

SCIENTIFIC THINKING AND ENVIRONMENTAL EDUCATION AS FACTORS OF
INNOVATION IN LITERATURE FOR CHILDREN**Scientific Thinking and Environmental Education as factors of innovation in Literature for
Children**

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Abstract

In children's literature science and nature have traditionally played the role of a narrative device, a landscape background for the setting where to let speaking animal characters act. It is only since the 70s that the environmental issue has started to appear through the ecological problems, by dragging new visions and critical analyses into literature. The article analyzes the influences the scientific environmentalism had on the Italian literature between 1970 and 1980, when an ecological awareness starts to progressively develop within the country.

By adopting some rules belonging to *ecocriticism*, attention is being focused on those works which are the first ones to be inspired by the "thought-through-connection" notion of modern ecology and which find their first expressive and artistic paths in the narrative for children and young adults by identifying, in a connected way, the *crossovers* with the popularization of science and with the objectives of environmental education.

Through the narrative themes and the popularising writing – adopting the ecocritical statute as a reference guidance – the strategic problems relating to the ecological issue within the Italian *fiction* and *non fiction* are brought to the fore: the effects deriving from the aggression to Third World's resources, the need for science to radically change its own traditional point of view, the inseparable interrelation between environmental damage and social damage by paying special attention to the role played by information. It is therefore suggested that modern ecological thought has remarkably contributed to the general innovation of literature and publishing industry for children which has developed in the subsequent twenty-year period.

Key words: children's literature, fiction, non fiction, ecocriticism, popularisation of science; ecological thought; interdisciplinarity; prejudices.

Zusammenfassung

In der Kinder- und Jugendliteratur hatten die Wissenschaft und die Natur traditionsgemäß die Rolle eines erzählerischen Notbehelfs, eines landschaftlichen Hintergrunds für die Szenerie, vor dem sprechende Tierfiguren agieren. Erst in den 70er Jahren beginnt die Umweltfrage durch Umweltprobleme hervorgerufen aufzutauchen und bringt in die Literatur neue Visionen und kritische Betrachtungen ein. Der Artikel analysiert die Einflüsse des wissenschaftlichen Umweltschutzes innerhalb der italienischen Literatur zwischen 1970 und 1980, als im Land eine allmähliche Verbreitung des Umweltbewusstseins begann. Unter Anwendung einiger Maßstäbe des *Ecocriticism* wird die Aufmerksamkeit auf Werke, die sich als erste von „*Gedanken im Zusammenhang*“ mit der modernen Ökologie inspirieren lassen und welche die ersten expressiven und künstlerischen Wege in der Belletristik für Kinder- und Jugendliche beschreiten, gerichtet, wobei die *Cross-overs* mit der

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populärwissenschaftliche Literatur und mit den Zielen der Umwelterziehung zusammenhängend ermittelt werden. Mit Hilfe von Erzählthemen und populärwissenschaftlichen Schriften sowie unter Anwendung des ökokritischen Ansatzes als Bezugsgröße werden die strategischen Probleme der Umweltfrage in der italienischen *Fiktion* und *Nichtfiktion* hervorgehoben: die Auswirkungen des Angriffs auf die Ressourcen der Dritten Welt, die Notwendigkeit, dass die Wissenschaft ihren traditionellen Standpunkt radikal ändern muss, die untrennbare Wechselbeziehung zwischen Umweltschaden und sozialem Schaden mit besonderem Augenmerk auf die Rolle der Information. Es wird daher die Hypothese aufgestellt, dass der moderne Umweltgedanke zur allgemeinen Innovation der Literatur und des Verlagswesens für Kinder- und Jugendliche, die in den darauf folgenden zwanzig Jahren ihre Entwicklung nahm, beträchtlich beitrug.

Schlüsselwörter: Kinder- und Jugendliteratur; Umwelterziehung; Ecocriticism; Populärwissenschaftliche Literatur; Umweltgedanke; Interdisziplinarität; Fiktion; Nichtfiktion; Vorurteile; Innovation.

