LORENZ'S PHILOSOPHICAL NATURALISM IN THE MIRROR OF CONTEMPORARY SCIENCE STUDIES

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ABSTRACT. Although major tenets of Lorenz's hypothetical-realist evolutionary epistemology have not withstood close philosophical scrutiny, by and large his philosophical naturalism can still inspire us today. To prepare the ground for my argument I interpret some key aspects of the current debate about the significance of Lorenz's scientific and philosophical achievements from the perspective of science studies, *viz.*, the history, philosophy, and social studies of science. I move on to assess Lorenz's peculiar brand of evolutionary naturalism in the light of the booming development of philosophical naturalism in the last three decades. Contemporary philosophical naturalism as I understand it may be defined in terms of four attitudes: (i) the articulation of philosophy in a way that is continuous with scientific method and explanation; (ii) anti-transcendence (*Diesseitigkeit*); (iii) an anti-transcendental stance that requires abandoning the ambition of finding epistemological foundations, and (iv) a deep appreciation of the bounded rationality of all cognizing systems, whether human, animal, or artificial. Lorenz's views, in particular in "The innate forms of possible experience" (1943) and *Behind the Mirror* (1973/1977), provide a powerful antidote for a variety of unwarranted anti-naturalistic leanings that persist in epistemology and the philosophy of mind to this very day.

KEY WORDS. Adaptationism, bounded rationality, context of justification, evolutionary epistemology, Konrad Lorenz, Immanuel Kant, philosophical naturalism, transcendence, transcendental arguments.

> Konrad Lorenz is a phenomenon—multilayered and controversial, discomforting, and impressive. The grand old man of ethology is not only a keen observer but also a piercing analyst and lucid theoretician. As a sober empirical scientist he strives for causal explanations. With the passion of an Abraham Santa Clara he preaches against the deadly sins of civilized man... Anthropologist, epistemologist, social and cultural critic—Konrad Lorenz is all that in one person.
>
> Heinrich Meier (1978, p. 141)

1. INTRODUCTION

The centenary of Konrad Lorenz's birth (7 November 1903) was celebrated by a number of initiatives, both in Austria and internationally, of the kind that is common in the case of important scientific and public figures. As far as I can see, it did not prompt much novel critical reflection on his

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work, and certainly almost none that meets contemporary historiographical standards [1]. Instead, especially in the Austrian and other German-language media, a heated debate was ignited that revolved almost exclusively around Lorenz's involvement in the National Socialist regime. This dispute was in many ways reminiscent of the commotion at the time Lorenz received the Nobel Prize (in 1973), with (by now mostly old) admirers and (old and new) foes quite predictably excavating the same stock of facts and conjectures. The only highlight was a new biography of Lorenz by Taschwer and Föger (2003), who could rely on previously inaccessible correspondence as well as a newly discovered autobiographical sketch by Lorenz. In an earlier book, the same authors had focused on the Nazi episode (Föger and Taschwer, 2001). The public controversy these publications stirred induced (or even compelled) the leading students of animal behavior in Austria to clarify their positions, as they felt their professional standing was at stake. This is not the place to discuss these arguments *per se*, as this paper is focused on Lorenz's philosophical naturalism. Yet, his naturalistic philosophical worldview was permanently influencing both his scientific and his more worldly endeavors. Moreover, much of the disagreements in the old and new debates about Lorenz (as far as I am concerned, all the *interesting* ones) ultimately concern the clash between the different *arenas* the Lorenz's discourse, and the discourses about Lorenz, belong to (the scientific arena, the cultural, the political, etc.). Therefore, I think it is worthwhile to apply some of the conceptual tools developed in recent science studies (see, e.g., Collins, 1985; Latour, 1987, 1991; Fuller, 1988; Giere, 1988, 1992; Bloor, 1991; Pickering, 1992, 1995; Kitcher, 1993; Jasanoff *et al.*, 1994) in an analysis of at least some of these disagreements, as they offer a perspective that transcends the often contradictory viewpoints of the respective categories of actors involved (section 3).

Major tenets of Lorenz's hypothetical-realist evolutionary epistemology or EE (see most notably Lorenz, 1973/1977) have not withstood close philosophical scrutiny (see, e.g., Hooker, 1987; Thomson, 1988; Engels, 1989; D. S. Wilson, 1990; Callebaut, 1993, 1994; Bradie, 1994; Callebaut and Stotz, 1998). The main claim I try to substantiate in this paper is that, nevertheless, Lorenz's philosophical naturalism, by and large, can still inspire us today. I will here concentrate on those general aspects of Lorenz's naturalistic philosophical outlook that throughout his career 'fueled' what I take to be his major *scientific* contributions, *viz.*, (classical) ethology (here taken to be synonymous with *Vergleichende Verhaltensforschung*) and a peculiar brand of EE, *viz.*, the 'hard' study of the evolution of cognitive mechanisms (e.g., Lorenz, 1941/1982, 1943, 1969, 1973/1977 [2]). The first step will be to ask how these are to be assessed today (section 2). I will not deal in this paper with other aspects of Lorenz's philosophical

views, such as his more specific views regarding the methodology of ethology (Brigandt 2003) or his philosophical anthropology [3].

2. LORENZ'S ETHOLOGY AND EVOLUTIONARY EPISTEMOLOGY TODAY

In his classic paper, "On aims and methods of ethology," Tinbergen (1963, p. 410) suggested that ethology "is perhaps defined most easily in historical terms, *viz.*, as the type of behavior study which was given a strong impetus, and was made 'respectable', by Konrad Lorenz." What united the early ethologists was their longing to return to the "plenitude of nature," so to speak [4], a *romantic* reaction (I will return to this in the next section) against the dreadfulness of both behaviorist psychology and a comparative anatomy that was increasingly preoccupied with mere homology to the detriment of function. "Zoologists with an interest in the living animal," as Tinbergen (1963, p. 412) put it, "went out to see for themselves what animals did with all the organs portrayed in anatomy handbooks and on blackboards, and seen, discolored, pickled and 'mummified' in standard dissections." The behaviorists tended to concentrate on a few phenomena, observed in only a handful of species that were kept in impoverished lab conditions (cf. the criticism of von Bertalanffy, 1969). Moreover, their physics envy made them aim for general theories, so they proceeded deductively by testing their theories experimentally. It was as if "in its haste to step into the twentieth century and to become a respectable science, psychology skipped the preliminary descriptive stage that other natural sciences had gone through," Tinbergen (1963, p. 411) complained. Notice that for Lorenz-the-biologist, science as a cognitive endeavor was always intertwined with aesthetic and even ethical motivations and considerations—a circumstance that any balanced discussion of his philosophical stance will have to respond to.

