become divorced from humaneness, it must embrace non-human animals.

Tom Regan's contribution fits into this heterodox tradition of moral philosophy. Regan's chapter expounds on the defining characteristics of his "rights view," which he considers the most appropriate ethical position vis-a-vis the global environmental crisis. Basically, for individuals to possess moral rights means: (a) that others are not free to harm their life, body and liberty; (b) that these rights are possessed equally by all; and (c) that respect for these rights is the foundational meta-ethical grounds of all morality. To be the "subject-of-a-life" is the main requirement for the possession of these rights. Nevertheless, such a characteristic does not limit these rights to humans. Other animals (mammals, birds, maybe even fish) possess them because, like humans, they are in a world of which they are aware and they are concerned with what happens to them. In other words, humans and other animals share a similar kind of subjectivity. This ethical framework has revolutionary implications: the end of all commercial use of animals for food and of the human predation that we call the "sport of hunting."

Regan also refutes environmentally-based objections that the rights view necessarily involves the extermination of predators, since predators violate the rights of their victims (Callicott 1989), and that it fails to provide a consistent basis for the preservation of endangered wild species. Firstly, in terms of predator–prey relationships, he defends the natural *laissez-faire* brought about by the struggle for existence. Secondly, he supports the applicability of some compensatory principles of justice to preserve species endangered as a consequence of human action. These species would have the right to compensatory assistance: in other words, humans owe them assistance because of the selective disadvantage that they caused them. At the same time, however, as a direct consequence of his ethical assumptions, and because of the absence of definitive convincing arguments to the contrary, Regan denies that species, ecosystems or the biosphere have intrinsic value.

Observing current developments in moral philosophy, it is not excessive to say that there are many different environmental ethics, almost as many as there are philosophers supporting them. However that may be, it is possible to identify some shared ontological and ethical foundations that make it possible to distinguish a minimal common basis for environmental ethics:

– Humans, like other species, are members of the Earth's single biotic community;

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– Humans, like other species, are an integral part of a system of evolutionary and ecological, biotic and abiotic relationships that allows them to survive, proliferate, and develop to the best of their potentialities;

– Humans must control their proliferation and their economic development in a way that allows for the highest possible level of biodiversity and evolutionary potential on the planet.

Concerning other foundational topics there is no unanimity. Moral philosophers proceed in a scattered order, supporting positions that are frequently mutually exclusive. One of these topics is the issue of intrinsic or, depending on the author, inherent value. We have already seen some elements of this philosophical debate about a moral ontology, about the entities accorded moral standing or the functions that make possible the attribution of such a standing. What entities possess intrinsic value? Only humans (Norton 1987, 2003, 2005)? All living entities equally (Taylor 1986)? All living beings, ranked by degree of intrinsic value (Rolston 1988)? Species, biotic communities and ecosystems (Callicott 1986, 1989; Rolston 1988)? All the individuals that are subjects-of-a-life – having perceptions, preferences, desires, etc. (Regan 1983, 1985)? Or individual living organisms that have a "good" of their own (Attfield 1987, 1999)?

With this intrinsic value issue as an ontological background, Robin Attfield's chapter explores one of the recurrent issues in environmental ethics: can environmental ethics reconcile individualism with a more ecological, holistic perspective? Is monism or pluralism the best meta-ethical framework to achieve such a goal? Attfield takes Carter's review of *The Ethics of the Global Environment* (2001) as a starting point for analysis. In this review, Carter asserted that theories of value pluralism are better adapted than monistic theories to cope with deeper ecological values, such as species and population preservation. Value-pluralism critiques the maximization of one value at the expense of other values, refutes comparability among values and maintains the incorporation of priority-values that specifically characterize normative theories into a broader theory. Attfield's critique of this pluralistic view is irreproachable. Such a combination of values is considered a source of contradiction, because anthropocentric, zoocentric, biocentric and ecocentric values are incompatible and mutually exclusive. Moreover, any decision making process involving such antithetical values would lead to complex and litigious policy choices. Finally, the most recurrent monistic theories, even if they hold to a specific value, simultaneously also honor other values. The Attfield critique simultaneously shows the inconsistency of pluralist attempts to combine values and the impossibility of reconciling ecocentrism with many forms of individualism.

