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**NEW PATHWAYS IN SCIENTIFIC EDUCATION: FROM BIOETHICS
TO ECOETHICS**

ABSTRACT. Maturana, Varela, Prigogine, Lovelock proposed new scientific ideas that involve ethical approaches. They open new pathways in the field of scientific education thanks to new anthropological views. This change leads from bioethics to ecoethics, following in Carson's, Potter's, Morin's footsteps.

Keywords: Scientific education; Maturana; Prigogine; Morin; Bioethics; Ecoethics

In this work I'd like to demonstrate how new scientific ideas have to promote necessarily a new education; I think about a scientific training that has its roots in an ethical sensibility unknown to science until some years ago; such a sensibility has been mostly ignored until physics "has known the sin" (Greco 1995) with the atomic bomb and until it has sensationally understood that science isn't neutral at all. Nowadays, from science and thanks to a secular

history, the necessity of an ethical afflatus is born, an afflatus that is able to go beyond the anthropological dimension.

My reasoning comes from the great scientific revolutions that went through the Twentieth Century, introducing new perspectives to approach reality (take for instance the systemic vision) and contaminations of disciplinary fields that demonstrate how nowadays is more and more necessary to have transversal knowledge, in spite of specialism (Morin 1977; Morin 1999; Giordano 2006; Gembillo-Anselmo-Giordano 2008). Such changes concern consolidated fields such as physics and chemistry; these new perspectives develop different directions of the studying of the living; for example, they try to look at the whole planet as a living organism itself (Lovelock 1979 and 1988; Bondì 2006).

The opening towards a new ethical dimension of science comes from the scientific ideas of the Twentieth Century (that started a redefinition of the relationship between man and nature) and from what we can define a recovery of the subject. Such a recovery had started in the first thirty years of the Twentieth Century, thanks to the theory of relativity (Einstein 1988), the principle of indetermination (Heisenberg 1927) and the principle of complementarity (Bohr 1927). From such efforts emerged how the sharp and estranging separation of subject and object was a methodological-instrumental and simplifying pretence (Schrödinger 1948).

Following such considerations I'd like to propose three rapid examples of scientific ideas that redefine the relationship between subject and object. My references will be Maturana and Varela, Prigogine and Lovelock.

According to the perspective formulated by Humberto Maturana and Francisco Varela, the difference between living beings and the machines is that the former are “autopoietic”. Thanks to such a theory it's very simple to criticize the classical relationship between the living and the environment. Because of the disappearing of the classical relationship between definite and distinct realities (the organism on the one hand and the environment on the other one), we have organisms that are closed according to the point of view of the organization but open according to the structural point of view (Maturana- Varela 1980).

Living beings need the environment and for this reason they have to realize a “structural congruence” with the environment itself. It's a non-mechanistic interaction. What is produced by the meeting of the human being and the environment is a “structural matching” (Maturana 1990, p. 34; Nucara 2004, pp. 450-458; Nucara 2014), as to say an absolutely mutual interaction that's the reason why «both organisms and environment undergo transformations» (Maturana-Varela 1984, p. 98). It's quite evident how the relationship between living beings and nature and the relationship between man (knowing subject)

and nature (object to be known) as well are totally renewed (as it is stressed by the two Chilean scientists in the reference to the role of language) (Maturana-Varela 1984, pp. 176-197). In this way the knowing and observing subject produces a linguistic universe that is able to generate a world (Maturana 1990, p. 115).

Ilya Prigogine as well, is one of the scientists who noticed strongly how from a new science (compared with the *classical* one) emerges necessarily an inner dialectics between man and nature, which, far from continue the old separations and breaks is able to unify them and to prospect new scenarios.

Such a reasoning comes from the admission that also in physics (and mainly in thermodynamics) we are in front of an irreversible time, the time of history, the time of life. In the same moment when the stronger diaphragm between scientific description and the vital one is destroyed (that's to say the difference of time between the former and the latter – reversible in the first case and irreversible in the second one) it's possible to say that science becomes on a human scale. According to Prigogine, «scientists have simply given up refusing what *everyone knew*» (Prigogine-Stengers 1979, p. 274): time is irreversible and it has a precise direction from the past to the future. It's a sort of “arrow of time” that is the property shared at any level by all the components of the universe.(Prigogine-Stengers 1979, p. XV). Such a property makes us live in a

“universe of participation” and it transforms science in an exploration of the nature from the inside. From such considerations comes the possibility of a “new alliance” between man and nature (Prigogine – Stengers 1979, p. 28; Giordano 2005; Gembillo-Giordano 2016).