Tinbergen submitted that the overall significance of Lorenz's contributions is best characterized by saying that "he made us look at behavior through the eyes of biologists" (*ibid.*); Lorenz's research program was to extend "the three major problems of biology" as defined by his "old comrade-in-biological arms" Julian Huxley [5], *viz.*, *causation*, *survival value*, and *evolution* from the study of anatomy and physiology to that of behavior and cognition. Tinbergen was keen to add a fourth problem: *ontogeny*. In all of these endeavors induction—observation and description—had to come first [6]. The salutary effect on animal psychology of this 'farmer's' research strategy (Lorenz's self-description of how he lived with 'his' animals) is acknowledged even by authors who otherwise tend to downplay the influence of predecessors on their work. Thus the evolutionary psychologists Tooby and Cosmides (1992, p. 36), referring to Lorenz (1965), wrote: "Once animal behavior researchers let the pigeon out of its

barren artificial cage, a rich flock of behavioral phenomena appeared, and questions inevitably arose about the mechanisms that guide the animal to do all the different things it needs to do in natural environments to survive and reproduce." They concluded that ethology "played an important corrective role [for behaviorist psychology [7]] by providing examples of the tasks organisms solve and the complex performances they exhibit in more natural conditions..."

Continuing the "boundary work" (Fisher, 1990) that was begun by E. O. Wilson, the founder of sociobiology himself, John Alcock in *The Triumph of Sociobiology* (2001) argues at length that the radical individual selectionism and adaptationism [8] introduced by George C. Williams in his *Adaptation and Natural Selection* (1966) is the real watershed separating classical ethology from sociobiology. Alcock emphasizes that it is not that "behavioral researchers gradually figured out that proximate questions could be discarded in favor of ultimate ones." Rather, "the pattern reflects the discovery of a host of questions that behavioral biologists had simply overlooked before they adopted the adaptationist approach to evolutionary issues" (Alcock, 2001, p. 95). Ultimate questions, Alcock stresses, are not more important than proximate ones, only different:

> Although many ethologists were interested in the evolved basis of behavior, most of their important work, much of it done between 1935 and 1950, had to do with the mechanisms controlling behavior, especially the mechanisms underlying instinctive behavior patterns. In other words, much of ethology dealt with the proximate side of behavior..., and it was this component that the Nobel Prize Committee honored when they bestowed the prize on Tinbergen, Lorenz, and von Frisch (p. 94).

The shift toward adaptationism in animal behavior studies, at least in the more serious work, was accompanied by a reliance on the formal tools of population genetics, evolutionary game theory, and the like that were previously unknown in this biological field. An objective assessment of the significance of Lorenz's contributions to ethology must take into account that he was *not* a geneticist and, indeed, *qua* evolutionary biologist, not someone who (despite his friendship with Huxley) was even remotely involved in the making of the Modern Synthesis [9] (Smocovitis, 1996 and personal communication, April 2001).

Students of animal behavior as well as human psychologists, social scientists, and philosophers working in an adaptationist vein continue to pay lip service to Tinbergen's "four questions"—the realization that a full-fledged explanation of characters requires answers to all of his four, separate, kinds of questions: proximate explanations of anatomy and physiology and of ontogeny, on one hand; ultimate or evolutionary

explanations of phylogeny and of function or selective advantage on the other. In practice, however, these different endeavors are typically pursued separately, if at all (with rare exceptions, the now dominant adaptationists tend to disregard the 'mechanistic', proximate questions—see, e.g., Rose, 1997; Rose and Rose, 2001); rarely indeed do they lead to a truly unified account. In this sense, Tinbergen's dream, which was also Lorenz's, remains unfulfilled (cf. Dewsbury 1999).

Yet another qualification is in order here. As Tinbergen (1963, p. 412) intimated, the variety of behaviors found in the animal kingdom is so vast, and their adequate description so much more laborious than the description of anatomical structure [10] that "selectiveness of description" is unavoidable. Although one of the lessons he drew from Lorenz's work, *viz.*, that "our science will always need naturalists and observers as well as experimenters," (p. 413) is still taken to heart by many contemporary students of animal behavior today, at least in their soul-searching moments, it seems fair to say that it is more and more overridden by the institutional imperative to "go genetic (molecular, neuro)." *Given* this trend, it seems to me correct to claim, as, e.g., Taschwer and Föger (2003, p. 289) do, that the Lorenzian, non-experimental, naturalistic approach belongs to bygone days.

Lorenz must not only be considered here as the father of ethology, but also as a prominent advocate of EE, which in his view was but a natural extension of the former [11]. Here I shall be very brief. Consider the following statement by a prominent Viennese philosopher of science, who participated in Lorenz's Altenberg circle and contributed substantially to the development of Altenberg-style EE himself: "What currently goes by the name of EE is a rather expatiated complex of epistemological statements thinned out by philosophical criticism. Apart from claims that are in part exaggerated and unfulfilled, it has become more and more internally contradictory and has departed considerably from the original intentions [12]" (Oeser, 1995, p. 270; my translation). I must admit that I cannot but fully endorse Oeser's view. What happened to the rich, "multiparadigm program" (Callebaut and Pinxten, 1987) of EE? We face a profound paradox here in that a most promising area of scientific and philosophical research (Derksen, 1998) has waned in the hands of some not-so-professional, but highly visible scientific enthusiasts and philosophically professional, but scientifically naive and, worse, *scientifically disinterested* philosophers at the very time when the progress of the neurosciences, developmental biology, developmental psychology, and even artificial intelligence offer prospects for EE undreamt of in Lorenz's day (Hendriks-Jansen, 1997). This situation is somewhat reminiscent of Gould's (2001, p. 89) exclamation: "What an odd time to be a fundamentalist about adaptation and natural selection when each major subdisc-

dipline of evolutionary biology has been discovering other mechanisms as adjunct to selection's centrality." (Gould was referring to phenomena such as neutral evolution, conservation of basic pathways of development, and punctuated equilibria and mass extinctions in macroevolution.) I have tempted to deal with the fate of EE elsewhere (Callebaut and Stotz, 1998; Callebaut, submitted), in both sociological and philosophical terms, and will not try to summarize these arguments here. Suffice it to say that I do see a future for a "lean EE," one stripped of most of the *Weltanschauung* layer in which it has progressively become hidden, but true to its Lorenzian—and Campbellian: Campbell (1974, 1988, 1997)—origins. However, the most promising scientific developments are now taking place 'elsewhere', and those engaged in serious work on the evolution of cognitive mechanisms rarely refer to EE, if they are aware of its existence at all. The hope for a re-unification seems dim, at least currently. This negative note notwithstanding, my purpose in this paper is largely constructive: The strategy I propose to pursue consists in stepping back from extant EE, Altenberg style, in order to reflect on its naturalistic roots in Lorenz's earlier work. The terrain thus uncovered, I surmise, could inspire a revival of EE.

