

Science in Wonderland

(1) Alice's Adventures in the Space of Interpretation

Lewis Carroll's Alice, who first explores Wonderland (1865) and later on the country behind the Looking-Glass (1872), belongs to the most well-known characters in world literature. Even those, who never read Carroll's novels and who do not know the Victorian author's name, are familiar with Alice and with the strange characters that she meets in the course of her adventures – as for instance Humpty Dumpty, the White Rabbit, the smoking Caterpillar and the Cheshire Cat. So frequent are the quotations from, and the representations and transformations of, Alice and her companions in everyday culture that in the course of time it has become probable to meet her first in a medium secondary in relation to Carroll's novels; Alice especially gained a broad popularity through Walt Disney's cartoon and picture books for children. Roughly we can distinguish between those transformations of Alice, which totally or partly re-tell the plots of the novels and those that are simple allusions to her and her adventures; there is, however, no clear borderline between both forms of inter-textual reception. Multimedia versions of Alice's adventures emerged within a broad spectrum of representational forms. Innumerable often her adventures became the object of allusions, were re-told, modified, transferred into contemporary contexts, especially in post-modern literature; they have been adapted by different visual and performing media – as for instance by the authors of dramatic plays, movies, video clips, drawings and other forms of graphical representation, by the producers of video games, comics, pop up books and so on.

We can also find Alice's traces in many philosophical and scientific texts. Wittgenstein, in his *Philosophical Investigations*, explicitly refers to Carroll.¹ The interrelations between Carroll's imagination and Wittgenstein's philosophy of language are, however, not restricted to such explicit references, and Carroll interpreters have repeatedly investigated the affinities between both the Austrian philosopher and the English mathematician and story-teller (Heath 1974). As Carroll bibliographies or even a superficial visit to any book shop reveals, readers and interpreters of Alice's adventures have analyzed various interrelations between the worlds of Carrollian imagination and those of modern sciences and

¹ No. 13 of Wittgenstein's *Philosophische Untersuchungen*: "Wenn wir sagen: 'jedes Wort der Sprache bezeichnet etwas' (,) so ist damit vorerst noch gar nichts gesagt; es sei denn, daß wir genau erklärten, welche Unterscheidung wir zu machen wünschen. (Es könnte ja sein, daß wir die Wörter der Sprache [...] von Wörtern 'ohne Bedeutung' unterscheiden wollten, wie sie in Gedichten Lewis Carroll's vorkommen, oder von Worten wie 'juwiwallera' in einem Lied.)" Wittgenstein 1971, 22.

philosophy. Above all Martin Gardner and Peter Heath, the authors of two annotated "Alice" editions, have pointed out those interrelations quite meticulously (Gardner 1960, Gardner 1990, and Gardner 1999). Heath mainly concentrates on the parallels between Alice's adventures and philosophical discourses, Gardner, however, besides many other information refers to quite different scientific discourses that are linked to Carroll's stories in various ways. Thus he reports on explicit references to Carroll given by the representatives of modern natural science as well as on further analogies between their topics and Carroll's imagination. Alice, for instance, before entering Looking-Glass World, starts reflecting about the possibility of Looking-Glass milk. In his commentary Gardner draws a parallel to the chemistry of the stereo-isomers, i.e. to molecules whose atoms are arranged in mirror-reversed order.² Additionally, he compares the idea of looking-glass milk to the concept of anti-matter, figuring out what would happen, if a human such as Alice would consume particles of such a substance.³ And according to Gardner, the episode in the sheep's shop ("Wool and Water"), where Alice does not succeed in fixating the objects of her observation because they are in constant motion lacking distinct shapes, can be interpreted as a simile of modern atomic physics.

Alice's difficulty in looking straight at the objects on sale in the shop has been compared by popularizers of quantum theory to the impossible task of pinning down the precise location of an electron in its path around the nucleus of an atom. One thinks also of those minute specks that sometimes appear slightly off the center of one's field of vision, and that can never be seen directly because they move as the eye moves. (Gardner 1999, 201)

² "Alice's speculation about looking-glass milk has a significance greater than Carroll suspected. It was not until several years after the publication of 'Through the Looking-Glass' that stereochemistry found positive evidence that organic substances had an asymmetric arrangement of atoms. Isomers are substances that have molecules composed of exactly the same atoms, but with these atoms linked together in structures that are topographically quite different. Stereoisomers are isomers that are identical even in topological structure, but, owing to the asymmetric nature of this structure, they come in mirror-image pairs. Most substances that occur in living organisms are stereoisometric. [...] Because the intake of food involves complicated chemical reactions between asymmetric food and asymmetric substances in the body, there often are marked differences in the taste, smell, and digestibility of left- and right-handed forms of the same organic substance. No laboratory or cow has yet produced reversed milk, but if the asymmetric structure of ordinary milk were to be reflected, it is a safe bet that this looking-glass milk would not be good to drink." (Gardner 1999, 144) Gardner's comment is quoted so extensively because he illustrates the fact that the annotated edition of a work of literary fiction may be used as a manual for readers interested in chemistry and other natural sciences. See also the following footnote.

³ "In 1957 two Chinese American physicists [...] received the Nobel Prize for theoretical work that led to the 'gay and wonderful discovery' [...] that some elementary particles are asymmetric. It now appears likely that particles and their antiparticles (that is, identical with opposite charges) are, like stereoisomers, nothing more than mirror-image forms of the same structure. If this is true, then looking-glass milk would be composed of 'anti-matter', which would not even be drinkable by Alice; both milk and Alice would explode as soon as they came in contact. Of course an anti-Alice [...] would find anti-milk as tasty and nourishing as usual." (Gardner 1999, 145).

