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Ficta: remixing generalized symbolic media in the new scientific novel¹

Søren Brier

This article analyzes the use of fictionalization in popular science communication as an answer to changing demands for science communication in the mass media. It concludes that a new genre—Ficta—arose especially with the work of Michael Crichton. The Ficta novel is a fiction novel based on a real scientific problem, often one that can have or already does have serious consequences for our culture or civilization. The Ficta novel is a new way for the entertainment society to reflect on scientific theories, their consequences and meaning. *Jurassic Park* is chosen for an in-depth analysis in order to bring out the essential characteristics of Ficta, showing how its reflections on complexity, fractals, self-reference, non-linearity and unpredictability in science transform our view of scientific knowledge as being the tool for deterministic control into a second order reflection on complexity and the limits of control and predictability.

1. Introduction

According to Niklas Luhmann's theory of social communication (Luhmann, 1995), society has developed functionally differentiated systems, some of which are "symbolic generalized media," such as art, science, money, love, religion, political power, storytelling/narration etc., which are the communicational highways of modern society.

In their book *Re-thinking Science: Knowledge and the Public in an Age of Uncertainty* Nowotny, Scott and Gibbons (2001) show that, in what they call "mode 2" societies, the functional differentiations of the modern mode 1 society, concerning science communication and evaluation in society, are becoming mixed again. The new Ficta novel, I will argue, is an example of this remixing in the popularization of science in the age of entertainment. As a genre, Ficta is represented by the works of authors such as Michael Crichton and Greg Egan (*Distress*), but also Umberto Eco (*The Name of the Rose* is an example from the softer "sciences").

The present paper is a study of such a case of "Ficta," concentrating on Michael Crichton's novels *Jurassic Park* and the sequel *The Lost World* as core examples of this new type of novel. His other books are about themes such as our understanding of the Middle Ages (*Timeline*), aircraft safety (*Airframe*), ape language (*Congo*), the fate of the

Neanderthal man (*Eaters of the Dead*), and self-organizing distributed systems of programmed nano-machines combined with genetic engineering (*Prey*).

There is a scientific message buried in every one of them in such a refined way that most people do not realize how revolutionary these books are.² Before discussing the characteristics and significance of the Ficta genre, let us state a few basic facts about popular science as such:

1. Popular science is not science. It is about science.
2. It is not supposed to teach the interpreter to be a scientist.
3. It is not teaching material.
4. You have to be able to read it on your own, without the aid of a teacher, and it has to be fascinating enough to keep you going all the way through the book.
5. Its purpose is to enlighten the reader about scientific knowledge, its consequences, possibilities and dangers.
6. It is supposed to interact with the citizen's common sense worldview, as well as political, ethical and religious views.

If science communication was once understood through the old idea of filling the citizen's lack of knowledge with objective data to learn to see things "the right way," it is now clear that a dialogue about, for example, genetically modified organisms, stem cell technology, nanotechnology, the use of embryos, and genetic therapy is necessary. At the same time, people get bored in this age of entertainment if they are simply fed with data from objective science provided by level-headed professors. Therefore, the genres of popularization have been transformed. We have seen several stages in the constitution of these genres:

- I. *The classical popular science book*, oriented toward the presentation of objective facts to the public in a detached way.
- II. *The popular science dialogue* (that already Plato and later Galileo used), consisting of a discussion between opponents to analyze theories or paradigms against each other, but without a real fictional plot,
- III. *The science essay*—such as Hawking's *A Brief History of Time*, the most sold popular science book ever—is a more personalized genre. Here, the famous and recognized scientist gives a more personal view of his or her area of expertise and has opinions on the frontier theories, which have not yet been established in the field.
- IV. *The fiction in science novels*—exemplified by Carl Djerassi's books *Cantor's Dilemma* and *The Bourbaki Gambit*—are novels where the story is situated within the culture of science, and the plot is about research and personal honor. In "fiction in science," well-known situations and experiences within science are presented in a fictionalized frame, like an imagined competition for the Nobel Prize.
- V. *The faction* is different from the "fiction in science" novel in that a well-known historical situation is enacted, using the historical persons as characters, but filling in unknown personal details in the storyline of a play, a movie or a film. Thus the plot is real, but the details are fictionalized so that they are as close to the historical situations as possible, but also with an eye to the dramatic.
- VI. *The science fiction novel* is a fictional dramatized form, be it short stories, novels or movies. It is mainly concerned with the impact of technological achievements on society, when they become a part of social struggle. Science fiction often points to, for technology optimists, *unexpected implications* when technology is misused. Often, the science fiction is argued as dystopias, such as *Brave New World* by Aldous Huxley, *This Perfect Day* by Ira Levin and *The Island of Dr. Moreau* by H.G. Wells. The science fiction novel is almost always about new technological frames for a society and the