3. THE FASHIONABLE FALLACY OF DISPENSING WITH LORENZ

Quite a few recent authors, some of them pointing to citation patterns, have suggested that Lorenz's scientific work has fallen into oblivion (e.g., Alcock, 2001, p. 95; Taschwer and Föger, 2003, p. 289). Others do not mention him at all (thus Lorenz is conspicuously absent from Galef's 1996 review of the origins of animal behavior studies). Others have tried to identify his "lasting contributions" (see in particular Kotrschal *et al.*, 2001). Here we have a clear instance of the "clash between arenas" I mentioned in the introduction. For scientists, it has been obvious since the eighteenth century to think about their enterprise in terms of *progress*, whether this takes the form of accumulative growth, or evolutionary progress (Nitecki, 1988), or revolutionary change à la Thomas Kuhn [13] (Richards, 1987, Appendix I: "The natural selection model and other models in the historiography of science," pp. 359-593). On a radical interpretation of the evolutionary model (*pace* Lakatos and many other philosophers of science), no cornerstone must remain in place, no "hard core" of foundational concepts and propositions must remain unchanged, given sufficient evolutionary time (Hull, 1988a, 2001). Thus, the "central dogma of molecular biology" has recently been given up without causing much of a stir. Of course, ideas of progress also operate outside of science and society—most notably, in the economic subsystem of society—but it is obvious that, say, in the realm of general cultural discourse, they have not (yet) disenabled deeply culturally entrenched cravings for Platonic "eter-

nal ideas." If one of your countrypeople is awarded a ('the'!) Nobel Prize, her or his star better shine forever, the more so if (s)he is the only one. Turning back to the scientific arena, the evolutionary picture gets a bit more complicated if one takes into account the role of *constraints* on development (and, through development, on evolution): some scientific 'ideas' (facts, theoretical propositions, etc.) are obviously more stable than others, because they have become more deeply "generatively entrenched" (Wimsatt, 1999). Thus questions about which of a scientist's contributions are still influential as against those that have lost their former appeal remain valuable if it is understood that we are discussing *matters of degree*. I mention but one example here, because it has played a central role in both the old and new (political) debates about Lorenz's legacy: his views on *domestication*. In the light of subsequent developments, they are no longer tenable, full stop (Campbell, 1975a; Kotrschal, 2001).

In November 1973, in an open letter to Lorenz, Simon Wiesenthal appealed to the father of the graylag geese to return the Nobel Prize, given that "he once endorsed the theses of this merciless dictatorship," *viz.*, the Nazi regime (Taschwer and Föger, 2001, p. 235). This episode is rarely discussed in the recent literature. There had been the famous case of Jean-Paul Sartre, whose reasons for declining to accept the Nobel Prize in Literature in 1964 had much of an act of balance in a Cold War plot involving the Russian writer Boris Pasternak (Contat, 1994). Presumably, a refusal by Lorenz would have been disapproved of by many of his scientific peers, as it could have been interpreted as casting a shadow on the science of ethology that was now finally getting the highest official recognition (Astrid Jütte, personal communication, October 2003). Again, we face a clash of scientific and political arenas here. In the rhetoric of the scientific arena, this sort of conflict is typically handled by explicit or (more usually) implicit reference to a distinction introduced by philosophers of science such as Karl Popper and Hans Reichenbach (a professor in Berlin with close ties to the Vienna Circle), with roots reaching back to John Herschel (van Fraassen, 1985). If the "context of discovery" (*quid facti?*) is separated from the "context of justification" (*quid juris?*) sharply enough, it becomes possible for scientists (or for philosophers of science attempting a "rational reconstruction") to assess the *scientific* significance of an idea independently of the sociopolitical (etc.) matrix in which it originated. The philosopher of science Ronald Giere, who also has a keen interest in social history, has conjectured that "part of the significance of the distinction for Reichenbach at this time [the 1930s] was its implicit denial that characteristics of a *person* proposing a scientific hypothesis have anything to do with the scientific validity of the hypothesis proposed" (Giere, 1995, p. 3). In philosophical terms, "Reichenbach seems to have made it a precondition of any scientific epistemology that it rule out

the possibility of any distinction between, for example, Jewish and Aryan science" (*ibid.*). Such a stance is entirely in line with the anti-psychologism the Vienna Circle philosophers adopted from the nineteenth-century logician Frege (Notturno, 1985; Kusch, 1991, 1995; cf. also Popper's "World 3" of "objective knowledge"), to which I will return in the next section.

If we adopt this stance even-handedly it should be permitted to assess Lorenz's scientific contributions in "splendid isolation" from his political alliances and overall conservative ideology (cf. below). Here I can mention only two lines of work that are grounded in Lorenzian ideas and seem to me very promising. Lorenz (1974) regarded his finding that behavioral characters can be *homologized* in the same way as morphological characters as his most significant contribution to science (cf. Atz, 1970). Lorenz's view that homologous characters, be they morphological or behavioral, are determined by homologous genes (*orthologues*) has recently been challenged. The evolutionary developmental biologist Müller invokes evidence from developmental and population genetics to suggest a different scenario that brings the *phenotype* to the foreground: "Rather, morphological homology denotes the evolutionary constancy of phenotypic building blocks, independent from changes in underlying genetic, developmental, and environmental determinants (Müller and Newman, 1999). The centrality of individualized homologues in phylogenetic patterns suggests that homologues assume an organizing role in the evolution of morphology" (Müller, 2001, pp. 127-128). Müller proposes that the same could apply for behavioral homologies: "While their genetic, developmental, and environmental backgrounds may change, certain behavioural elements may become 'organizers' of behavioral evolution, and remain constant across related taxa." He concludes that in this sense, "the behavioral homology concept coined by Lorenz remains heuristically useful and could form the basis of a theoretical ethology concerned with the evolutionary organization and dynamics of behavior" (128).

Müller's proposal can be fruitfully likened to Hendriks-Jansen's (1996) autonomous agent account of behavior and intelligence, which reconsiders and puts to use the theoretical and methodological framework of Lorenzian ethology in a search for natural grounding (cf. Callebaut and Stotz, 1998). With his notions of "situated activity," "interactive emergence," and "history of use" Hendriks-Jansen captures a threefold emergent process: "(species-typical activity patterns) emerge in a species as a result of natural selection, in a maturing individual as the result of ontogeny, and every time they occur within the life of that individual as the result of interactions between the creature's low-level activities and its species-typical environment" (Hendriks-Jansen 1996, p. 248). A fully evolutionary explanation must include the complex processes of the *life*

cycle that mediates between an abstract Mendelian genetic level and the level of natural selection. Like Müller, Hendriks-Jansen seems to share a commitment to a view of *development as interactive emergence over time* that has also come to be known as the Developmental Systems approach (Oyama, Griffiths and Gray, 2001).

Müller's and Hendriks-Jansen's views offer two examples of contemporary work (originating from developmental biology and artificial intelligence, fields that are both quite distant from animal behavior and from each other) that reinvigorates Lorenzian views or continues to mine classical ethology in search for solutions to problems posed elsewhere (cf. Darden and Maull, 1977, on 'interfields'). Other instances are documented in Wimsatt (1999) and Kotrschal *et al.*, (2001). This constructive stance contrasts with a considerable body of scientific, historical and philosophical work in which Lorenz's view on the inheritability of behavioral and cognitive traits and mechanisms is chastised for its "static universality" (Hahlweg and Hooker, 1989, p. 30) or diagnosed as having been rebutted by Daniel Lehrman's and others' critiques (e.g., Johnston, 2001), or more generally, is viewed as simply obsolete.