Gardner's annotations on Alice continue a remarkable tradition of comparing and connecting what Carroll imagined with modern science. Bertrand Russell, who highly esteemed Carroll, in chapter 3 of his book concerning *The ABC of Relativity* quoted a passage from *Through the Looking-Glass*; he applied several lines from the song of the White Knight to the so-called Lorentz-Fitzgerald contraction hypothesis that deals with the measurability of the speed of light.⁴ In his treatise on *The Nature of the Physical World*, chapter 2, the astronomer and physicist Arthur Stanley Eddington quoted the same four lines - pointing out that nature does not reveal its internal structure to human observation. As Gardner additionally reports, cosmologists referred to the changes of Alice's body size in order to illustrate theories of a constantly expanding universe.⁵ The contraction processes of Alice's body were analogously connected with the idea of a permanent contraction of the universe, as it was humorously developed by the mathematician Sir Edmund Whittaker.

When Alice falls through the rabbit-hole the annotator Peter Heath mentions the insight of modern physics that it is impossible to measure velocity and distance in a state of motion.⁶ The episode with a glass of orange marmalade that Alice takes from a shelf and later puts back on to another shelf while her fall continues makes it difficult to describe her movement in conventional terms. As Martin Gardner annotates, Carroll was of course aware of the fact that in an ordinary free fall Alice would neither have been able to let the glass fall down (as it would have moved in a course parallel to herself) nor would it have been possible to place it on a shelf (as Alice would have been moving too fast) (Gardner 1960, 27). (In a similar episode of *Sylvie and Bruno* [Part I, Chapter 8] the characters discuss the difficulties of drinking tea in a house that is falling down.) Such thought experiments anticipate ideas of the theory of relativity, especially "[...] the famous 'thought experiment' in which Einstein used an imaginary falling elevator to explain certain aspects of the theory of relativity [...]" (Gardner 1960, 27). Eddington and other writers on the theory of relativity have compared the Mad Hatter's tea party where it is always six o'clock, to De Sitter's model of cosmos that is dedicated to the idea of time standing still; Gardner, in his comments on this idea, refers particularly to Eddington's work *Space Time and Gravitation* (Gardner 1999, 75). Among all Carrollian characters the Jabberwocky was the

⁴ "According to this hypothesis, objects shrink in the direction of their motion, but since all measuring rods are similarly shortened, they serve, like the White Knight's fan, to prevent us from detecting any change in the length of objects." (Gardner 1999, 247).

⁵ "Alice's periodic expansions have provided cosmologists with a source of illustrations for the theory of an expanding universe." (Heath 1974, 25) Similar Gardner who continues: "Her narrow escape in this passage calls to mind a diminishing-universe theory once advanced in Carrollian jest by the eminent mathematician Sir Edmund Whittaker [1951]. Perhaps the total amount of matter in the universe is continually growing smaller, and eventually the entire universe will fade away into nothing at all." (Gardner 1999, 39).

⁶ "Alice, in free fall, discovers the fact pointed out by Hume and by now familiar to astronauts and aircraft passengers, namely that motion, by itself, gives no impression of distance covered, or therefore of velocity." (Heath 1974, 14).

physicist's special favourite, as Gardner points out (Gardner 1999, 150). In his writings Eddington mentions the famous monster more than just once, for instance in "New Pathways in Science" where he compares the syntactical structure of the "Jabberwocky" poem to mathematical group theory.

In his paper on *The Nature of the Physical World* Eddington states that conventional descriptions of elementary particles follow a kind of 'Jabberwocky principle': Words are applied to "something unknown", and we do not know what this unknown object actually does. However, "[...] because the description contains numbers, science is able to impose a certain amount of order on the phenomena and to make successful predictions about them [...]" (Gardner 1999, 151) Referring to the Jabberwocky poem Eddington points out the fact that an object that is originally unknown to the physicist successively gains a shape in the course of description. Eddington characterizes scientific observation and description as follows:

we begin to realize the difference between oxygen and nitrogen. Eight slithy toves gyre and gimble in the oxygen wabe; seven in nitrogen. By admitting a few numbers even 'Jabberwocky' may become scientific. We can now venture on a prediction; if one of its toves escapes, oxygen will be masquerading in a garb properly belonging to nitrogen. In the stars and nebulae we do find such wolves in sheep's clothing which might otherwise have startled us. It would not be a bad reminder of the essential unknownness of the fundamental entities of physics to translate it into 'Jabberwocky'; provided all numbers – all metrical attributes – are unchanged, it does not suffer in the least. (Eddington, as cited in Gardner 1999, 151)

Obviously, Eddington was particularly interested in the abstract scientific implications of Carroll's ideas. Thus he also commented on a famous remark of the red queen who tells Alice that she has already listened to nonsense, compared with which the suggestion that a hill could be a valley sounds as sensible as a dictionary.⁷ Eddington quotes this statement in the last chapter of *The Nature of the Physical World* in order to discuss the "physicist's problem of nonsense". From physics' point of view, as he states, it may be nonsensical to suggest the existence of a reality beyond the laws of physics, but compared to the suggestion, that there was *no* such reality, the 'realistic' option is as sensible as a dictionary (Gardner 1999, 162).

Martin Gardner as well has observed the specific rules of scientific discourse by comparing them to Carrollian inventions – as for instance the meaning Carroll produces by using the phrase "Grin like a Cheshire Cat". The Cheshire Cat, dis-

⁷ "When you say 'hill'", the Queen interrupted, 'I could show you hills, in comparison with which you'd call that a valley.' / 'No, I shouldn't', said Alice, surprised into contradicting her at last: 'a hill CAN'T be a valley, you know. That would be nonsense' / The Red Queen shook her head. 'You may call it "nonsense" if you like', she said, 'but I'VE heard nonsense, compared with which that would be as sensible as a dictionary!' (Gardner 1999, 162).

appearing successively only leaving her grin behind, is according to Gardner a quite suitable symbol of abstract mathematics. The phrase "A grin without a cat" is, as he says,

not a bad description of pure mathematics. Although mathematical theorems often can be usefully applied to the structure of the external world, the theorems themselves are abstractions that belong to another realm 'remote from human passions,' as Bertrand Russell once put it in a memorable passage, 'remote even from the pitiful facts of Nature . . . an ordered cosmos, where pure thought can dwell as in its natural home, and where one, at least, of our nobler impulses can escape from the dreary exile of the actual world [...]' (Gardner 1990, 91)