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Scientific Thinking and Environmental Education as factors of innovation in Literature for Children**Introduction**

The representation of childhood and the search for an ideal relationship with nature find interesting examples on the basis of an explicit environmentalist message to children at the end of the Nineteenth century, in England and in the United States, due to associations striving for the protection of parks and wild animals (Rahn 1995). Influenced by the heritage of Rousseau's natural education, the writers belonging to this tradition were not particularly successful but they started to legitimise an environmentalist literature involving also great classics, such as those from the Victorian Age, during which colonialism had encouraged discussion on discoveries, explorations, pristine places, e.g. *The Jungle Book* by Rudyard Kipling or less exotic and cosier contexts, such as Kensington's gardens in the adventures of Peter Pan, or the *Secret Garden* by Frances H. Burnett.

As a matter of fact, the literature by authors from North European Countries seems to be the privileged framework for analysis, as if the feeling for nature had specific national narrative forms or if the narrativization of these Countries' national feeling were intimately linked to a certain way of perceiving nature. Paul Hazard's (1954) opinion on Andersen's fairy tales and on 'Nordic' literature as a whole is emblematic: the Danish writer proves to be a master in animating animals and objects until their deep voice can be heard clanging.

He provides enchanted paintings, letting the readers discover the 'fantastic dominions of snow and ice', thousands of nuances of the long and sleepy winters, with a range of colours which are not flaming but delicate and vague, and an imagination which is closer to dream, deeply linked with emotional life, with its uncertainties and doubts. The world of nature, meant as a dimension of the imaginative world, has always represented a place elsewhere where man can escape alienation and depersonalization but, as well, the background against which to develop initiation paths, a magical and fairy dimension dominated by fancy and animism which are typical of children's thinking.

But it will be with another Danish writer, Karin Michaelis, that the romantic feeling for nature will be translated into a real ecological pedagogic programme. Already in *The Green island* (1937), the story of a boy and of his fellow citizens who see their village covered with water because of a flooding being transformed into an island, she will introduce some fundamental issues: islanders are indeed compelled to talk together about *vital space*, and about agricultural holdings which should

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have determined a sustainable development, compatible with respect for the environment. Especially the series of novels dedicated to her best known character – the young *Bibi* who, during her travels around Denmark both alone and together with her friends, devises strategies in order to improve the world and rediscover nature – introduces important topics, such as the relationship between tradition and innovation, the contact with nature as a way of expressing the most genuine side of oneself, the training value of travelling. Bibi finds an association for the protection of animals; she takes part in environmental movements of *avant-garde* schools attended by young people from all over the world near the Black Forest; she travels on mighty ships cracking the ice of the North Sea; when in Berlin she is hosted by Albert Einstein and, in the city, she finds out about the emergence of shopping malls and of new public transport means. The writer therefore appears to be extremely wise, in her novels, when weighing out on the one hand a childish vision of nature – seen as a dimension close to childhood, an almost magic and unspoiled place, mainly a rural one, onto which the popular point of view projects mighty fantastications – and, on the other hand, a modern and amazed look facing historical facts which, exactly in the Thirties, were changing the relationship between man and reality.

The nature covered through the large number of trips taken by Bibi brings to mind a sort of a geography handbook, a narrative scheme shared with other classics of literature for children and young adults, from *Sans famille* by Malot to *Cuore* by De Amicis and to *Nils Olgerssons underbara resa genom Sverige* by Lagerlöf. These are books whose approach is certainly a little strict but which have had the merit to provide their children-readers with an initial sense of national identity and of space, by progressively moving away from familiar contexts to gradually broadening knowledge horizons, metaphorically narrating, in this route, the growing up of characters who gain a more complex maturity by experiencing life directly.