To round off this section I want to return to the clash between Lorenzian ethology and behaviorism mentioned in the introduction. I want to claim that it echoes the century-old opposition between Romantic and Enlightenment ideologies, in the sociologist of knowledge Karl Mannheim's (1953) sense (cf. Meier, 1978 on Lorenz's conservative ideology). As sociologist of science David Bloor has argued [14], "the methodological style of Romantic thought can be contrasted point by point with that of Enlightenment thinking" (Bloor, 1991, p. 63f.): (i) Romanticism is not atomistic or individualistic but treats wholes as having properties of a certain kind that require independent study—cf. Lorenz's 'fulguration', a term he preferred to the more fashionable 'emergence[15]'; (ii) the concrete and the historical, always viewed in context, are more important than the universal and the timeless—cf. Lorenz's aversion for Platonism (e.g., Lorenz, 1973/1977, p. 14f.; 1942/1970) and its replacement by an evolutionary epistemology, ethics, and aesthetics as programmatically stated in Lorenz (1943); (iii) stress on concrete individuality instead of abstract deductive schemes bringing particular cases under general laws (e.g., Lorenz 1973); (iv) the analytical, dissolving quality of Enlightenment thought is countered by an insistence on the reality of features such as the wholeness, intricacy, and interconnection of things which the abstract stance tends to ignore, resulting in the welding together of the descriptive and the normative. Especially this last point seems to me of particular importance if we want to understand Lorenz's thought "in context"—why, for instance, on the fourth page of a book that is supposedly about EE he already issues a warning about the necessity "to examine the ills of our civilization"

(Lorenz 1973/1977, p. 5), or why later on he invokes his authority as a physician to do so—ten years after Michel Foucault (1963) had written his devastating critique of the "medical gaze": *Naissance de la clinique: une archéologie du regard medical.*

Toward the end of his book, *Phenotypic Plasticity: Beyond Nature and Nurture*, Pigliucci (2001) ponders how scientists should answer pressing questions from the public and policy makers (in his case, concerning our current scientific understanding of intelligence and other human behavioral traits). He believes "some answers and suggestions can be given, but only if accompanied by careful statements about the serious limitations imposed by the impossibility of carrying out the proper experimental manipulations [16]" (p, 260). He then goes on to offer a threefold answer: (i) Since human behavioral traits tend to be plastic, "regardless of any ideologically motivated agenda, education programs that improve the learning environment of an individual do have a good chance of succeeding" (*ibid.*). What if human individuals are genetically distinct in their abilities and even an improvement in environmental conditions will maintain such differences? Pigliucci points out that this is a very unlikely scenario by comparison with known reaction norms in other organisms and insists that even then "it would still be worth funding education." (ii) Most human traits (including behavioral ones) *do* have a genetic basis: "It simply cannot be otherwise, given that the structure of the brain is dictated in part by genes and considering all we know about the effects of brain anomalies on behavior" (p. 261). Genetic differences between genders and among races and individuals, then, may indeed exist, "regardless of how politically incorrect such an admission might be" (*ibid.*). This acknowledgement, however, does not justify any discrimination or abuse, for the latter could only be 'grounded' in the naturalistic fallacy. (iii) The third point is negative:

> What scientists cannot and should not venture to say ... is that we understand the interactions of genes and environments in humans to a point that that knowledge can safely be used to inform social policies. This is indeed a crucial question because specific educational approaches, for example, may be more or less fruitful depending on the precise shape of human reaction norms. The same can be said for policies concerned with curbing crime or for a host of other fundamental and difficult societal decisions. It should be eminently clear by now that this is where the line must be drawn, and the only honest answer a scientist can give is: *I do not know*. The reasons to yield to the temptation to saying more that one's data and theories allow are, of course, easy to understand (*ibid.*).

What a pity Lorenz did not take more strongly to heart his old friend 'Karli' Popper's motto: *We know nothing—that is the first thing. Therefore we should be very modest—that is the second thing. That we should not claim to*

know what we don't know, that is the third thing (Popper 1996; my translation)!

I now turn to my characterization of contemporary philosophical naturalism proper and argue for the enduring significance of Lorenz's take on it.

4. LORENZ IN THE MIRROR OF CONTEMPORARY PHILOSOPHICAL NATURALISM

Philosophical naturalism (PN, henceforth) has meant many things to many people, ranging from the isolated white-supremacist plea for a renaissance of metaphysical thinking to save "white humanity" (König 1971, p. 7) to the fashionable postmodernist celebration of relativism (Rorty [17]). All the authors I consider in this paper agreed with the late Harvard philosopher Willard Van Orman Quine (e.g., 1969, 1975, 1992) that naturalism implies banishing the dream of a first philosophy and pursuing philosophy rather as part of one's system of the world, continuous with the rest of science, which at once implies that the naturalistic philosophy is, or at least aims to be, a *testable* theory [18] (Giere 1988, 1989). In the vein of Quine's conception, naturalistic approaches to philosophy may be properly seen as contributions to an emerging *science of science*, although quite a few contemporary naturalists shun this term because of its scientistic connotations.

In contradistinction to the subject-based philosophy that was inaugurated by Descartes and lived on in two of the main currents in twentieth-century philosophy, logical empiricism and phenomenology, the point of departure of PN is not the epistemic subject's phenomenal world but the physical world at large, which it regards as a natural unity that includes human beings (e.g., Campbell, 1974, 1988, 1991; Quine, 1975; cf. Shimony's, 1981 "integral epistemology"). Naturalistic epistemology and ontology are neither intuited nor the result of some transcendental deduction, but derived from our current scientific understanding of inorganic, organic, and cognitive evolution. On such a view, any idea that the human mind has access to truths that are independent of investigation or somehow transcend it is a "hangover of superstition" (Dudley Shapere in Callebaut, 1993, p. 69). The naturalistic understanding of the philosophy of science is also based on a peculiar but plausible interpretation of the historical relation between science and its philosophy. On this view, science is a *self-corrective* activity, and the theory of science may be viewed as a sort of 'meta-learning module' that allows science to "learn how to learn [19]" (*cf.* Shapere, 1984). This research strategy, which regards all ontology as theory-dependent, is in line with Quine's (1969) "ontological relativity," and more generally with the naturalist's *rejection of any first philosophy whatsoever* (cf. below).

Antecedents. Most generally, and somewhat presentistically speaking, the main sources of naturalism in the philosophical tradition are *materialism* in metaphysics (Democritus, Epicurus, Lucretius, Hobbes, D'Holbach, La Mettrie, Feuerbach, Marx, Haeckel, ...) and, in epistemology, *skepticism* and *empiricism* (Carneades, Occam, Bacon, Locke, Hume, ...), including its modern variant, *experimentalism*[20] (John Stuart Mill, Russell, Neurath, ...) (Kurtz, 1990, p. 12; Strawson, 1985). Let me stress that although it is often misleadingly presented as just that, *current naturalism is not usually committed to either a reductive materialism or a narrowly defined empiricism* (Callebaut, 1995b).