Douglas Hofstadter, Gardner's successor as columnist for *Scientific American*, quotes Carroll repeatedly – not only the Alice books –, and derives important suggestions from his Victorian idol for his own essays that aim at a broader audience (Hofstadter 1997). Hofstadter is particularly interested in the circular relationship of causality between the world that Alice experiences and the world that is created in the dream of the White King. In a famous episode from the Looking-Glass book, the Tweedle brothers state, that the whole world, Alice and themselves included, actually exist only in the dream of the sleeping king. By the end of the book, however, the White King, like all looking-glass creatures, seems to have emerged from Alice's dreams.⁸ Hofstadter interprets this episode by relating it to the pattern of infinite recursion, which he also examines in mathematics and in the arts. His book *Gödel, Escher, Bach* includes the reprint of a Carrollian text, the so-called Carrollian paradox.⁹ Enthusiastic interpreters have stressed the artistic character of Hofstadter's book that results mainly from his imaginative-ness in combining forms and contents. With regard to his cross-writing strategy between scientific discourse on the one hand, and literary dialogues and narration on the other, Hofstadter was most probably inspired by Carroll.

P. E. B. Jourdain has made use of Carroll's texts in order to plead for modern logics (*The Philosophy of Mr B*rr*nd R*ussell. With an Appendix of leading Passages From Certain Other Works*). The "leading other works" quoted by Jourdain are exclusively taken from Carroll's writings. Several Critics have commented on the fact that his texts confront their readers continuously with philosophical problems, especially focusing on logics and on the problems of experience and knowledge.¹⁰ Calvin R. Peterson has referred to the Theory of Relativity in order

⁸ "He's dreaming now," said Tweedledee: 'and what do you think he's dreaming about?' Alice said 'Nobody can guess that.' / 'Why, about YOU!' Tweedledee exclaimed, clapping his hands triumphantly. 'And if he left off dreaming about you, where do you suppose you'd be?' / 'Where I am now, of course,' said Alice. / 'Not you!' Tweedledee retorted contemptuously. 'You'd be nowhere. Why, you're only a sort of thing in his dream!' / 'If that there King was to wake, added Tweedledum, 'you'd go out—bang!—just like a candle!' (Gardner 1999, 189).

⁹ In *Gödel, Escher, Bach* Hofstadter mainly discusses the topics of consciousness and of artificial intelligence. One of his leading questions is – in accordance with several Alice episodes – what "self" actually means.

to comment on Carroll's inventions. Einstein, according to Petersen, conceived his new theory only five weeks after the crucial insight that time is always 'responsible', an insight that had formerly been expressed in Carroll's works (Petersen 1985, 427).

(2) Alice's Adventures in the Worlds of Scientific Imagination

Several times Carroll's Alice takes over the role of a travel guide through the worlds modeled by modern science, especially in popular introductory books for students and non-specialists. In an introduction to chaos theory written by John Briggs and Frederic David Peat she is transposed to the country of fractals in order to familiarize the reader with the ideas and concepts of chaos theorists (Briggs/Peat 1989). Among the mottoes that precede the book, there is a Humpty Dumpty quotation; and Briggs and Peat regard their treatise as a "journey through the mirror-worlds of order and chaos" (Briggs/Peat 1989, 31). Under the title *Looking Glass Universe*, which directly alludes to Carroll's second Alice book, Briggs and Peat introduce their readers to modern physics, especially to quantum mechanics, as well as to new theories of chemistry, biology, and neurophysiology; it mainly focuses on the revolutionary effect of those new theories regarding the way we think about reality (Briggs/Peat 1984). According to the Publisher's blurb, these

'looking glass' theories propose that we are at this very moment living in an Alice-in-Wonderland universe where each part is in fact the whole, where a scientist conducting an experiment is himself the experiment, and even inanimate objects contain consciousness.¹¹

Alice and her adventures present themselves to be conducive to outlining a scientific revolution that mainly is characterized by the insight that the objects of observation cannot be regarded as stable and definitive entities anymore, and that the observer is always connected with the objects of his observation.¹² Popular information about physics that mainly speaks to non-specialists benefits from the potential suggestions offered by the themes in Carroll's works. In order to mention just one example, one might refer to a website entitled *Through The Cosmic*

¹⁰ Philips 1971, especially Holmes' *The Philosopher's Alice in Wonderland* in Philips 1971, 199–216.

¹¹ Publisher's information to be found at "http://www.learn-tovisualize.com/Recommended%20Reading/Looking%20Glass%20Universe%20page.htm" Screenshot: August 2005, last checked July 2007.

¹² "Quantum mechanics [...] brought troubling paradoxes. Physicists learned, for example, that an elementary unit of light can behave schizophrenically like a wave or a particle, depending on what the experimenter chooses to measure. [...] As we described in 'Looking Glass Universe', these paradoxes and others eventually had the effect of driving a number of scientists like David Bohm to theorize that the universe must be fundamentally indivisible, a 'flowing wholeness,' as Bohm calls it, in which the observer cannot be essentially separated from the observed." (Briggs/Peat 1989, 28pp.).

*Looking-Glass*¹³, where the cosmological concepts of "black holes" and "white holes" are explained by drawing a parallel to the beginnings of *Alice in Wonderland* and *Through the Looking Glass*".

England, 1871. – Lewis Carroll's Alice goes through the looking glass and physicists all over the world are ready to follow. Lewis Carroll dreamt of a little girl who goes through a mirror and enters a world inhabited by chessboard characters. Fifty years later physicists also imagined a universe filled with intriguing characters: white dwarfs, red giants, black holes." (<http://fusionanomaly.net/throughthecosmiclookingglass.html> - August, 2005)¹⁴

In 1999, William B. Shanley, a science journalist, and several co-authors published a book entitled *Lewis Carroll's Lost Quantum Diaries*.¹⁵ Directed by Shanley, representatives of theoretical and empirical physics, biophysics, philosophy, mathematical cosmology, and science theory contributed to this project in order to give an outline of recent scientific theories about reality, especially about the world explored and modeled by physics. In the 26 chapters of *Lewis Carroll's Lost Quantum Diaries* Alice travels through differently shaped worlds, being acquainted with their inhabitants who usually remind of the characters in Carroll's books, corresponding to their respective provenience and way of behaving, those creatures provide instructions on how the world is modeled by Werner Heisenberg, Niels Bohr, and Erwin Schrödinger, hence quantum physics and quantum logics. They also provide information about the quantum world according to the theories of John von Neumann, about physical neo-realism and the theory of relativity in general, about chaos theory, biology, natural philosophy, ecological thinking, and feminism - and about the reception of George Berkeley's idealistic philosophy (*esse est percipi*) by physicists of more modern theories. Awkward questions that are left open by modern science are repeatedly taken into regard as well.