A nature regarded as a placid and unspoiled dimension, a romantic metaphor for the human soul, a landscape living in perfect harmony with the events taking place within it – events which are especially related to the life of rural community – reappears in the novels by Astrid Lindgren, in the trilogy dedicated to Emil and, above all, in *Holidays on Seagulls' Island* (1964) which is inspired by the beauty of the Stockholm Archipelago: life on the island teaches Karin, the main character, the capacity to feel the energy of a simple, happy and intimately unspoiled nature flowing through her body, a nature able to represent a sort of reservoir of positive emotions from which to draw on for the rest of her life. A wild, totally absorbing and primordial nature, which requires respect and knowledge, is instead the absolute protagonist of the beautiful novel *Ronja* (1982): a kind of *forest feeling* runs through the whole book. The joining with all creation, the experience of seasons, the

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ecstasy about the arrival of spring, the changing in perceptions during the different hours of the day, all of this represents a sort of melody flowing through the novel's pages (Edström, 2000, pp. 277-278).

Today books for children and young adults focusing, in a more or less direct way, on the topics of environmental education represent a remarkable share of the publications market, expressed through a wide catalogue of opportunities, ranging from the classics of environmentalist thought, such as *The Man Who Planted Trees* (1953) by the French author Jean Giono, to handbooks and activity books, with games and experiments introducing young people to ecosystems, arriving to popularisation books dealing with the topic of biodiversity and climate change, e.g. the denunciation book by Al Gore - *The Crisis of Global Warming told to Youth* (2008), and to publications mainly linked with active citizenship. It may be said that the beginning of a literature for children which is not pedantic or moralistic but indeed latched on to contemporary times from a stylistic and thematic point of view, which is sensitive to the reality to be presented to the young reader without any censorships or sugar-coating, stems also from a profitable contamination with the environmental and scientific culture of the Seventies. In this sense, the contribution by Gianni Rodari has been emblematic: he was the pioneer of an experimental literature for children and young adults, marked by the «coming down of barriers among literary genres, the use of parody and of the technique of rewriting, the high rate of intertextuality» (Rossitto, 2011). The works by Rodari show a deep ecological awareness in the expression of a strong solidarity towards people, being in a close conjunction with the natural environment surrounding them. It is not for nothing that the main character of the nursery rhyme whose title is *A mature man with an unripe ear* (NoT, Original title in Italian: *Un signore maturo con un orecchio acerbo*), defined as being an original 'pacifist ecological manifesto' (Panzarasa, 2011), has a young ear which is useful to understand things adults have forgotten about: the words of trees, of birds, of clouds passing by, of stones, of streams, and also of children when they say things which may sound mysterious and incomprehensible to a mature ear. Not only does Rodari significantly pay attention to scientific themes but the ecologist level of his work goes together with those important problems, such as the debate over the neutrality of science and the role played by scientists, towards which the author takes a clear and sharp value position already in *The Cake in the Sky* (NoT, Original title in Italian: *La torta in cielo*, 1966). A sensitivity which will widely resound in books and tales by authors who will bet on the productive connection among literature, science and ecology: by putting together narration and popularisation, they will refer to the new paradigms of science, such as the thought through connections, the unpredictability and irreversibility of environmental damage, by expressing a kind

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of ecology which is no longer limited to the observation of the living systems, to their aesthetic vision but which is indeed able to make a problem of the environmental situation, and to provide young generations with updated and refined critical and hermeneutical skills. These international pedagogic and cultural principles and trends will be referred to and re-launched during the *Intergovernmental Conference on Environmental Education in Tbilisi* where, among the other recommendations, it is established for the first time that: «A basic aim of environmental education is to succeed in making individuals and communities understand the complex nature of the natural and the built environments resulting from the interaction of their biological, physical, social, economic, and cultural aspects, and acquire the knowledge, values, attitudes, and practical skills to participate in a responsible and effective way in anticipating and solving environmental problems, and in the management of the quality of the environment.» (UNESCO, UNEP, 1977).

1. Three important books in Italy

Between 1970 and 1980 in Italy, together with Rodari's production, three books introducing modern environmental concepts in children and young adults' literature are published. If reread from a contemporary ecocritical point of view, they appear to be the first ones to be dealing with thought through ecological connections by offering it as a character of the plot and a construction of the writing: *The Island* (NoT, Original title in Italian: *L'isola* 1974) by Giulia Niccolai and Luciano Marco Boschini, *Blue Sky Chlorophyll* (NoT, Original title in Italian: *Clorofilla dal cielo blu*, 1975) by Bianca Pitzorno and *A Hare having the Face of a Young Girl* (NoT, Original title in Italian: *Una lepre con la faccia di bambina*, 1978) by Laura Conti.