The modern shift from philosophical construction to philosophical reflection. One problem with the conventional listing of antecedents of naturalism above is that it overlooks that both philosophy and science have changed tremendously since their common beginnings in, say, the natural philosophy of the pre-Socratics—what Karl Jaspers (1949/1983) called the *Achsenzeit* of Western civilization. To be able to interpret the relation between 'science' and 'philosophy' in terms of continuity (see below) at all, the two must be distinguishable. Now, as MacDonald Ross (1990, p. 799) has warned, "the very fact that they are contrasted can easily lead to the conclusion that they differ in *essence*, and therefore that they cannot overlap or merge into one another." MacDonald Ross refers to Wittgensteinian "family resemblance," evolutionary naturalists who reflect on historiography (e.g., Richards, 1987; Hull, 1988a) invoke "population thinking" (Ernst Mayr) to deny any such exclusion. Others still fall victim to it (e.g., Gjertsen, 1989). Of special importance in the context of our discussion is one particular transition that was brought about by the newtonian revolution: the shift from what one could call a *constructive* (or *productive*) *view* of philosophy—as still evident in Descartes—to a *reflective stance*. Because it is overlooked in most historical treatments of naturalism, I rather extensively quote the sociologist and moral philosopher Eugène Dupréel's interpretation of Newton's accomplishment:

> L'évidence des progrès réalisés par un Newton forcera le philosophe à reconnaître que la science n'est plus à inaugurer, qu'elle existe et progresse sur des fondements éprouvés. Bien plus, ces fondements, ce sont les savants eux-mêmes, en tant que tels, qui les ont posés, et cela indépendamment des principes universels sur lesquels disputent les métaphysiciens : le savant trouve et pose les principes dont il a besoin. Dès lors le philosophe ne se considèrera plus comme celui qui crée la science, mais comme celui qui réfléchit sur ce que les savants ont établi et sur ce qu'ils découvrent. *Il y a un donné qui est la science déjà faite* (Dupréel, 1967, p. 134; my italics).

In moral philosophy, a similar change was inaugurated by Shaftesbury and others.

Contemporary PN as I understand it may be defined in terms of four attitudes: (i) the articulation of philosophy in a way that is continuous with scientific method and explanation; (ii) anti-transcendence (*Diesseitigkeit*); (iii) an anti-transcendental stance that requires abandoning the ambition of finding epistemological foundations, and (iv) a deep appreciation of the bounded rationality of all cognizing systems, whether human, animal, or artificial. I will discuss each of these four tenets in turn.

(i) *Continuity*: *The natural unity of the world and of our understanding of it.* As a "weasel word" (in David Hull's sense [21]), and notwithstanding its long usage, naturalism is notoriously difficult to define, even approximately. Usually a definition is not even attempted, which easily leads to confusion and contradictions. The criteria or dimensions I offer should allow to eliminate a few pretenders to the naturalistic crown. At any rate, *continuity* seems to be the key term to understand what naturalism is about. Thus the *Encyclopaedia of Philosophy* defines naturalism (in recent usage) as "a species of philosophical monism according to which whatever exists or happens is *natural* in the sense of being susceptible to explanation through methods which, although paradigmatically exemplified in the natural sciences, are continuous from domain to domain of objects and events" (Danto, 1967, p. 448).

Dimensions of continuity. Danto's definition mixes descriptive elements ("domains of objects and events" ...) and normative terminology ("methods," "paradigmatic exemplification"). At least four dimensions of continuity—ontological, epistemological, semantic, and methodological continuity—can be disentangled in principle (Moser and Trout, 1995). In practice, most of the debate concerning the pros and cons of the naturalistic stance has concerned *methodological* continuity. This is more or less what one would expect, given that labels such as 'physical,' 'biological,' 'psychological,' 'sociological' and so forth "apply properly not to particular objects or events but to ways of characterizing them," as Hempel (1969, p. 181) noted a long time ago.

Levels. A similar observation applies to *kinds* or classes of things or events, which are traditionally required to formulate the theories about domains and levels in nature. Following Fodor (1974), natural kinds have come to play an important role in recent arguments for the (dis)unity of science (e.g., Rosenberg, 1980; Dupré, 1983; Callebaut, 1995c). Here too, rather than of phenomena of a certain kind, we should speak of physical, chemical, biological (etc.) *characterizations* of phenomena. A biological characterization, say, would be "one that contains essential occurrences of biological terms (i.e., is not logically equivalent to one that contains no biological terms)," etc. (Hempel, *ibid.*). Once the theory-dependency of

scientific domains and levels is granted, epistemological and methodological considerations can come to the fore [22].

Degrees. It follows directly from the continuity view that naturalization is a matter of degree. Consider the debate concerning intentional explanation in animal behavioral ecology. On the most austere, empiricist interpretation of "the language of natural science" (which, of course, stated so generally can at best be an idealization), 'mature' natural science uses only *extensionalist* language. Accordingly, naturalism may be viewed as the doctrine that restricts the language of science to extensionalist notions (Nelson, 1984). Thus Quine (e.g., 1960, 1992) has consistently advocated the total elimination of all kinds of intentions, intensions, meanings, essences, and conscious mental events. The problem, of course, is that even our picture of physics will be very much diminished by a Quinean naturalization sand bath. (To Quine's "ontology of the desert," Wimsatt has opposed an "ontology of the tropical rain forest"—see Callebaut, 1993, pp. 133-134 and *passim*.) Others, such as Hintikka, have therefore allowed (hierarchies of) sets of possible worlds in their theories; their main concern is rather with the reduction of intention to extensional semantics. A "third grade," which is naturalist "by courtesy" only (Nelson, 1984; Haack, 1993), comprises the views of those who accept such Fregean entities as 'sense' and 'proposition' and who wish to comprehend intentionality without invoking entities not already supposedly called for by the intensional aspects of language. It is clear, then, that in cases such as our example of intentionality in nonhuman nature, naturalists are in no position to *prescribe* the scientists what they should or should not do. The naturalist rather witnesses the debate (Harré and Reynolds, 1984) and records a gradual but seemingly inevitable progression of causal-mechanistic explanations which now supplant intentional explanations (contrast here Atlan, 1994 and Dennett, 1995). Dennett has aptly labeled the latter 'killjoys'. Technically speaking, a killjoy is an explanation of the apparently intentional behavior of (say) animals in terms of purely causal physical mechanisms, i.e., an account that attributes no mentality, no intelligence, no communication, no intentionality at all. The exemplar here is Darwin's nonteleological explanation of teleological achievements by means of his mechanism of evolution by natural selection. A more recent illustration would be the "general demise" of learning, understood as instruction, which Piattelli-Palmarini (1989, p. 1) takes to be "uncontroversial in the biological sciences, while a similar consensus has not yet been reached in psychology and in linguistics at large." Our example also makes clear that philosophy is (or is not) naturalized with respect to the sciences *of a given time*. Since the substantive content, methods, etc., of science change, what is considered (non)natural today may no longer be so tomorrow [23].

Methodological commitment. Homo sapiens, including our culture, so the naturalist contends, is part and parcel of biological evolution. The 'new Darwinism' for which Richard Dawkins is a most eloquent spokesperson has sensitized us to the progressivist traps of *evolutionary humanism* as represented by an older generation of evolutionists such as Julian Huxley or Lorenz. But even a radical evolutionary anti-progressivist such as David Hull (1988b) grants that what distinguishes humans from all other animals is their "success in the knowledge game" (Hull, 1988a). It is not far-fetched, then, to claim that only in humans has evolution become self-conscious or reflexive. In the words of Lorenz (1976, p. 51; my translation): "The creativity of the human mind is not only congenial to the great organic becoming; it is a special case of it. But it elevates itself to a categorially higher level by being reflected upon." From this ontological view, a methodological agenda follows, *viz.*, "to develop relevantly unified theories" (Hooker, 1987, p. 262; Giere, 1988, 1992). The ideal of a *methodological unity of the sciences of nature and culture* (Giedymin, 1973), the view of *philosophy as continuous with science* (Danto, 1967), and the requirement of *testability*, *viz.*, the claim that *matters of fact are as relevant to philosophical theory as they are to science* (Callebaut, 1993)—which is part of a more general concern about the productive integration of theoretical and empirical levels of inquiry (Cavallo, 1979)—are three successive ramifications of the naturalist's methodological agenda. As Oeser (1987, p. 12; my translation) justly notes, "Evolutionary epistemology is the most consistent form of naturalization, because it provides not only an empirical interpretation but also explains the origin and development of the epistemic subject [24]."