social consequences of this, or shows that no matter what new technology one invents, the social problems will be the same. But they can also be imaginative about how new technologies can shape our lives and propose new problems that we will have to face in the future (for instance if robots could have emotions).

VII. Finally, *the Ficta novel* is an even more radical result of the search for more entertaining forms of science communication and popularization in the form of narratives and games. Its features include:

1. It is a new way of popularization of science through fictionalization, as the deep plot of the novel is about scientific theories; often, a competition between scientific theories or paradigms played out in praxis, for example in a thriller story, far more entertaining than the dialogues.
2. It is a mixing of genres and document types.
3. It is a fiction novel based on a real scientific problem; often, one that can have or already has serious consequences for our culture or civilization.
4. It is focusing on discussing the consequences, problems and limitations of scientific knowledge.
5. The discussion of science and its consequences focuses more on the philosophy of science, worldview and existential aspects and problems than on the technological-social in contrast to science fiction.
6. It has become a new way for society to reflect on scientific theories, their consequences and the meaning of the worldview they assume (often more or less implicitly).

An example of how various scenarios for—often competing—theories are played out, is Greg Egan’s book *Distress*. Here, we follow different scientists and parties endorsing various versions of the Grand Unification Theory (GUT) of physics. Among other things, the novel focuses on imagining what happens when we find the correct theory for everything. Will we, or the world, then change—and how would we change? Or will the answer just be “42”? If you read Douglas Adams’ *The Hitchhiker’s Guide to the Galaxy* or saw the movie, you will know what “42” means; to the rest of you, this is the answer a supercomputer called “Deep Thought” came up with after seven and a half million years of computing on “the ultimate question of life, the universe and everything” (Adams, 1996: 120).

This unique, deeply sarcastic and humorous book is not typical of anything, but it has clear Ficta characteristics in its underlying theme and ongoing discussion of what scientific computable knowledge can contribute to that question (life, the universe and everything!), as the book is filled with scientific knowledge about the universe, rationality and computing, on the one hand, and on the other with reflections—in the form of humorous events—on the role of emotion and meaning in human rationality. This is done through humorous and sarcastic scenarios about what could happen if developments in technology made it possible for us to install these “features” in computers and robots.

We have seen some of the same discussion in *Star Trek* around the android Data, who gets “an emotion chip” from the humans and a skin graft from the Borgs. The attempts of this rational android robot to deal with these new (sensed) aspects of reality—including humor—are played out in different scenarios; including one with a trial discussing if “it” (Data) has any rights. The same theme is played out in a different fashion in the movie *Blade Runner* and the book behind it by Philip K. Dick: *Do Androids Dream of Electric Sheep?* It is deeply psychological, and asks questions such as: what is empathy and human emotion? Is consciousness an emergent quality? What defines intelligence? The movie is a

little more crude, but discusses when the artificial life in the form of androids stops being merely machines and becomes subjects.

But Adams' overly happy and servile spaceship computers (probably inspired by the supercomputer Hal in Stanley Kubrick's *2001: A Space Odyssey*) or the deeply depressed super-robot Marvin and neurotic elevator computers deal in a sarcastic way with the techno-optimistic and unrealistic staging of the possibility of constructing and implementing "emotion chips" or human memories in Data and other androids that do not have a human body and a childhood. In showing some of the absurd consequences of emotions in a supercomputer, Adams constructs a unique, humorous and critical Ficta.

Yet *Star Trek* is not just another science fiction. Its hallmark is the discussion of the possibilities of science for understanding ourselves, the universe and our role in it. Its Ficta aspect is just a fairly scientific version. Adams, in contrast, portrays the ruler of the universe as a radical skeptic antirealist and further disbeliever in the control of complex systems. When asked if he rules the universe, he says "I try not to." So Ficta and science fiction can be present in the same story. It is the Ficta aspect that makes *Star Trek* stand out among other science fictions.