The Island is for younger children and it talks about the resources of a territory being exploited and the subsequent exclusion of its inhabitants from this process. It is maybe the first time that this topic is being dealt in a simple and direct way in the literature for children and young adults.

The story talks about a Happy Island discovered by the powerful Society PQRSTT which is ruled by 7 Authorities. 'As soon as they landed on the island thanks to their competences, the 7 Authorities soon became aware of the happiness and healthiness of that place, as well as of its resources. And, in order to better exploit the latter, they decided that the former should be eliminated'. So they build factories, plants and megalopolises which are identical to those of the countries they come from, they sell Catarine's monkeys –which had been living there for a long time– to zoos and those that succeed in escaping are able to survive by remaining hidden within the

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island together with children who, on their turn, have been moved away because they can no longer play in the occupied lands. By clearly alluding to the seven oil companies which, in the 70s, had a monopoly over the market of oil world exploitation, the story highlights the close connection between assault on environmental resources and impoverishment of territory through the exportation of their own economic models. The illustrations by Boschini are the ones to provide the right view for a significant and poetic interpretation of the whole book. Every picture of the Happy Island's surface is indeed drawn according to the curvature profile of the earth's horizon, thus suggesting that the story refers not only to that remote island but that it has something to do with what is actually happening in every part of the world. The horizon's representation provided by Boschini shows us that weak people are the first victims of any Exploitation Organization, as a matter of fact the horizon «...is the first line to trace so that the earth can be conceived, that is invented [...] it allows the local order and the cosmic order to overlap exactly because it sets up a hinge not between two different and separate parts of the world, between finite and infinite, but between two conceptions: the world which is made up of processes and relations and the world which is made up of things» (Farinelli 2007).

While keeping the pedagogic interpretations and the literary interpretations of books for children and young adults as separate as possible, it is clear that the new scientific and environmental knowledge represents innovative contaminators. From 1970 onwards, the notion of environment itself goes beyond the aesthetic approach in order to gain the statute of being «a huge, enormously complex living machine that forms a thin dynamic layer on the earth's surface. [...] Each living species is also linked to many others. These links are bewildering in their variety and marvellous in their intricate detail» (Commoner, 1971). In the same way as in the Environmental Education the change in habits and points of view becomes a new territory for pedagogic research, so in the literature for children there is the emergence of stories interpreting them.

Blue Sky Chlorophyll is probably the first book embracing the new environmental vision in its plot, since it talks about a vegetal extraterrestrial baby girl fallen down to earth in Milan, one of the most polluted cities in Italy, who is at risk of dying because of urban smog. The characters of the story are the scientist Erasmus and his two nephews who, with the help of a doorwoman, will save the baby girl from the one who wants to vivisect her for studying her and, then, from death caused by pollution. What makes this book one of the classics of environmental literature for children and young adults is not only the theme of air pollution, the evident basis of the plot, but indeed the narrative solution given by the author to Chlorophyll's problem. As a matter of fact, the progressive poisoning of the vegetal baby girl is not treated through a specialised-medical approach, aimed at

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curing exclusively her disease, but indeed through an environmental intervention on the whole city: Milan will be covered with very strange and unknown invaders (green plants able to produce a plentiful quantity of oxygen) which will improve the life of all of its inhabitants and, at the same time, will save the young alien. In this way Bianca Pitzorno puts forward science as being a positive factor within the individual life but only if it derives from a social science which is substantially different from the 'official' one, a science which is aware of the limits beyond which there is no return, by adopting one of the quality points of scientific environmentalism in the literary construction: the goal of consistency among knowledge, values and behaviours.