Catherine Larrère's essay goes on to take into consideration the debate on the modalities of existence of intrinsic value in nature, in correlation with the analysis of an antithetical philosophy of the environment: the philosophy of technology. The philosophy of nature, arguing for intrinsic value, seeks the best ethical and meta-ethical principles to preserve nature in its many forms and levels – wilderness, wild species, ecosystems, biosphere. Such a perspective is grounded in the assumption that there is probably something wrong with the relationship between humans and nature. The philosophy of technology, on the other hand, does not consider mankind responsible for our ill-adapted relationships with the environment, but sees our incapacity to master technology as the main cause of the environmental crisis. Behind these philosophies are an ethics of respect for nature and an ethics of responsibility. Pragmatically speaking, Larrère reminds us that the preservationists would leave a wilderness alone (let a forest burn, for example), whereas the technologically-oriented conservationists would prefer to intervene in natural processes, taking into account the development of human societies (controlling forest fires to limit the greenhouse impact, for example). Larrère concludes that this confrontation between the philosophy of nature and the philosophy of

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technology is no longer useful for understanding and pragmatically coping with the environmental crisis because of the proliferation of "hybrid objects" that are neither totally artificial, nor totally natural (global warming, GMOs, etc.). Specifically, arguing against Latour's persistant dualism (1999) – nature versus society and technology – Larrère privileges a synthesis of an ethics of respect and an ethics of responsibility. Only such an ethical perspective would be capable of recognizing that nature is a standalone entity, and at the same time that nature is no longer a "given" but the outcome of scientific and social controversies.

A tendency towards anthropocentricity is connatural to the human species. Without this propensity we probably would not have been able to survive. In fact, during evolutionary times we have had to contend with nature to proliferate and develop our civilizations, which directly emerge from this confrontation with nature. The point of no return was reached when humanity was able to overcome its direct dependence on nature, when humanity achieved the lasting ability to adapt its environment to its needs, and not simply to follow evolutionary and ecological processes in the same way as all other species. Of course, we are embedded in nature, and we are ontologically dependent on ecological systems and evolutionary processes. But at this stage of our history we have available many different ethical options for the development of our societies and our possible relationships with nature.

The current anthropocentric and globally dominant ethical worldview emerges from this history of relationships between man and nature, and we must recognize that this helped us to find our place in the world. The crucial question at issue is this: nowadays, is anthropocentrism, even in its weakest forms, the most suitable way to cope with the environmental crisis and the decline of biodiversity, which, practically speaking, are the direct results of this ethical worldview? To identify intrinsic value only in man, or to identify a ranking of intrinsic values in living beings, expresses the traditional religiously or philosophically-grounded hierarchicalist Great Chain of Being worldview. Is it possible to reform these positions in an environmentally-oriented sense that could radically change relationships between mankind and nature? Or, on the contrary, do we require an epistemological and ethical rupture with respect to the idea that humanity has of itself and of its place in the world?

We hope that the contributions in this volume will provide some elements of a response to the complex weave of evolutionary, ecological and moral questions that are posed with respect to the possible future pathways of development of humanity's relationship with the rest of nature.

Notes

1. The word 'transaction' and some elements of the corresponding methodological procedure was already proposed in *Conduct and Experience* (1984, 220 [1930]) by Dewey, where he points out that in the complex organism-environment: "Only by analysis and selective abstraction can we differentiate the actual occurrence in two factors, one called organism and the other, environment".

2. The term 'environment' refers not only to the environment of the organism, but also to any other "context" of the entities under selection.

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