The place of man in nature keeps more and more organic features – if we can say this- in James Lovelock’s perspective, in the theory of “Gaia”, according to which it’s possible to consider the entire planet as a unitary living being.

If we had to explain this very briefly, we could affirm that according to Lovelock «the edge of the planet circumscribes a living being, Gaia, that’s a system made up of living beings and of their environment. On the surface of Earth we don’t have a clear distinction between living matter and the inanimate one. There is only a hierarchy of intensity that moves from the “material” environment of rocks and of atmosphere to the living cells.» (Lovelock 1988, pp. 54-55).

In a natural reality interpreted as an organism, it’s possible to found with much awareness the alliance between man and nature wished by Prigogine. We can understand, as men, to be “the critical conscience” of a process which would have neither awareness nor aims without us and which is able to go beyond itself thanks to us (Gembillo-Anselmo-Giordano 2008, p. 51).

A critical conscience cannot be but an ethical one; but what kind of ethics is this in relation to the new perspectives of science? It seems to emerge a new paradigm that Fritjof Capra defines as a «new deep ecological awareness that admits the fundamental interdependence of all the phenomena and that we, as individual and social beings, play a very important role in the cyclical processes of Nature (and we definitively depend on such processes as well)» (Capra 1996, p. 16-17).

Such an “holistic” perspective is the same that comes from Maturana and Varela’s theories. According to them, every living being is part of a web that regards all the other living beings and the environment in a circuit of interaction and retroaction. (Gembillo-Anselmo-Giordano 2008 pp. 111-113).

At a human level, according to Maturana and Varela, each of us constitutes *a world* and not *the world* (Maturana-Varela 1984, pp. 202-203). For this reason «we cannot reaffirm what we say according to our point of view. On the contrary we should admit that our point of view is the result of a structural matching in a domain of experience *as good as the our interlocutor’s one, even if this seems to be less desirable*» (Maturana-Varela 1984, p. 203; Giordano 2009).

According to a gnoseological perspective the problem is to find a sense for the scientific conscience and for its applications. (Maturana-Varela 1984, p. 205;

Heisenberg 1955, p. 76). But now such awareness is not enough. Ethics is in front of unexpected and unpredictable scenarios offered by science. Since the 1960, for example, the biologist Rachel Carson has pointed the attention to the risk of a “silenced spring”. Guided by the longing for domination, we have forgotten how our history is an history of interaction with the environment, during which living beings had never upset the equilibrium in a radical way (Carson 1962, pp. 13-14).

Nowadays, on the contrary, we are in front of very frequent changes, and «the speed of such changes and the speed through which new situations are produced, don't come from the following natural events but from the violent and hasty eagerness of man» (Carson 1962, p.14). Thanks to an evident shortsighted attitude, «man – as Carson argues – leaves behind himself a frightful track of destructions which regard both the earth and the living beings who live with him, along his progress towards his proclaimed goals of conquest of nature» (Carson 1962, p. 79)

According to such a point of view, men represent the destructive-factor, but also the salvation one (Lovelock 1988, pp. 235-236). Everything chiefly depends on us because the *ecocide*, in the end, is just the suicide of a species that drags along its own environment (Lovelock 1988, p. 214).

Such an holistic and systemic vision of the relationship man-environment needs an awareness and an ethics not just “human” (or simply an anthropological ethics) but and ethics of *bios* in a more general way. (Gembillo-Anselmo-Giordano 2008, p. 98). Moreover, this was the way theorized by the American oncologist Van Rensselaer Potter who coined the word “bioethics”. Such a statement has a “surviving” task. According to Potter: «A science to survive must be more than just a science, and for this reason I propose the term “*bioethics*” to emphasize the two most important elements to be conquered for the new wisdom, the two most important elements we need: biological knowledge and human values» (Potter 1971, p. 39)

Bioethics comes from the awareness that we can’t forget how man is unable to live without environment (Gembillo-Anselmo-Giordano 2008); this to say that (according to Potter again) «man can’t live without picking up plants or killing animals. If plants die and animals are unable to reproduce, man will be sick and he’ll die and he won’t be able to reproduce his species» (Potter 1971, p. 40).