One or two cultures (or more?). Here it will be useful to separate the question whether philosophy has its peculiar problems and methods (as contradistinguished from those of natural science) from the more general issue of the methodological (dis)unity of the natural sciences, on the one hand, and of the social sciences and humanities on the other.

A discipline like experimental psychology, which struggled hard to emancipate itself from philosophy and succeeded quite well in this endeavor, obviously comes closer to the natural science pole of the 'naturalization continuum' than, say, theoretical sociology, which continues to make ample use of hermeneutical methods (cf. Van den Berghe, 1990). This distinction, though usually overlooked, is crucial for our purposes here. For *naturalism in philosophy and naturalism as regards the 'sciences of culture' do not always go hand in hand*—quite the contrary:

a. One can favor "naturalistic methodological monism" (Giedymin, 1973) as regards social science, *viz.*, accept "the doctrine that there can be a natural scientific study of society" (Thomas, 1979: 1; cf. Little, 1986), while endorsing foundationism/anti-naturalism in matters philosophi-

cal. This combination, which the consistent naturalist judges schizophrenic, is what both the logical empiricists' and critical rationalists' philosophical doctrines ultimately boiled down to. Thus the "*Gesellschaft für empirische Philosophie*" ("*Gesellschaft für wissenschaftliche Philosophie*" from 1931 on), the official name of Reichenbach's so-called Berlin Circle, declared programmatically:

> Scientific philosophy is understood as a philosophical method that presses forward to philosophical questions and answers by analysis and critique of substantial disciplinary results. By such a method of analysis of science the Society consciously opposes all claims of a philosophy that wants to appropriate reason and aims to formulate statements with *a priori* validity that are not subject to scientific critique (quoted in Stadler, 1990, p. 19; my translation).

Similar statements are found in the Vienna Circle's pamphlet, *Wissenschaftliche Weltauffassung* (Neurath, 1973: 299-318). The trouble is that, save for a few exceptions (most notably Otto Neurath), the philosophical views elaborated by the positivists by way of their 'logic of science' typically fail the litmus test of naturalism as understood here: that *the results of inquiry must be allowed to impinge on the conditions of knowledge*. That is, they fail to be reflexive (cf. below). Popperians, although they like to picture themselves as anti-foundationists, are in the same boat. Most notably, they don't regard their cherished principle of falsification as itself falsifiable.

b. Conversely, one can accept philosophical naturalism in the sense of a testable account of science that is at once reflexive and (the other side of the coin) 'detranscendentalized' or 'de-Kanted', yet still embrace "methodological separatism" (Hans Albert) as regards the relations between natural and social science. This combination is typical of proponents of the sociology of scientific knowledge (Bloor, 1981, 1991; Collins, 1985; Pickering, 1992), actor-network theorists (Latour, 1987, 1991), and other social or radical constructivists, systems theorists, and poststructuralists (e.g., Luhmann, 1990; Schmidt, 1987, 1992; Milberg, 1993).

Complementing these two varieties of 'inconsistent naturalism' are two additional positions, which I will label 'consistent anti-naturalism' and 'consistent naturalism', respectively:

c. *Consistent anti-naturalism*, which combines philosophical foundationism with an insistence on the methodological peculiarity of the human sciences, is represented by traditional continental philosophical currents such as phenomenology and hermeneutics (references in Giedymin, 1973; Bogen, 1985; Kaleri, 1992; Ginev, 1993: Pöltner, 1993).

d. Finally, *consistent naturalism* is the view that is being articulated by the proponents of the current naturalistic turn (e.g., Hooker, 1987, 1994; Giere, 1988; Hull, 1988a; Fuller, 1992a; Callebaut, 1993; Kitcher, 1993).

Naturalism and (neo)pragmatism. This is not to suggest that the latter view is altogether new. To the contrary, as one of the profoundest contemporary representatives of evolutionary naturalism (Hooker, 1987, p. 269) grants, the naturalistic framework he offers to reconstruct what is valuable in current science studies is in many respects "*pragmatism* recapitulated (though, charitably, perhaps in more explicit, more systematic form!)." Yet our situation today is quite different from the intellectual environment the pragmatists faced around 1900, when the *Geisteswissenschaften* barely existed. Was it a coincidence that Wilhelm Dilthey's famous dictum, "Nature we explain, the mental life we understand," which inaugurated the methodological barrier that the contemporary naturalists try to abolish again, was proclaimed thirteen years after Darwin's death (Oeser, 1987, p. 141)? Arguably, Darwinism was and remains the 'prime mover' behind the naturalistic movement. Naturalism was, historically, first and foremost an attempt by American psychologists (James Mark Baldwin, William James), philosophers (Charles Saunders Peirce, John Dewey, George Santayana, Abraham Edel, Roy Wood Sellars), and social scientists (George Herbert Mead) to come to grips with the challenges posed to their fields by the Darwinian revolution in biology (Danto, 1967; Kurtz, 1990; Fuller, 1992a). (Naturalism has been viewed as "the coming to self-consciousness of the presuppositions inherent in the American temper"; Danto 1967, p. 450.) Not only the times have changed, the intellectual world has become a smaller place as well. While the original American pragmatists were naturalizing epistemology, analytic philosophy (which, in positivist guise, was to become its chief contender) originated in Germany with the logician Gottlob Frege's anti-psychologism [25] (Kitcher, 1992). Now, as Fuller (1992b, pp. 398-399) reminds us, pragmatism "shared with the nineteenth-century positivism of Auguste Comte and John Stuart Mill the conviction that science should be applied to everything, and that everything would thereby improve." The Americans, "swallowing their Darwin with large doses of Lamarck," tended towards "the more evolutionary account of science's ascendancy" and stressed "continuity with everyday life." The Continentals emphasized the distinctiveness of science instead, whence their concern with *demarcation* (see, e.g., G. Simon, 1987). Neopragmatists such as Rorty (1991) have "knowingly shifted the terms of the debate so as to highlight those tendencies in the original [pragmatist] position that emerged most clearly from its opposition to positivism" (Fuller, 1992b, p. 400). The "non-interventionist stance" that is typical of science studies today finds at least a partial explanation here.