In this article, Michael Crichton's³ book (and not the movie) *Jurassic Park* is chosen for analysis, in order to bring forth the characteristics of Ficta. Crichton's book is quite famous and he is probably the most well-known and successful inventor and user of Ficta in a series of worldwide published successful thriller novels, nearly all made into movies. Furthermore, *Jurassic Park* reflects on the contrast between the classical mechanical deterministic science and the new science of complexity, fractals, self-reference, non-linearity and unpredictability, and as such discusses the limits of scientific knowledge and their consequences on our expectations of predictability and control from science. The book focuses on how the complexity and self-organization paradigm changes our worldview and our understanding of the limitations of scientific knowledge and of the possibility of control.

Such a focus, narrated—for example—in the form of a thriller, is typical for Ficta (as is Egan's pondering about what will happen to humans and human consciousness if we find the ultimate unifying theory of physics). Adams, of course, has the following sarcastic Ficta-remark to those who—like Stephen Hawking—think that we can know the deep reasons of the universe scientifically: "There is a theory which states that if ever anyone discovers exactly what the Universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable. There is another theory which states that this has already happened" (Adams, 1996: 148).

Above, I have argued that especially Michael Crichton's books, *Jurassic Park* (the self-dynamics of genetic engineering, non-linear systems, chaos and ecological systems), *The Lost World* (the role of behavior in non-linear, self-organizing evolutionary theories) and, partly, *Congo* (communication, especially monkey language, monkey intelligence and modern communication technology), *The Andromeda Strain* (viral infectious processes and patterns and the possibilities of getting them from space), *Airframe* (aviation construction and maintenance, security systems and the inability of the press to describe complex technical systems) and *Timeline* (results generated by new research of the medieval period presented via time travel) are the central examples of the recent development of this particular genre of novels. This genre integrates fiction and facts on the premises of fiction to such an extent that the audience does not realize they are being lectured by Crichton, who has profound knowledge of his subject areas.

This strategy may be the only one that can compete with the movies and at the same time carry that intellectual and scientific content that modern mass movie makers seem

unable or unwilling to communicate. For instance, in the movie *The 13th Warrior*, the Ficta high point—that the cannibals the Vikings are fighting seem to be the last Neanderthals who have survived thousands of years longer than anybody thought—is not made adequately clear. And this is exactly the science-dramatic main plot of Crichton’s book, *Eaters of the Dead* from which the film script was made.

It is interesting that the Neanderthals are actually portrayed in Jean Auel’s book, *The Clan of the Cave Bear*—and the rest of this very popular book series—which can be viewed as archaeological and ethnographic Ficta. Here we are dealing with the more soft sciences, since the subject varies between biological theories of human origin, paleontology and physical anthropology.

But let us move to the historical development and analysis of Ficta based on examples to illustrate and document what I have claimed to be the essential features of this genre.

2. Precursors to Ficta

We all know of very early fictionalized world images and epistemological problems. Plato used dramatized dialogues to present philosophical and scientific concepts and Galileo also dramatized dialogues, albeit without any specific storyline, see for example *Dialogue Concerning the Two Chief World Systems* (1632). Francis Bacon (1561–1626) also dramatized his visions of the new science in *The Advancement of Learning* and *The New Atlantis* in novel form. However, this last is more closely related to the genre providing socio-scientific themes and named after Thomas More’s *Utopia*, i.e., *utopic novels*.

These books, however, do not present so much specific scientific theories—in this case, socio-scientific—as they offer ethical, legal and power-distributing sociopolitical visions. In Bacon’s and More’s worlds, the idolization of reason and science was part of this. Likewise, Jonathan Swift’s *Gulliver’s Travels* and Thomas Hobbes’ *Leviathan* are also dramatized social commentaries. This approach has been more difficult to apply with regard to the problems of natural science, unless one wants to include Jules Verne’s books, such as *All Around the Moon*, *Twenty Thousand Leagues under the Sea* and *Journey to the Centre of the Earth*, in this genre. These novels are often optimistic about the future and are meant to provide dramatic visions of science’s new world picture and its technological consequences.