As Shanley's book can be understood to be a representative example for the interest modern science and especially its didactics take in Carroll, the narration's contents will be sketched briefly: Following Alice, the reader has to adapt to the notion that the world of modern physics is a mobile universe. A Professor Flow

¹³ <http://fusionanomaly.net/throughthecosmiclookingglass.html> – screenshot August 2005, rechecked July 2007.

¹⁴ These remarks continue as follows: "space science is but a game of chess against natural preconceptions – such as a flat Earth. Nevertheless, according to the creative English writer, 'anyone who will take the trouble to set the pieces and play the moves as directed,' will find the solution 'to be strictly in accordance with the laws of the game.'" Alice's way down the rabbit-hole and through the mirror is explained in terms of modern physics: "She must have gone through a wormhole. That is, there must have been a miniature Black Hole on the surface of the looking glass that sucked her in and then a White hole in the other side that spewed her out."

¹⁵ Up to now the English version has not been published. Therefore all references are to the German version entitled *Alice zwischen den Welten*. The titles of the chapters were kindly handed to the Author by William Shanley.

explains which ideas are connected with the concept of a "quantum universe": He calls the quantum universe a magic and paradoxical world behind the atoms, where parallel facts coincide and things change their places without moving through space. Time and space, energy and matter, can only be measured by very specific means. Sometimes things disappear gradually and become invisible for the spectator (Shanley 1999, 30). Essential to all experienced reality is the observation process as such. Everything depends on observation in quantum world, and observation changes the universe. Before observation, there is no such thing as reality; there is no universe, but only a resplendent distribution of vibrating possibilities. As soon as they are looked at, everything coagulates to a static distribution of particles; it is, however immediately turned into a bare possibility, when observation stops (Shanley 1999, 47). Moreover, in the quantum world a thing can be simultaneously at more than one place. Only if we observe it, a particle becomes real. At the same time, our observation affects the particle's twin brothers at all the other places, no matter, how distant they are from each other (Shanley 1999, 31). The different models of the universe with which Alice becomes acquainted, are functionally equivalent to each other. They withstand verification as well as falsification from an external point of view, and they can, above all, not be judged according to some "yardstick of truth" that derives from the concept of 'appropriateness' to the very nature of things. When Alice experiences a roller coaster ride together with a character representing the world of chaos theory, called the strange attractor, he explains to her that the relationship between chaos theory and quantum theory cannot be summarized. Models and realities must be strictly distinguished from each other; and science is only concerned with models. A mystical cartographer, who sells metaphysical maps, models, metaphors and meanings for all age groups (Shanley 1999, 231), also stresses the parallelism and equivalency of different scientific constructions of the world. Sciences and philosophy – as the cartographer puts it – supply mankind with maps of the world that are necessary for decisions and actions and that give a direction towards human life. But these maps should not be taken for the represented territory itself (Shanley 1999, 231).

One of the most important orientation crises Alice suffers in Carroll's narration concerns her own identity. Repeatedly, she is irritated by the question who she is, especially when her memory fails to connect her present state with the past or when her words reveal themselves to be disobedient to her. Before all, in her dialogue with the caterpillar Alice's identity is questioned – corresponding to the idea of metamorphosis and temporality that is symbolized by the caterpillar.¹⁶ Just like Carroll's Alice, her double in 1999 gets confronted with the problems of personal identity. Transferred into a multiple world, she becomes aware of the fact that there are also multiple Alices. The universe appears to her as a mirror cabinet, in which everything and everyone may emerge infinitely often, although repeatedly in a slightly different way. Professor Flow introduces himself as a distinguished specialist for Metaphysics and portrays himself – thus humans in general – as most mobile and metamorphic entity. As he puts it, he is just one trillion

time one trillion molecules, a living wired network of ten billion neurons, which tell billion body cells what to do – and he participates in multi-cultural and multi-media-live-experiences. One of them is the strange conviction that he is himself – just as Alice's believes in her own identity (Shanley 1999, 32). Everything in the universe must move according to Professor Flow's descriptions otherwise it would cease to exist (Shanley 1999, 33). In addition, Flow presents a peculiar something called the "WIFF!" to Alice: It is the invisible, expanding, pulsating spirit of transition, appearing briefly before the wave of possibilities collapses in order to become a particle of matter (Shanley 1999, 34). Like a lightning, the WIFF! detours Flow and Alice, but it can not be captured in an image. Singing and dancing it introduces itself as the mathematical function that transforms possibility into reality (Shanley 1999, 35).