(ii) Naturalism is anti-transcendent. This typical Enlightenment view (Kurtz, 1990) is also often echoed by reactionaries (Pöltner, 1993) or postmod-

ernists (Latour, 1991) criticizing the Enlightenment. Thus, for instance, in his *Kraft und Stoff* (1855), Ludwig Büchner proclaimed that "science ... gradually establishes the fact that macroscopic and microscopic existence obeys, in its origin, life, and decay, mechanical laws inherent in things themselves, discarding any kind of supernaturalism and idealism in the exploration of natural events." He concluded by stating the classical view of mechanistic materialism: "There is no force without matter; no matter without force." In the same spirit, Lorenz in his famous paper on the 'biologization' of the Kantian *a priori* forms and categories (1941/1982) dubbed it an "attempt at natural explanation" as opposed to one in terms of "supernatural factors," (Platonic) ideals, i.e., unchanging factors shaped by God. Lorenz proposed to reinterpret his *explanandum*—the *Vernunft*—naturalistically as "a (function of an) organ" or an "apparatus." In his venomous criticism of Bierens de Haan's *finalistic-holistic approach* to ethology (Lorenz, 1942/1970), Lorenz's anti-transcendent stance is even more outspoken. To illustrate the one-sidedness of the predominantly or exclusively teleological conception of life—which he links to the religious background of its adherents—he uses the comparison of a car driver who is on his way to a distant city to lecture. The person is there "to lecture," and the car "to be driven."

But then, something unexpected happens: the car breaks down, and the person gets nervous about reaching his destination in time. If he does not succeed to recognize the *causes* of the normal functioning of his car in general and of its current malfunctioning, there goes the whole finality of the trip (*so ist es um die ganze Finalität seiner Reise geschehen*).

(iii) Naturalism is anti-transcendental. One of the clearest statements of this criterion I am aware of features in the theoretical sociologist Niklas Luhmann's *Die Wissenschaft der Gesellschaft* (1990): *a theory is transcendental if it does not allow its results to impinge on its preconditions* [26].

Wittgenstein's statement in the Tractatus (4.111) that philosophy is not a natural science but must be 'above' or 'under', not on a par with science, might stand as an epitome for the position the naturalist wants to combat. For rebuttals of the objection that naturalism must be viciously circular, see, e.g., Vollmer (1985), Giere (1988), and Nickles in Callebaut (1993, ch. 5). Altenberg EE, including Lorenz's evolutionary naturalism, has had very little of philosophical value to say about the issue of transcendentalism in general, although a book title like *Evolution and Self-reference of Knowledge* (Fenk, 1990) may suggest it did. In fact, for empiricists it is striking that Lorenz—contrary to, say, Mach—was prone to the "absurd idea that acquired or innate forms of judgment or reaction can be interpreted as *a priori*" (Haller, 1988, p. 77)—leaving room for an *a priori* interpretation of philosophy as methodology of science (cf. above). This is *not* to suggest

that apriorism and (radical) empiricism must be opposed *necessarily*. On an alternative understanding, both are (rival) versions of attempts to offer a "tradition-independent" conception of human knowledge. But as we now know (see, e.g., Kitcher, 1984; 2000), even logical and mathematical knowledge *are* tradition-dependent. Kitcher (2000) thus suggests "a resolve to explore the complex ways in which experience has figured in the genesis of our current logical and mathematical knowledge." Again we have a case here where a torch that was lighted by Lorenz (among others) is now being carried on by others who would not in general identify themselves with his program for epistemology. Notice, finally, that 'de-transcendentalized' or 'de-Kanted" (Binmore, 1996) is not synonymous with 'anti-foundational' in a wider sense [27].

(iv) Bounded rationality. Ever since Aristotle, Western philosophy has been under the spell of a *categorical* or *substantive* conception of rationality. As far as I can see, the toughest part of the naturalization project will be its replacement by an *instrumental* or *procedural* conception of rationality (H. A. Simon, 1976, 1978, 1983; Giere, 1989, 1991). One characterization of this problematic, the constructive realist's, locates the naturalist's predicament somewhere on a spectrum ranging from a cognitive science type of model of the *individual scientist's* decision making to a Rorty-like, 'thick' description of *social justification*. It may be summarized thus:

> Scientific judgment is neither the application of categorical principles of rationality nor just social consensus; it is something in between. Scientists really do judge the fit between their models and the world. But the theory of how they make these judgments is completely naturalistic. Their judgments are hooked causally to the world—that is where experimentation comes in. ... This involves creating something completely artificial, to be sure. But it allows nature to provide clues as to which way it is going. (Giere 1991, p. 521.)

Following Herbert Simon, I think there are good in principle reasons to reject the fashionable optimization approaches originally developed by economics and now also used (admittedly successfully at a *pragmatic* level) by evolutionary biologists (Callebaut, 1998). By rephrasing the "limits of adaptation" thesis dear to the Altenberg school in EE in terms of Simonian bounded rationality, Lorenz's philosophical naturalism can be 'de-Kanted' further than he was able or inclined to do himself, thus making it more consistent and capable of dealing with a number of justified criticisms. But this is, right now, just a promissory note (cf. Callebaut, submitted).

NOTES

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1 The main exception is a major book on the history of ethology by Richard Burkhardt, Jr., forthcoming at the University of Chicago Press.

2 In contradistinction to the evolutionary account of science first envisaged by authors such as Popper and Toulmin and later elaborated by Hooker (1987, 1994), Giere (1988), Hull (1988a, 2001), and others.

3 The often fascinating interrelations between philosophical naturalism, naturalism in the biologist's sense, and naturalism in art and literature—see, e.g., Serres' (1975) interpretation of the novels of Émile Zola in the light of the thermodynamics of his time—also cannot be explored here.

4 No association suggested here, of course, with the pre-Darwinian notion of *plenitas* as so beautifully rendered by Lovejoy (1936)!

5 See the dedication in Huxley (1962).

6 In E. O. Wilson's tribute to Lorenz and his fellow ethologists—he credits them for having convinced us that "behavior and social structure, like all other biological phenomena, can be studied as 'organs'"— Tinbergen's broad and pluralist view of ethology is diminished to a gene-centered one, as behavioral 'organs' are here reduced to "extensions of the genes that exist because of their superior adaptive value"(Wilson, 1975, p. 22).

7 On the major role ethology played in the demise of behaviorism, see also Turner *et al.* 1997, p. 57f.

8 In Wilson's characterization: "The pervasive role of natural selection in shaping all classes of traits in organisms can be fairly called the central dogma of evolutionary biology. When relentlessly pressed, this proposition may not produce an absolute truth, but it is, as G. C. Williams disarmingly put the matter, the light and the way" (Wilson, 1975: 21-22). Note that the adaptationist movement transcends biology and includes psychology, the social sciences and humanities as well as medicine and psychiatry. A succinct characterization of this "new Darwinism" may be found in the June 25, 1993 issue of the *Times Higher Education Supplement* at the occasion of the conference on "Evolution and the Human Sciences" held at the London School of Economics, London, 24-26 June 1993.

9 It is therefore—-and especially in the light of the general development of biology from the 1930s on—preposterous to hail Lorenz as the "Darwin of the twentieth century," as some of his admirers do.

10 Thus Tinbergen envisaged "a policy of filing descriptive material in libraries or archives (including film libraries) rather than publishing it in the usual journals," as journals demand a reduction of the descriptive material to the absolute minimum (or even less) required for an understanding of the experiments reported on. Having pointed to what philosophers nowadays would call the inevitable *theory-ladenness* of all observation—an implicit criticism of Lorenz's view that the observer ought to approach his objects in an 'unbiased' way (see Brigandt, 2003)—he nevertheless insisted (here echoing Lorenz) on the positive heuristic function "naive, unsophisticated, or intuitively guided observation" may play by "open(ing) our eyes to new problems" (Tinbergen, 1963, p. 412). See also Lorenz (1973).