In more recent times, just before World War II, George Gamow with his book, *Mr Tompkins in Wonderland*, succeeded in presenting the problems of the new physics in a fictive, almost allegoric form. He used dream sequences in combination with banal everyday stories and explicatory lectures to illustrate the impact of quantum mechanics and the theory of relativity.

Let me give a sample of the style and the complicated subjects Gamow has succeeded in illustrating with a number of quotes from Tompkins’ fourth dream. First, we join a tiger hunt in the “Quantum Jungle,” where it is possible to experience the quantum effect of the micro-world in, for example, the shape of a quantum elephant. The subject is Heisenberg’s Uncertainty Principle, according to which it is not possible to simultaneously determine the precise position of both a particle and an impulse (mass multiplied by speed). Precision in one determination results in imprecision (uncertainty) in the other. Here it is explained how it works for elephants:

Mr Tompkins inspected the elephant from all sides; it was a very beautiful, large animal, but there was no marked difference in its behavior from the elephants he had seen in the Zoo. He turned to the professor—“You said that this was a quantum

elephant, but it looks just like an ordinary elephant to me, and does not behave in any funny way, like the billiard-balls made from the tusks of some of its relatives. Why doesn't it spread out in all directions?"

"You show a peculiar slowness of comprehension," said the professor. "It is because of its very large mass. I told you some time ago that all the uncertainty in position and velocity depends on the mass; the larger the mass, the smaller the uncertainty. That is why the quantum laws have not been observed in the ordinary world even for such light bodies as particles of dust, but become quite important for electrons, which are billions of billions of times lighter. Now, in the quantum jungle, the quantum constant is rather large, but still not large enough to produce striking effects in the behavior of such a heavy animal as an elephant. The uncertainty of the position of a quantum elephant can be noticed only by close inspection of its contours. You may have noticed that the surface of its skin is not quite definite and seems to be slightly fuzzy. In course of time this uncertainty increases very slowly . . ." (Gamow, 1965: 86–7)

Following this wonderful explanation, he turns to—what Niels Bohr in quantum mechanics calls—"acts of observation": the phenomenon that the apparatus interacts with the quantum effect of the actual measurements; we now move from looking at elephants to petting kittens to demonstrate what the quantum means if it were placed in our everyday world:

After the professor and Sir Richard with his rifles had climbed into the basket fastened on to the elephant's back, and Mr Tompkins, in his new capacity of mahout, had taken his position on the elephant's neck, clutching the goad in one hand, they started towards the mysterious jungle.

. . . "Can you tell me, please," he asked, turning to the professor, "*why* do bodies with small mass behave so peculiarly, and what is the commonsense meaning of this quantum constant that you are always talking about?"

"Oh, it is not so difficult to understand," said the professor. "The funny behavior of all objects you observe in the quantum world is just due to the fact that you are looking at them."

"Are they so shy?" smiled Mr Tompkins.

"'Shy' is an unsuitable word," said the professor bleakly. "The point is, however, that in making any observation of the motion you will necessarily disturb this motion. . . . if you learn something about the motion of a body, this means that the moving body delivered some action on your senses or the apparatus you are using. Owing to the equality of action and reaction we must conclude that your measuring apparatus also acted on the body and, so to speak, 'spoiled' its motion, introducing an uncertainty in its position and velocity."

"Well," said Mr Tompkins, "if I had touched that ball in the billiard room with my finger I should certainly have disturbed its motion. But I was just looking at it; does that disturb it?"

"Of course it does. You cannot see the ball in darkness, but if you put on the light, the light-rays reflected from the ball and making it visible will act on the ball—light pressure we call it—and 'spoil' its motion."

"But suppose I used very fine and sensitive instruments, can't I make the action of my instruments on the moving body so small as to be negligible?"