After the visit Alice has paid to Professor Flow who particularly makes her familiar with the theories of Werner Heisenberg about the atom as a concept of the mind, chapter 3 is dedicated to the research projects of Professor Who about reality and its profound dimensions. Who's physical appearance and his environment are obviously inspired by Carroll's caterpillar scene, i.e. the episode in which Alice is repeatedly asked, "who" she is. Who's laboratory contains innumerable flexible tubes reminding, as the narrator says, of caterpillars and water pipes (Shanley 1999, 42). The professor, addressing Alice again and again with different names, explains to her the fundamental ideas that form the physical theories of Schrödinger as well as of Heisenberg, and he comments on their convergences. He compares the worlds of those two modern physicists with Newton's, in which every event is foreseeable and can be properly represented. In Newton's world, observation is nothing special, as Alice learns by watching a cartoon (Shanley 1999, 45). In the quantum world, however, every observation is an interference with the observed sphere itself, and it depends on the mode of observation whether a quantum object behaves like a particle or like a wave (Shanley 1999, 46). Chapter 4, "the oyster quadrille" (quoting the title of Carroll's chapter "The Lobster Quadrille"), begins with an experience causing dizziness: Alice tumbles through a snowstorm of dancing oysters (Shanley 1999, 50) and lands in a bathing resort where *she runs into* two old men playing cards, Dr. Yes and Dr. No. They present themselves as students of John von Neumann (Yes) and Niels Bohr (No). They reveal more information about the conception of the world according to modern physics to Alice. The question of human identity, discussed in chapter 5, stimulates profound irritation, as Alice meets a series of doubles, which can be regarded to as the visual manifestations of alternative possibilities of

¹⁶ "Who are YOU?" said the Caterpillar. / This was not an encouraging opening for a conversation. Alice replied, rather shyly, 'I – I hardly know, sir, just at present – at least I know who I WAS when I got up this morning, but I think I must have been changed several times since then.' / 'What do you mean by that?' said the Caterpillar sternly. 'Explain yourself!' / 'I can't explain MYSELF, I'm afraid, sir' said Alice, 'because I'm not myself, you see.' / 'I don't see,' said the Caterpillar. / 'I'm afraid I can't put it more clearly,' Alice replied very politely, 'for I can't understand it myself to begin with; and being so many different sizes in a day is very confusing.'" (Gardner 1999, 47pp.).

her own self. The meeting takes place in a multiplied world of parallel possibilities. Then, Alice makes the acquaintance of an unconventional cat, which is heavily made up and provokes the question whether it is male or female. This quantum cat, counterpart of Carroll's Cheshire Cat, is called Schrödinger; according to Erwin Schrödinger's famous thought experiment, in which the cat is dead and alive at the same time. In chapter 6, Alice learns how her profound self produces the phenomenal world starting from billions of quantum possibilities (Shanley 1999, 69). Again, the chapter commences with a stroke of dizziness, which has the consequence that Alice is not able to recognize anything. An Indian Guru named Goswami teaches her that the universe is created by consciousness – and compares the old world of "Newtonville" with the quantum world (Shanley 1999, 70). In modified form the characters repeat a famous dispute of Carroll's Looking-Glass book: it is concerned with the question whether Alice is dreaming the red king or the king is dreaming Alice. In addition, Goswami's ideas about the Quantum world consisting of possibilities are reminiscent of Buddhist theories and of the idea that all appearing things are only illusions. Chapter 7 leads Alice into "Bohmland", where a taxi driver supplies the proof for David Bohm's world model. The reader witnesses a breath-taking taxi ride. Incessantly the taxi rushes to Queens (New York) on various ways and it arrives over and over again at the Empire State Building. As one might have expected, Alice is completely dizzy (Shanley 1999, 82). The taxi driver does his best to make clear to his client, Alice, that not alone the world, but also the taxi passengers transform continuously. In David Bohm's universe, as he puts it, everything is connected. The whole universe can be regarded as an enormous, intelligent movement, as a kind of dance, as a ballet, or a piece of music. Some people compare it to a hologram, in which each part contains information about the whole; strictly spoken, there are, however, no parts, as the universe must be regarded to as a holistic entity. During her taxi ride, Alice faces a vision, in which art, music, dance and nature are projected as unreal, whirling images into a holographic dream (Shanley 1999, 89). In chapter 8 Alice arrives at the centre of the universe, where a cook called Beatrice shows her the cosmos; here, the re-telling of Carroll's plot is obviously connected with allusions to Dante's *Divina Comedia* (Shanley 1999, 90pp.). Milk cups dance before Alice's eyes like stars, forming another "milky way". In "Chaosland" (chapter 9) Alice gets informed, that chaos is just a subtle form of order (Shanley 1999, 99pp.). She meets a man in a clown's dress who is moving around in turnabouts and who reminds her of the Mad Hatter in Carroll's Wonderland (Shanley 1999, 99). He presents himself as the "strange Attractor" and guides Alice through chaos country, where things emerge from nothing, change their sizes and behave completely unpredictable by undergoing all kinds of conversions. Everything is in a circular motion; the universe itself consists of cycles within other cycles (Shanley 1999, 102). Chapter 10 consists of a free paraphrase of the croquet play episode in Carroll's Wonderland novel. "Queen Rosie" and Alice play with hedgehogs and flamingos just like Carroll's Alice and the Queen in Wonderland did. Rosie admonishes Alice to remain cautiously aware of patriarchic prejudices in science. She incorporates a feminist attitude, according to which an unbalanced inclination toward rationality alien-