11 One of his most ardent admirers, Bernd Lötsch (2003), does not hesitate to call Lorenz "the philosopher to whom we owe the most significant progress of epistemology since Kant," nay: the "Darwin of the human soul."

12 The context of this verdict is a discussion of Ludwig Boltzmann's EE. Oeser also questions the value of an epistemology that can endorse methodological conceptions as differing as Boltzmann's mechanicism and the phenomenalism of that other pioneer of EE, Boltzmann's rival Ernst Mach: "What is the value of an epistemology that leads to such different methodological conceptions in physical reseach?" (Oeser, 1995, p. 271; my translation).

13 Recall that Kuhn always remained unhappy with the impossibility of defining progress across scientific revolutions—a consequence of his own model of scientific change (Callebaut, 1995a).

14 The context was a comparison between Thomas Kuhn's and Karl Popper's views of science. Bloor (2000) is an attempt to make sense of Wittgenstein's philosophy by viewing him as a conservative thinker in Mannheim's sense. Judging from his bookshelves, Lorenz seems to have been fascinated by Wittgenstein.

15 "In describing evolution, we are forever hampered by the fact that our vocabulary was created by a culture not yet aware of phylogeny. All the existing terms (development, evolution, *Entwicklung*, etc.) imply the unfolding of something preexisting, wrapped closely into a tight bundle, as a flower is in its bud. They fail miserably to do justice to what is the essence of evolution, the coming-into-existence of *something entirely new, which simply did not exist before*. Some philosophers of evolution, feeling the inadequacy of these words and groping for a new one, have rather pathetically hit on the term 'emergence', which, worse than any other, suggests that an entirely preexisting thing, like a surfacing walrus, puts in an appearance above the water, which previously, to a literally superficial view, had seemed empty. Some theistic philosophers have coined, for the act of creating something entirely new, the term *fulguratio*[,] "lightning," which implies that a creative stroke of lightning emanates from an all-knowing and eternal god. By an etymological fluke of coincidence, this term is more descriptive of what really happens than are all those aforementioned. To us, the thunderbolt of Zeus is an electric spark like any other, and the first thing that comes to our mind on seeing a spark at an unexpected point in a system is a short circuit. When the beginning and the end of a one-way chain of causation establish a connection, so that the end effect influences the first cause, a feedback cycle is established; in other words, the previously linear chain is transformed into a system possessing entirely new systemic properties" (Lorenz 1969, p. 16).

16 These limitations have to do with the characteristics of complex systems (cf. Hacking 1983; Moss 2003).

17 In Haack's (1990. 1993) useful typology of naturalism, Rorty is featured as a "revolutionary nihilist."

18 For surveys of the contemporary debate on naturalism in epistemology and the philosophy of science see Kornblith (1985), Shimony and Nails (1987), and Haack (1993). For a historical perspective on the issues underlying the naturalization of epistemology see Hatfield (1990).

19 I discuss this point in some detail in Callebaut (1995b); the best elaboration I know of is Hooker (1994). Although I think that my usage of the term 'meta-learning' is appropriate in our context ("learning about learning"), it should not mislead the reader to think that naturalistic theories of science

require a 'levels view' of science that dismisses cognitive evolution at the 'methodological' level, as in the logical empiricists' and Popper's view (they viewed their philosophy of science as analytic *a priori*). In principle, any naturalistic/scientific account of science must be reflexive, for otherwise one would "get out of the system." Atlan's (1986) "acrobatic reason" is an apt description of what is at stake here: "*une raison acrobatique et sans filet qui ne peut plus se prévaloir d'un métadiscours, d'une métathéorie (méta-physique, méta-biologique, méta-psychologique ou autre).*"

20 Inconvenient about this classification is that it leaves out philosophers like Aristotle or Spinoza, who have also been regarded as major ancestors of naturalism. Thus Shimony (1981, p. 100) writes: "A naturalistic view of human knowledge is at least as old as Aristotle's *De Anima*, though it has been greatly expanded by applications of the theory of evolution" As to Spinoza, not only did he oppose Descartes' mind-body dualism, he also rejected the Cartesian idea of a transcendent God as non-intelligible, and a personalized conception of God and Providence as anthropomorphic (cf. Atlan, 1986).

21 "Weasel words buy time while the scientists develop their positions. Science is a conversation with nature, but it is also a conversation with other scientists. Not until scientists publish their views and discover the reactions of other scientists can they possibly appreciate what they have actually said" (Hull, 1988a, p. 7).

22 In discussing these issues one should be sensitive to the fact that *in this very respect our natural languages are heavily laden with history*. One, quite arbitrary, example: "It may be that the commonly felt disquiet [among English-speaking scholars] at classing human studies as sciences derives from the way in which the modern English word 'science' evolved from the older distinction between the natural and the human. In German, by contrast, the term *Wissenschaft* corresponds more closely to the epistemological concept of *scientia* or *philosophia*, denoting a methodology rather than an area of study" (Macdonald Ross, 1990, p. 802).

23 In my view, to assess the 'degree of naturalization' of any account (philosophical or other) of science, one must take into account all four (semi-independent) criteria, which makes the 'test' more severe than is often thought. For instance, accounts that are reflexive but fail to meet the causal-mechanical explanation condition—such as Luhmann's *Gesellschaftstheorie* and, in fact, much work belonging to the various constructivist schools, to the extent that they are concerned with (human) society, do not meet my combined standards.

24 Ethical naturalism, which holds that "there are no values in the world that are not reducible to or explainable away in terms of the naturalistic conceptual scheme of things" (Adams, 1960/1973, p. 14), is coming back on the intellectual scene forcefully, after a long demise that was mainly due to its (not entirely deserved) association with social Darwinism. Although it is both historically and systematically related to the methodological debate that is currently referred to as *normative naturalism* (Laudan, 1987a,b, 1990), neonaturalism in ethics will not be dealt with here (see, e.g., Nitecki and Nitecki, 1993, Farber, 1994, Thompson, 1995).

25 Psychologism, a view about the nature of logic and reasoning that was influential until the early twentieth century is, minimally, a variety of naturalism claiming that the processes by which we *ought* to arrive at our

beliefs are (or ought to be) informed by the processes by which we *do* arrive at our beliefs (Kornblith, 1985). Anti-psychologism denies the relevance of the factual to the normative.

26 *"Ungeachtet aller spezifischen Theorieannahmen (Bewußtsein, Vernunft, Subjektivität betreffend) kann man eine Theorie als transzendental characterisieren, wenn sie nicht zuläßt, daß die Bedingungen der Erkenntnis durch die Ergebnisse der Erkenntnis in Frage gestellt werden. Transzendentale Theorien blockieren den autologischen Rückschluß auf sich selber. Als empirisch oder als naturalistisch kann man dagegen Erkenntnistheorien bezeichnen, wenn sie für sich selbst im Bereich der wissenswerten Gegenstände keinen Ausnahmezustand beanspruchen, sondern sich durch empirischen Forschungen betreffen und in der Reichweite der für Erkenntnis offenen Optionen einschränken lassen"* (Luhmann 1990, pp. 15-16).

27 Matters are actually even more complicated: On certain construals, naturalism and transcendentalism *are* compatible (see most notably Bhaskar, 1979, 1986, 1989).

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