“That is just what we thought in classical physics, before the *quantum of action* was discovered. At the beginning of this century it became clear that the *action* on any object cannot be brought below a certain limit which is called the quantum constant and usually denoted by the symbol ‘*h*’. In the ordinary world the quantum of action is very small . . . and is of importance only for such light particles as electrons which, owing to their very small mass, will be influenced by very small actions. In the quantum jungle we are now approaching, the quantum of action is very big. This is a rough world where no gentle action is possible. If a person in such a world tried to pet a kitten, it would either not feel anything at all, or its neck would be broken by the first quantum of caress.” (Gamow, 1965: 87–8)

To really show the quantum effects, Gamow now takes us into the quantum jungle, where the effects are very big. This helps Gamow to address the profound epistemological questions through dramatic examples. Here the tiger attacks them on the elephant in the quantum jungle:

“This is all very well,” said Mr Tompkins thoughtfully, “but when nobody is looking, do the bodies behave properly, I mean; in the way we are accustomed to think?”

“When nobody is looking,” said the professor, “nobody can know how they do behave, and thus your question has no physical sense.”

“Well, well,” exclaimed Mr Tompkins, “it certainly looks like philosophy to me!”

“You can call it philosophy if you like”—the professor was evidently offended—“but as a matter of fact, this is the fundamental principle of modern physics—*never to speak about the things you cannot know*. . . . The things which cannot be observed are good only for idle thinking—you have no restrictions in inventing them, and no possibility of checking their existence, or of making any use of them. I should say . . .”

At this moment a terrible roar filled the air and their elephant jerked so violently that Mr Tompkins almost fell off. A large pack of tigers was attacking their elephant, jumping simultaneously from all sides. Sir Richard grabbed his rifle and pulled the trigger . . . he shot right through the tiger’s head without causing any damage to the animal.

“Shoot more!” shouted the professor. “Scatter your fire all round and don’t mind about precise aiming! There is only one tiger, but it is spread around our elephant and our only hope is to raise the Hamiltonian.”

The professor grabbed another rifle and the cannonade of shooting became mixed up with the roar of the quantum tiger. . . . One of the bullets ‘hit the spot’ and, to his great surprise, the tiger, which became suddenly one, was vigorously hurled away, its dead body describing an arc in the air, and landing somewhere behind the distant palm grove.

“Who is this Hamiltonian?” asked Mr Tompkins . . . “Oh!” said the professor, “I am so sorry. In the excitement of battle I started to use scientific language—which you cannot understand! Hamiltonian is a mathematical expression describing the quantum interaction between two bodies. It is named after an Irish mathematician, HAMILTON, who first used this mathematical form. I just wanted to say that by shooting more quantum bullets we increase the probability of the interaction between the bullet and the body of the tiger. In the quantum world, you see, one cannot aim precisely and be sure of a hit. Owing to the spreading out of the bullet, and of the aim itself, there is always only a finite chance of hitting, never a certainty. In our case we fired at least thirty bullets

before we actually hit the tiger; and then the action of the bullet on the tiger was so violent that it hurled its body far away. The same things are happening in our world at home but on a much smaller scale. . . . The actions which play an important role inside an atom are of the same order of magnitude as the elementary quantum of action and thus the whole picture is largely spread out. The motion of the electron round the atomic nucleus is in many respects analogous to the motion of our tiger, which seemed to be all around the elephant.”

“And does somebody shoot at the electron as we did the tiger?” asked Mr Tompkins.

“Oh yes, of course, the nucleus itself sometimes emits very energetic light quanta or elementary action-units of light. You can also shoot at the electron from outside the atom, by illuminating it with a beam of light. And it all happens there just as with our tiger here: many light quanta pass through the location of the electron without affecting it, until presently one of them acts on the electron and throws it out of the atom. The quantum system cannot be affected slightly; it is either not affected at all, or else changed a lot.” (Gamow, 1965: 89–92)

The main attraction here is the application of these dream sections to provide a phenomenological insight into physical consequences, for example that items become shorter when accelerated towards the speed of light, or in this case, where Planck’s constant becomes so huge that the quantum effect can be perceived macroscopically. These effects are presented as dramatic events, characteristic of the period, offering the professor the space and opportunity to explain the theoretical background. He does this with great pedagogical skill. The dramatization is too innocent and does not relate with sufficient depth to the actual scientific problems under consideration in order to be genuinely prototypical of what I would term *Ficta*—even though it is a clear move in that direction. But the book is nonetheless a very charming treatment of quantum physics, succeeding in illustrating quantum and relativity effects via dreams, by amplifying them to fit our world, it remains popular science draped in a literary robe.