ates human beings from nature (Shanley 1999, 108pp.). Chapter 11 ("Alice in Ireland") is about a railway travel through Ireland, and Alice meets George Berkeley, the mathematician William Rowan Hamilton as well as a writer named Miles Na Gopaleen. The latter proves to be a specialist for *mise-en-abyme* constructions; he wrote a book, in which different persons create themselves mutually by writing and dreaming (Shanley 1999, 121). Berkeley makes a comment on his principle "esse est percipi" (Shanley 1999, 122). Lewis Carroll turns up with his civil name Charles Lutwidge Dodgson and continues to exist in the reality of his fictitious characters. Feeling dizzy, Alice tries to explain the episode to herself as a bad dream. Her adventure with the Cheshire cat Fiffred (in chapter 12 "Alice Meets the Cheshire Cat") provides new insights on "the self" (Shanley 1999, 136pp.). The cat is perceivable only in a diffuse way, and it informs Alice about the fact that this "Cheshire effect" is also called 'Heisenbergsche Unschärferelation' (The Uncertainty Relation) in German. Chapter 14 takes place in the country of biology. Alice receives a lesson about genetics. She becomes acquainted with Gaia and experiences her self floating into the world in a relaxing process of dissolution (Shanley 1999, 171pp.). In the bio light community (chapter 15) Alice participates in the "dance of life". In a charming garden she becomes aware of an increased biological radiation and meets a bright green caterpillar, who presents himself as the proto-type of a psychedelic, pleomorphic butterfly and informs Alice about metamorphosis. Again Alice experiences a dissolution of her self. In the following chapters (16 and 17) she goes underground. In the basement of Oxford University she receives new instructions about recent scientific explanations of the world. Here, she visits a reality laboratory and meets several scientists, who mainly are depicted in analogy with Carrollian characters; one of them is a descendant of Dodgson. In this episode, it becomes clear that the crucial problem of modern natural science consists in its modalities of representing experience. In chapter 18, Alice travels, together with a certain Mr. Jordan, to the macro world of the universe as well as to the micro world of the human body. In "Aliceland" (chapter 19), together with Shakespeare, she invents an esoteric card model of human character (Shanley 1999, 245pp.). In this chapter there are various reminiscences to Carroll, for instance to the nobody episode and the playing cards in Wonderland. After that, Alice visits "The Holographic Theatre" (chapter 20), representing the discipline of brain research, where she is informed about several models of the human psyche. She returns to Wonderland (chapter 21), meeting other Wonderland inhabitants. She learns what it is like to be a light particle (chapter 22; "A Quantum's Eye View"). A body-less quantum, manifesting itself only as a voice, stresses the affinities of the book, from which Alice derives and the world constructed by theory of relativity. In chapter 23 Alice is imprisoned in the network of time. A spider demonstrates the time web to her, and Professor Flow again insists on the self being just an illusion (Shanley 1999, 300).

What seems to be most remarkable about all the world models that are presented to Alice is their aesthetic quality. Often they are described as analogous to artistic forms of representation – either to narratives, to visual or to performing representation forms. According to the mathematician Hamilton, the world is an incessant dance of movements, and metamorphosis, following an order, that only

mathematics can describe by producing and transforming abstract functions (Shanley 1999, 129). The differentiation between actuality and fiction has however become obsolete. In chapter 13, dealing with the arts as mirrors, Alice experiences the world from an artistic perspective (Shanley 1999, 149). She finds herself in a looking-glass room of immense extension, and every mirror shows objects that are not to be seen anywhere else. Here she meets Dodgson again. He leads her into the space of literary imaginations, as for instance into a quantum version of Dickens' *Christmas Carol* (Shanley 1999, 150). He points out that in the representations of literature and arts the world models of modern natural science have already been anticipated, as additionally to Dickens' narration, also another example may illustrate this: the painting of a Chinese artist, that in spite of representing a certain object reminds of the fractal world of chaos country. Shortly after, in chapter 24, Alice experiences the universe as a symphony, i.e. as a musical piece of art. A penny farthing rider named Wheeler presents her a machine that produces space-time and thus provides for the different universes' nutrition (Shanley 1999, 306). She also meets Virginia Woolf and Johann Sebastian Bach, who understand the cosmos as an enormous organ, where new melodies and variations are played in endless modulations (Shanley 1999, 312). Finally, Professor Collins instructs her about the forces holding the universe together (chapter 25, universal attraction). In chapter 26 Alice's journey ends; she is back in Newtonville, dancing the Nut Cracker's Suite with a partner.

The analogies suggested by *Lewis Carroll's Lost Quantum Diaries* between the theories presented and Carroll's Alice stories are no less constructions than the stories are themselves. Nevertheless, narration, as it seems, fulfills an important function in the space of abstract physical and mathematical theories: While they try to explain the world, narrations, following the imagination of Carroll, try to explain the theories.

(3) Some Remarks on the Functions of Mythical Tales

The various adaptations of Carroll's characters by most different discourses, in which they take over new functions, may remind of the conventional use of myths. Every transformation of a mythical tale presupposes the basic recognizability of its plot as well as its formability. The effect of myths that are re-told is in first regard based on the connotative value of names. Often single elements or characters are taken from the original mythical plot context and functionalized as relatively independent narrative element. As for example, one might refer to Minotaur, Daedalus and Ariadne as elements that derive from the complex of the myths around Theseus. Comparably, the White Rabbit, the Jabberwocky or Humpty Dumpty have started to live their own post-Carrollian lives, sometimes relatively independent from Alice's story. The White rabbit, for instance, has become the protagonist of a famous pop song performed by the group "Jefferson Airplane", and this song has later been quoted by several movies (*Platoon*, 1986, *The Game*, 1997, *Fear and Loathing in Las Vegas*, 1998). Like myths, the Alice

stories have been re-told in different media, although they were originally created as verbal narrations.

Resembling to the heroes of mythical stories, Alice as a narrative dispositive has become relatively independent of her inventor Carroll. Clearly, the author's intentions can not be regarded as the yardstick in order to interpret and to judge the recycling of Alice in multimedia, arts and sciences. These (and other) parallels between myths and the Alice stories raise the question for mutual functional analogies. But what is a myth – and under which pre-conditions can literary narrations gain a mythical value?

In principle we can differentiate between different strategies of defining myths: first of all concepts that refer to contents, secondly descriptions of specific mythological structures and thirdly functional models. Theories referring to contents usually focus mythological tales as reports about gods and heroes, about the origins and principles of the world or the reasons of specific institutions. Structuralists and Semioticists have mainly explored the forms and medial shapes of myths; so for instance myths are frequently regarded as narratives or as rituals. Functional concepts of myth are mainly interested in finding out for what sorts of functions myths are required and what roles they play in cultural contexts – as in particular for the interpretation of natural forces and for the legitimation of human actions and institutions.

The overwhelming multiplicity and complexity of impressions humans experience in the world requires, according to a leading theory about myths, to be structured and interpreted. By narration myths, man projects order into the world and organizes it actively according to his own concepts. According to Blumenberg myths de-potentiate what he calls the "absolutism of reality" – a reality that first appears as amorphous, nameless, overwhelming and frightening. In other words: Myths express the replacement of speechless fright by verbal activities. They tell stories about what is beyond complete understanding. They make the uncanny familiar and accessible (Blumenberg 1979, 29). By naming the numinous world, by providing for verbal access to the forces of the indistinct mythological narrations fulfil functions analogous to more rational strategies of exploration and modeling. According to Blumenberg, there is no absolute difference between myth and science.