Potter understood very well how salvation of man passes through the bio-preservation; but it’s for man to save himself, otherwise (as Lovelock remembered) life will disappear, maybe, in the known forms but the planet will get itself started out again on other levels and vital possibilities.

Bioethics has more and more lost its first features and it has become an anthropo-ethics (Gembillo-Anselmo-Giordano 2008, pp. 96-118); it has renounced «its two original elements it was made up of: the relationship with nature (ecology) on the one hand and the responsibility towards the future of mankind on the other one» (Paolozzi 2009, p.21). Such a new bioethics (and the definition proposed by William Reich in 1978 in *Enciclopedia of Bioethics* was very good) would be as «the systematic study of human behavior in the sciences of life and health-care, because such a behavior is examined in the light of moral values and principles» (Cited in Paolozzi 2009, p.17); nowadays it is possible to perceive the limits of such a bioethics, starting from the context of the new ideas produced in the scientific fields; these ideas far from being a preestablished “must be”, propose an ethics authorganized around (and by) them, because all of them involve the perception of a global and symbiotic dialectics between living beings and environment. So we need an ethics that in the same way, is able to go beyond man: we need a planetary ethics.

We may ask Edgar Morin some help in this last part of our reasoning. According to the French philosopher, after the awareness of the human identity, nowadays we need “the awareness of the mutual destiny that binds human destiny to the planet one, even in its daily life” (Morin 2004, p. 162). According to such a point of view – Morin goes on – «the human relationship with nature cannot be

understood in a restrictive and disjoint way. Mankind is a planetary and biospheric entity. The human being, natural and supernatural at the same time, has to take root in the living and physical nature which he comes from and which he is distinguished from with nature, thought and conscience. Our consubstantial link with the biosphere makes us abandon the promethean dream about the domination of nature for the aspiration to conviviality on Earth» (Morin 2004, p. 163).

What Morin proposes is the idea of an “Earth-Country” (Morin –Kern 1993); it’s a perspective of a planetary ethics that “cannot be but symbiotic” (Morin 2004, p. 165), without excluding individualities to privilege totality. (Morin 2004, pp. 163-164). Morin proposes an eco-ethics but such dimension admits the anthropo-ethical dimension because “it needs what is more individualized in the human being, the autonomy of conscience and the sense of responsibility” (Morin 2004, p. 199, cfr. Jonas 1979). Without individual awareness of the responsibilities there is no ethics; moreover the planetary ethics cannot exist, this eco-ethics that is the ethics (remembering again Prigogine) of a “new alliance” between human conscience and nature: new scientific knowledge insists on a new ethical awareness that cannot be but eco-ethical. According to such a point of view this new knowledge needs new educational models.

Nowadays a lot of proposals are put forward. Take for instance the idea proposed by Morin about restraining the exclusive teaching of isolated disciplines. On the contrary Morin asks for a frame of sense – as a general problem or a big subject – on which the realization of a cooperation between disciplines is possible (Morin 1999a; Gembillo-Anselmo-Giordano 2008; Giordano 2013). But in our changing period, a very important role (especially in the scientific field) is the one played by the awareness of what kind of research you are doing or you are studying. Morin calls it “epistemological tithe”. He writes: «We should set up in all the Universities and in all the faculties an epistemological or transdisciplinary tithe, that should take the 10% of the time spent for each common subject on the assumption of different knowledge and the possibilities of putting them in contact» (Morin 1999a, pp. 87-88; cfr. Morin 1999b). The epistemological tithe might also be an historical reconstruction that is able to give sense of the genesis and development of a discipline, of a theory or an idea, of a field of research. (Gembillo-Anselmo-Giordano 2008, 149-188). I think we can only do two things. Firstly, it’s possible to put into a tradition the new knowledge that is continuously produced and that generates new “paradigms” that make us live in worlds different from the ones in which the supporters of the previous scientific hypothesis live (think about what Thomas Kuhn says). Secondly, according to such an historical awareness it’s possible to

find the way through which new scientific models can transmit new scientific knowledge building up a new ethical conscience that comes from them.

In the end, I'd like to reaffirm how such new situation can be produced only by an historical reconstruction of the development of our knowledge, because just history shows us how much precariousness and uncertainty is behind the achievements of knowledge and it shows us how such a situation marks the opening towards the future according to an "infinite task" - paraphrasing Edmund Husserl (1959) - that should be carried out with ethical spirit, rather, eco-ethical.

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