In the 1990s, the Norwegian writer Jostein Gaarder further developed the philosophic-scientific dialogue in a novelistic dramatized form in his successful book, *Sophie’s World*. The fictionalized form is, in this case, also quite obvious to the reader as a dramatic robe. The novel cannot live by itself, but it worked well when the reader actually read to get some insights into philosophy. But, philosophy is philosophy and not science as such. We very rarely see entire scientific fields being investigated with regard to how they influence our understanding of nature and technology as well as their interrelations with the problems of human survival on this planet. This is a more familiar feature of philosophical problems, especially when they concern ethical and social matters. Philosophy applies at a much more personal level and is thus of greater common interest.

So, in spite of the above mentioned precursors, I claim that Michael Crichton’s work³ constitutes a real innovation. Here we are offered a discussion of entire scientific fields and theories by one of the most prominent developers of the techno-thriller genre. I will focus especially on his two most well-known popular thrillers, *Jurassic Park* and *The Lost World*. If one has only seen Spielberg’s movies, it may be hard to imagine that the books provide a deep knowledge of current scientific developments, or for that matter that Crichton should be on a mission to criticize society’s handling of the progress of science and technology. Nonetheless, this is the case. To convince oneself of this, it is sufficient to read the foreword, which, to anyone with even a modicum of biological insight, far exceeds the horror of the dinosaur plot. A few examples:

The late twentieth century has witnessed a scientific gold rush of astonishing proportions: the headlong and furious haste to commercialize genetic engineering . . .

Biotechnology promises the greatest revolution in human history . . .

But the biotechnology revolution differs in three important respects from past scientific transformations.

First, it is broad-based . . .

Second, much of the research is thoughtless or frivolous.

Third, the work is uncontrolled . . .

But most disturbing is the fact that no watchdogs are found among scientists themselves. It is remarkable that nearly every scientist in genetics research is also engaged in the commerce of biotechnology. There are no detached observers. Everybody has a stake. (Crichton, 1991: vii–viii)

Now, this is a critical perspective of considerable power. Even though we have a fictionalized form, scientific information is presented here in the manner of the most serious efforts within new journalism.⁵ It is also clear that Crichton has a personally engaged selection of theories to argue his view of science, nature and the question of control with genetic research. *Jurassic Park* is about the implications of developments within biotechnology, or it constitutes an example of such developments. Crichton, who has a medical degree, has a solid grip on scientific details, and a great interest getting them right—as one can especially see in his book *Prey*, containing an excellent scientific reference list at the end. His first Ficta—a crime novel—addressed the abortion dilemma, debating doctors’ moral principles and balance of power.

I have a double purpose in giving extra space to *Jurassic Park* in the following sections. It is partly because I wish to argue that it is in fact a new genre, and partly because the book also provides a dramatic perspective on the new social conditions of present science, thereby also indicating new themes of popular science that call for future attention. Crichton is, as we shall see, clearly taking sides for the complexity view, personified by the chaos theoretician Malcolm.

3. *Jurassic Park*

At first glance, the novel looks like a puffed-up “bio-science fiction thriller,” whose main theme concerns the prospect that biotechnology can recreate dinosaurs, and how it is for humans to be prey and not predators. When the book opens, a small girl is bitten by a bird-like dinosaur on a beach somewhere in South America, while, at the same time, rumors are heard about babies from a nearby jungle village, who were more or less snatched from their cradles by twittering animals.⁶ A part of the above mentioned animal arrives at the laboratory of an American researcher, where it causes great wonder because of its strangeness and resemblance to a dinosaur. Two specialists in paleozoology and paleobotany, who work at excavating dinosaurs in the US, are invited to inspect the security systems of an animal park situated on an off-shore island, and here they find genetic reconstructions of dinosaurs. The team of investigators also includes a mathematician, who is an expert in non-equilibrium systems, chaos and fractals, and who also represents the park’s investors.