As the philosopher Odo Marquard states emphatically, myths should be regarded before all as stories with practical functions; in this regard they are equivalent to conceptual knowledge. All knowledge requires representation, and according to Marquard narrative representation is substantial for all processes of experiencing and modeling the world. No other form of representation can replace narration. From Marquard's point of view, Myths are in first respect narratives. As human experiences are submitted to changes – in individual spaces of experience as well as in public ones – it is always necessary to tell new stories. Mythical narration and rational knowledge are complementary to each other. Outgoing from the basic thesis that "narrare necesse est" (Marquard 2000, 60pp.) Marquard repeatedly stresses the significance of mythopoetic creativity even in

the modern world that is generally shaped by science and technology. As a contra-indication against the "absolutism of reality" he highly estimates polymythic narration: There should be different and even contradictory narrative representations of experience in order to avoid totalitarian concepts.

(4) Orientation Crises reflected in the Alice Books

Carroll's stories about Alice deal with different kinds of orientation crises. On the one hand, these crises concern the world experienced respectively the modalities of its experience: Conventional conceptions of space and time collapse, conventional ideas about causality prove to be insufficient. Spatial order is experienced as unstable; time occasionally seems to stand still or to run backwards; effects precede their causes; courses of action are reversed as in a movie that is played backwards. Several times and under several aspects, the narrations refer to the ideas of disorder and contingency: Rules are arbitrarily set up and just as arbitrarily violated. Strange games are played by ignoring set rules – if the rules they follow can be formally defined, at all. Especially the games serve as moments in which all orders and all regularities are questioned – which appears to be more important as the interactions between the different characters are generally modeled according to the idea of games, starting with the game of 'behaving properly' to the idea of an ultimate judgment.

However, Alice experiences orientation crises not only with regard to the outside world, but also related to her self-experience: Repeatedly she undergoes physical metamorphoses, and more than once the failure of her memory provokes an identity conflict. Furthermore, Alice seems to be alienated from her own language. It becomes questionable whether one can "explain oneself" verbally. On the one hand, the interrelations between word and things reveal themselves as contingent and instable, whereas on the other hand the power of word proves to be sufficient to create realities or at least to suggest the existence of imaginary objects of naming.

What is questioned in particular is the possibility of communicating sense, or, more abstractly spoken, the distinction between meaningful and senseless speech. According to Gilles Deleuze, the Alice books in narrative form represent a profound crisis of the sense; Lewis Carroll's works, as he put it, are shaped by an interrelation of sense and nonsense, a cosmos of chaos (Deleuze 1993, 18). Referring to Carroll's episodes as a sort of manual Deleuze deals with a series of paradoxes which, in his opinion, form a "theory of the sense". According to Deleuze, the fact that this theory presents itself in paradoxical form is easy to explain: all sense is related to nonsense. Whether we follow the reading strategy suggested by Deleuze or not: The narrations about Alice's adventures are certainly concerned with the contingencies of meaning, order and so-called reasonable actions.

Although Alice has to face various types of orientation crises and although the realities she experiences resist definite interpretations there is one sort of

problem with which she is not confronted: In Alice's world there are no supra-natural forces. All the characters in *Wonderland* and *Behind the Looking-Glass* are strange, but they are neither god-like nor demonic. Some of them remind slightly of goblins and other creatures of collective popular imaginations. But, they are not connected to any numinous transcendence. (Many of them are word creatures, derived from conventional expressions, manners of speaking, phrases, and verses. This dependency on language implies that their provenance is decidedly immanent.) Different from antique myths that often deal with the embedding of humans into a conflict of the gods and other numinous forces, there are no gods, no demons, no fatal forces in Carroll's world. And there is no hidden meaning beyond the experienced things and events. Moreover, Alice's self may be a puzzle to herself, but it is certainly not inflicted with supra-natural influences and mysteries. All irritations that are reflected in her adventures are related to the process of immanent experience and immanent orders of life.

(5) In the Labyrinths of Science

Alice's orientation crises as well as her identity crises correspond to topics and subjects of different scientific discourses – as they are explored in social sciences, in communication science, in linguistics, philology, and psychology. The question raised by all the adventures might be identified as the question on the relation between the self and the empirical world on the one hand (Alice's introductory reflections about the words longitude and latitude already point out the fact that the narration deals with the place of the self within its world), with the possibility of self-transparency on the other hand. It seems plausible that the popularity of Carroll's Alice episodes results from the circumstance that they resemble myths from a functional point of view: They are easily recognized, re-told, and transformed, and they are generally concerned with the problem of orientation. Different from antique myths, they abstain, however, from metaphysics. As they illustrate, the physical world is puzzling enough.

Modern science is shaped by the idea that all objects of knowledge depend on their forms of representation. There is no such thing as a "plain" reality. The worlds that sciences explore are constructions, and each theory creates its own world. This idea may cause a second-degree orientation crisis, as the multiplicity of theories and explication strategies raises the unanswerable question for their validity as well as for their utility. A character like Alice represents the intellectual whirlwind provoked by the complexity and incompatibility of the steadily multiplied theories about the world. Some reflections of Friedrich Dürrenmatt referring to the problem of modern science may suggest a more elaborate explanation for Carroll's popularity. Dürrenmatt repeatedly stressed that man lives in a world that he creates himself but does not understand. All the most complex theoretical descriptions of the world produced by modern science cause a multiplication of the labyrinth instead of serving as a guideline – and they all inevitably lead to something incomprehensible beyond rational understanding.