As a matter of fact, it is precisely the notion of *limit* which in those years comes to appear within the new environmental and scientific culture, also thanks to the publishing of *The Limits of Development* (NoT, Original title in Italian: *I Limiti dello sviluppo*; Peccei 1972) and of the report by the System Dynamics Group Massachusetts Institute of Technology (MIT) which, for the first time, shows that the notion of unlimited development is taking the planet on the brink of collapse.

In Italy a practical demonstration of this notion occurs in a dramatic way in Seveso in 1976, when a breakdown in the production reactor of Icmesa (a chemical and pharmaceutical factory belonging to Hoffman – La Roche multinational) releases a high amount of dioxin in the air, a chemicals substance which causes general damage to living organisms up to genetic alterations lasting for generations. The tragedy of Seveso, for the first time in Italy, makes ordinary people feel that the ecological issue actually affects everyday life. It is Laura Conti, the mother of Italian scientific environmentalism, to give substance and expression to this matter through her book “*A Hare having the Face of a Young Girl*” (NoT, Original title in Italian: “*Una lepre con la faccia di bambina*”). It is the story of two twelve-year-old children, Marco and Sara, – he is from a well-off family and she is a girl from the poor South of Italy, emigrated with her family – who find themselves plunged into the polluted territory, being victims as their community is. Laura Conti lives this drama from the inside: she is a member of Lombardy Regional Council when the event takes place, she is a doctor with a long active membership in the anti-fascist and anti-Nazi resistance, and she is a great popularizer since she has already written books for children and young adults on ecology and sexuality.

This time Conti chooses indeed to narrate more than to go for journalism or popularization. She does it so for some good reasons explained in the foreword to the book that, if reread today, bring to mind in quite a predictive way the contents which, almost ten years later, would become some of the framing pillars of the *Brundtland Report* on behalf of the United States. In this report, the term *sustainable development*, also as a linguistic christening, occurs for the first time: «Humanity has

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the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs». (WCED,1987). Narration, Laura Conti says, makes it possible to go beyond chronicling and the coldness of scientific information, allowing her to analyse from the inside the social damage which is always related to environmental damage, as also Svetlana Aleksievič will state, many years after, in her book on Chernobyl, by writing that «narration makes it possible to reconstruct feelings more than events». Laura Conti talks indeed about social breakdown seen through the feelings of two kids touched by this event exactly during their growth, the weakest ones among weak ones. A dimension causing life projects to go lost, whole families to be disorientated when facing the impossibility of reorganizing their own everyday life upon some kind of certainties because of poor or contradicting public-service information, leaving everyone in doubt and indecision. Marco and Sara are thus obliged to look for information on their own: they eavesdrop on the murmuring of adults in squares and in their houses, they assign their own meaning to what they listen to and to their fears, until they open a window on the pains of life, one's own life and that of people one loves, in order to come to terms with it sometimes in a cynic way – as Sara often does – or in a desperate way as it happens to Marco. Through the description of the social isolation experienced by the population of Seveso, the author identifies *information* as being a quality element within sustainable development for ruling in a healthy and ecological way a territory and a community, by describing an information system which omits information and is subject to the powerful pharmaceutical multinational company and its political connivance. Marco and Sara's families, as all the other families from Seveso and the nearby, are kept in the dark about the real damage caused by dioxin released during the accident and, what's more, they are distracted towards parallel topics in order not to be alarmed but, actually, in order not to be made aware of real facts. By rereading the book adopting a selective approach when giving back a historical approach to some contextual factors, one gets the impression that it talks more about future than that it narrates the present it was inspired by. As a matter of fact, the accident in Bhopal in 1984 and the Chernobyl's explosion in 1986 will present once again most of the problematic environmental and social questions which one can find in the book, and the issue of disinformation will be equally important and interrelated with the ecological damage.