Das menschliche Wissen stößt an Grenzen, es hat seine Grenze. Ich glaube, heute ist annähernd jede Wissenschaft auch wissenschaftskritisch geworden. Das Denken steht immer wieder aufs neue an einer Grenze und kommt nicht weiter. Das Denken kommt an die Dinge heran und bleibt immer dort stehen, wo es diese Dinge nicht mehr begreift und ihnen keinen Sinn mehr geben kann. An dieser Stelle können wir nicht mehr weiterfragen. Das Sinnlose ist für mich darum auch ein Zeichen für die Grenze des Denkens. Sinnlosigkeit ist für mich nichts Negatives, sondern ein Grenzbegriff. Da ist die Frage nach dem Sinn sinnlos [...]. (Dürrenmatt 1993, 103)

As Dürrenmatt emphasizes, not only the historical-cultural environment of humans needs to be regarded as a construction, but also the modern world modeled by the natural sciences.

Newton dachte sich eine ideale Natur, er dachte sich die Natur als Idee, gleichsam als abstraktes Kunstwerk [...]. Die Physiker denken sich eine Welt zurecht, in der die Naturgesetze zum Vorschein kommen. Es ist eine platonische Welt, nur ist der Demiurg kein Gott, sondern der Mensch. Die Naturgesetze, die er findet, sind nicht seiend, sondern weisen auf Seiendes hin. [...] Eine physikalische Idee muß fallengelassen werden, erweist sie sich als unhaltbar. (Dürrenmatt 1998, 89)¹⁷

Thus, to the experiencing self reality is never directly accessible, but only by way of mediums such as concepts, terms, and models, none of them reflecting the 'nature' of things, but just the structures of thinking. The further sciences and technology proceed, the more they intensify the world's labyrinth structure. This problem cannot be dissolved – it can however be subjected to aesthetical representation.

The scientific reception of Carroll's stories – concerning physics as well as the humanities – has taken place on different levels. On the one hand, on the level of contents, various Carrollian ideas and episodes obviously correspond to topics, subjects and models that are treated in the contexts of scientific discourses. Therefore they can be quoted or alluded to in order to represent theories and questions (and sometimes their answers) – as for instance physical models of the world (as Shanley and Briggs/Peat illustrate) or theoretical models of language and communication. The latter have quite often been illustrated by Alice's ways of using and exploring words and by those episodes in Wonderland and behind the Looking-Glass that explicitly refer to language, dialogue, and understanding.

On a more abstract level of observation, Carroll's stories have been used in order to explain and to discuss the pre-conditions, the procedures, and the limits of scientific modeling as such. Above all, they make it possible to narrate on the problem of defining and observing an 'object' of research. Thus, these objects are reflected by the Jabberwocky, who in spite of what we learn about his actions

¹⁷ This passage contains a reference to Michelson and Morley.

never appears in a clear shape or by the Cheshire Cat who is inclined to disappear as soon as observers try to get hold of her. The different theories and opinions, the diversity of time- and space-structures in Wonderland and beyond the Looking-Glass remind of the labyrinth complexity of scientific re-constructions of reality. As far as Carroll's texts explicitly refer to experience, there is an implicit affinity toward constructivist theories; with regard to the topics of naming and representation they are similarly inclined to illustrate nominalist concepts. Regarded from a point of view as it is suggested by Wittgenstein's philosophy of language, Alice's adventures in more than one regard illustrate the analogy of verbal actions to games. According to Deleuze, the paradox structures of the world that Alice experiences give an idea of all meaning being groundless and all logic being subverted by the illogical.

Finally, besides all affinities of Alice's adventures to scientific attempts to explain the world, the absolutely incomprehensible is present in Carroll's books as well. Especially the self proves to be something profoundly incomprehensible – in spite of scientific psychology or social sciences; it is metamorphic, beyond possible objectivity, resistant to theory. As for another thematically important dimension of the incomprehensible one might also refer to the multiple forms dealing with and alluding to death in the Alice stories.

As Carroll's narrations make clear, literature is concerned with those orientation crises from which scientific research and world modeling derive, but also with those crises that are conjured by scientific theories themselves. From this point of view, the Alice books – as exemplary works of literature – refer to the labyrinths of theories and hypotheses that are created by science, by languages, and even by logic itself, thus contributing to a temporary and tentative orientation by just representing the different dimensions of disorientation and their symptoms. The puzzles of world description and interpretation are not dissolved, but it is at least possible to represent them by narrations: *narrare necesse est*. Thus, narrations such as Carroll's structurally take over the function of myths, always shaped by a post-metaphysical attitude that is far beyond asking or arguing for an absolute truth.

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Isabel Capelo Gil

Sentimental Physics:

Gottfried Benn, Werner Heisenberg & Co.

Physik ist das Negativ der Dichtung, oder derselbe:
Kunst ist die progressive Anthropologie.

Novalis

Wer Strophen liebt, der liebt auch Kata-Strophen.

Gottfried Benn, Drei alte Männer (1948)

(1)

The challenge to address the complicated relation between literature and science can range from impossible – if one argues from a positivist stance that disregards the former as subjective and thus hopeless, the latter as objective and thus useful – to possible but difficult, – from an ethical point of view – or even probable, in the light of an anthropological concept of culture as a web, made out of fibers that represent each a field of knowledge, among which energies circulate. The concept of the web of culture, devised by anthropologist Clifford Geertz, is very much the concept I'm indebted to in the following discussion, with literature and physics as some of the threads that make up its pattern (Geertz 1983, 23). At first glance, physics and literature seem to be uncommon bedfellows, but upon a closer look, and particularly after deeper scrutiny into the development of quantum physics in the 20th century, not only conflicting models but also points of contact become visible. These are especially apparent on two levels: the first is structural and theoretical and it refers to the role of science and literary aesthetics in the fast disaggregating world of the mid-twentieth century but also to how subjects can be positioned within it; the second level is ethical and addresses the aesthetical shockwave which came about on the verge and in the aftermath of the nuclear debate.

The title of this paper "Sentimental Physics" pays homage to two 2005 commemorations: one is the European Year of Physics, that celebrates the anniversary of Einstein's *anno mirabilis*, 1905, the year he published the prestigious *Annalen der Physik* his five groundbreaking essays that laid the foundations for the theory of relativity: *Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt* (AP 17, 1905, 132-148); *Eine neue Bestimmung der Moleküldimensionen* (Ph.D. thesis, AP 19, 1906); *Über die von der molekularkinetischen Theorie der Wärme geforderte*