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2. Occurrences in the popularisation for children and young adults

Therefore it is exactly literature – meant as narration or fiction – that in Italy seems to anticipate the scientific and environmental themes characterising popularisation genres today, themes which only recently have been finding their own matrices for a critical reading which is consistent with contemporary issues and questions. As a matter of fact, the popularisation of science and environment, given the delicate educational issues it puts at stake and the involvement of everyday behaviours, must be considered within a wide system of continuing education and not as a separate element, isolated from the context. The capacity to build bridges between science and imaginary worlds is one among the most important indicators of a good popularisation: from the reader's point of view, the tale about Chlorophyll, as well as that about the second principle of thermodynamics, are both great narrations within which the meaning context makes it possible to move freely between fiction and non-fiction, between narrative literature and scientific literature on the basis of the bridges they are able to build, rather than the rigidity of genres. Ultimately, it is a matter of taking into consideration the sets of meaning related to reading, of providing science with space for narration and popularisation in an integrated way generated by readings and books able to contaminate each other. This is the reason why in environmental literature narration and science, poetic metaphor and strictness of contents, all look for connecting rather than separating factors. Within a sort of new statute for 'sustainability', the more relevant genres and matters are, the more crossovers they open rather than defending self-referential keeps, starting from the sham contrast between humanistic culture and scientific culture, already reported by Percy Snow at the beginning of the Sixties.

A cultural contamination to which, in Italy, Serenella Iovino makes a crucial critical contribution in 2006 through the publishing of the only book in Italian, to this day, on ecocriticism. Ecological literature "*meets the need for interdisciplinarity which an interpretation of the cultural images of nature requires*" and "*The main objective of this kind of writing is that of inspiring the reader to (an ecological or proto-ecological) consciousness of the interdependence among life forms*". In addition ecocritical analyses "*are interested in how literature and writing, in general, become the expression of the socio-ecological conflicts, of the issues related to the difference (in gender, species, ethnic groups, abilities and so on..) in the environmental discriminations (racism, environmental class system*" (Iovino, 2006). This critical statute of literature, regarded by ecocriticism as being "...the study of the relationship between literature and the physical environment" (Glotfelty, 1996) builds a bridge between science and its communication through

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environmental and natural values and their shared cultural meanings, and today it represents the most advanced orientation among the reference statutes oriented towards the principles of the Environmental Education established in Tbilisi.

As a matter of fact, the impact with the imaginative worlds, the *imprinting* that often information and models have on deep knowledge and on mind maps, become representations of knowledge, summaries of ideas, significant metaphors which have often gained the common sense by causing the successful dissemination of scientific theories and marking significant cultural turning points: any description which is not a poetic one could ever be a complete one (Barrow 2009). In the history of scientific communication new ideas have been represented through images which have subsequently become symbolic, these images have characterised the revolutionary passage – not only scientific *stricto sensu* – but the change itself in the collocation within time and history of man and in the vision of oneself. Imagine, for example, the shift in the representation of the earth from a geocentric to a heliocentric model of the universe. But, on their turn, the same symbols have then represented strong limits and resistance in themselves – by turning into prejudices – the moment when science was finding out new interpretations to new changes because, in the meantime, they had been filled in with values and common senses which are difficult to be overcome, as it has happened for atom's representation by Rutherford. Described through a planetary model, where planets turn around the sun, its dissemination as a visual metaphor has become so deeply rooted to oppose its own overcome, so that «an effective hyperbola to display the behaviour of the nucleus and of electrons inside the atom has turned into an obstacle to comprehension, once it has proved to be an out-of-date interpretation of reality» (Goutier, Ioli, 2006). However, the coexistence of a strictness degree and of a poetic degree within popularisation literature becomes an important indicator for the education to sustainability, science is filled with language, plunged into the linguistic expressions of concepts and new paradigms, and it consequently performs a narrative function which, in a set of continual references, draws on and creates new semantic materials (De Santillana, 1966).

René Thom writes that explaining means replacing complicated visible evidence with simple invisible evidence and that the term 'explain' carries all its etymological strength as well as that of a constituting signifier, that is to unfold, to open, to make what lies inside the folds visible, to bring outside the paths hidden by the folds, by showing what is invisible. If this is the conceptual operation carried out by popularising actions, the same operation underlies the overcome of stereotypes which we often tend to adopt in order to 'explain' to those who do not know, without even thinking that children know, indeed they know, and they learn fast.

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Conclusions

Today science and environmental values go hand in hand, following the fading – in the period after the Second World War – of a certain ‘aesthetic’ environmentalism often conceiving science as an enemy to fight since it generates progress and pollution. Of course, also science needs to make non-neutral choices on the basis of shared values, and the debate about its neutrality is started in Italy in 1976 with the publishing of the book *The Bee and the Architect* (NoT, Original title in Italian: *L’ape e l’architetto*), whose title refers to an imaginary pair by Rodari, and which places itself in a new cultural environment at an international level. As a matter of fact: «Literary critics and cultural theorists in particular have been notoriously slow to register those changes in thinking about the relationship of culture and society to the natural world which began to be articulated in neighbouring disciplines, above all philosophy, but also theology, politics and history, from the early 1970s» (Rigby 2002, p. 152). This new need to choose shown by science, and certainly its ethical and environmental profile, must be taken into account and stated by a popularisation book. This is the reason why “the completeness and updating of information are essential requirements. An old book, which does not take into account the most recent discoveries or theories, is a useless book” (De Marchi 2000, p. 27). This indicator carries with it the need for a simplification of language, a simplification which is still often confused with making it stupid. It has already been underlined how the poetic gradient represents one of the elements which is specific to the scientific communicative language, to its capacity to evoke original images and to cause crowding out leading to reflection and curiosity. If this is accompanied by daily experience, going through the idea that ‘theory’ is actually very practical, whilst being considered as ‘abstract’ in the commonplaces, the result will be for example a book like *Science on the Swing* (NoT, Original title in Italian: *La scienza in altalena*, 1999) which in Italy has been one of the important innovation guiding in order to popularise scientific principles through testable games. The element of testability should not be confused, of course, with the classic *experiment* carried out in the classroom, such as bean germination, which in some periods of the year involves placing small vases with wet cotton and relating seeds under the windows. Testability should instead invite to and spur into action within nature or into observation within nature, in environment, for two new characteristics that, among other things, the environmental scientific culture has introduced within communication and education.

The first one is that of fostering a multi-disciplinary approach, by facilitating connections and links with other subject matters, so to provide a track which makes it possible to understand

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that complex systems need to conceive subject matters not as obstacles but rather as bridges. For this reason, popularisation must also put forward autonomous tools, on the side of the young reader, in order to obtain further information beside that provided in the specific book one is reading, a sort of acceptable challenge accompanying him/her towards building new questions, rather than acquiescing in correct answers. And at the same time popularisation must deal with the topic through problems rather than themes. This is how Mika, the young inhabitant of the stars, explains to his terrestrial friend: « 'When you bow, you give way' – Mika went on – you must never give way to an answer.' 'Why not?' 'An answer is always the stretch of the road that's behind you. Only a question can point the way forward'».(Gaarder 1997, p. 74) Suggesting paths to learn how to make questions is, therefore, one of the quality factors of books for children and young adults on science and environment. This allows oneself to get in the game, to adopt an approach to analyse the real world but wondering about the reasons, by developing the critical thought required to change one's own habits when facing a problem.

The second characteristic is that of keeping the facts well separated from the opinions of the popularizer or from those opinions one deems it necessary to account for in the book. This characteristic is one of the most important indicators – this being particularly true for any kind of information – and it is held particularly dear by the National Science Teachers Association which periodically draws up precise evaluation criteria for popularisation books in co-operation with the Children's Book Council. «Science is passion, science is wonder. The best books about science stir the minds and hearts of readers in very special ways; and when they do, the impressions they make can last for years», as you can read in the introduction to the list of the best 38 books of 2010. Books whose reading record remains for many years and, as such, books which talk about the future, at the level of contents and values, as Vichi De Marchi still reminds us.

« The racist and sexist elements, the stereotyped representations, are harshly criticised. Also the anthropomorphising of plants and animals, so widespread in the most part of literature, is not regarded as being a valuable element: avoiding the humanisation of animal and plant life is a sign of respect and of a deeper understanding of natural balances and of the characteristics of the different species» (De Marchi 2000, p. 28).

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