At the same time, a major company with a special interest in biotechnology is trying to locate someone who has experience with the reconstruction of dinosaurs. By paying a large

sum of money, the company manages to persuade the constructor and manager of the island's computer safety system to steal a number of dinosaur fetuses from the hatchery. The drama is concentrated around a number of accidents that happen after the computer expert manipulates the security systems to gain access to the hatchery. The dinosaurs break loose and, headed by a *Tyrannosaurus rex* and the fast raptors, they chase the inspection team and some visiting children. In effective and engrossing scenes, one gets a feeling of what it is like to be the prey instead of the predator. At the same time, information on the latest scientific theories about dinosaurs being warm-blooded, their intelligence and ability to hunt in groups is reported. As it turns out, the animals have overcome their mono-sexuality, designed to prevent them from reproducing. This has happened as a result of the insertion of amphibian genes to fill the knowledge gaps in relation to some of the dinosaur genes. The amphibian is a hermaphrodite (can fluctuate between the two sexes). It also appears that the animals are capable of overcoming the genetically inserted defect, encoding a need for the amino acid, lysine, which was meant to confine them to the island abundant in lysine-rich forage. So, not only are they reproducing, they are also migrating from the island via the ferry service. On top of this, the park grows deserted, and several people, among them the IT-director and the park manager, are devoured by dinosaurs. Nature's system is non-linear and chaotic and breaks all artificial limitations humans might attempt to put up. There is an obvious parallel to the classic film, *King Kong*, which Spielberg chooses to imitate in his film version of *The Lost Worlds*.

The scientific personification of Jurassic Park

At first glance, both books appear to be well-constructed mixtures of horror and science fiction stories, presently the most powerful product of international popular literature. But as reading proceeds, the reader comes to wonder why there are so many scientific explanations, not to mention environmental descriptions. On closer inspection, one notices that now and then, all three researchers become subsidiary storytellers, addressing other characters within the story. These subsidiary stories are part of creating the theme of the drama of the dinosaur island. As an example of this, here is the opening doomsday lecture by the chaos researcher and mathematician Malcolm, explaining why the island can never become a secure closed system, while at the same time introducing the chaos theory itself in a very brief and clear manner:

Gennaro said, "Your paper concludes that Hammond's island is bound to fail?"

"Correct."

"Because of the chaos theory?"

"Correct. To be more precise, because of the behavior of the system in phase space."

...

"Let's go back to the beginning." He paused, staring at the ceiling. "Physics has had great success at describing certain kinds of behavior: planets in orbit, spacecraft going to the moon, pendulums and springs and rolling balls, that sort of thing. The regular movement of objects. These are described by what are called linear equations, and mathematicians can solve those equations easily. We've been doing it for hundreds of years."

"Okay," Gennaro said. "But there is another kind of behavior, which physics handles badly. For example anything to do with turbulence. Water coming out of a spout. Air

moving over an airplane wing Turbulent events are described by nonlinear equations. They're hard to solve—in fact, they're usually impossible to solve. So physics has never understood this whole class of events. Until about ten years ago. The new theory that describes them is called chaos theory. Chaos theory originally grew out of attempts to make computer models of weather in the 1960s. Weather is a big complicated system, namely the earth's atmosphere as it interacts with the land and the sun. The behavior of this big complicated system always defied understanding. So naturally we couldn't predict weather. But what the early researchers learned from computer models was that, even if you could understand it, you still couldn't predict it. Weather prediction is absolutely impossible. The reason is that the behavior of the system is sensitively dependent on initial conditions." (Crichton, 1991: 73–4)

This is excellent, brief and to-the-point popular science. Not only is it an extremely compressed form of communication, but the presentation, with Plato and Galileo as inspiration, is also placed within the dialogue form, and, finally, again presented as part of a scientific novel, where a dispute about genetic reproductive knowledge concerning living beings is staged. This insertion is used to set the scene for the actual drama on the *Jurassic Park* island. At the same time, the park is set as an illustrative model of any attempt to gain full control of any ecosystem anywhere and of all attempts to protect it from the import and export of organisms. These are the conditions of any laboratory working with genetic engineering and of any field test conducted with genetically manipulated organisms. The utopia is theoretically explained and demonstrated in a practical and dramatic form.

Further into the book, it becomes evident that the chaos researcher Malcolm plays an important role as the all-knowing reporter of complexity and chaos. He combines ecology and complexity-thinking in a short description of all bio-environmentalists' and cybernetic systems critics' favorite example of "big technology," namely the Aswan Dam, where the side effects reached unimaginable dimensions:

"I'm sorry," Malcolm said, "but the point remains. What we call 'nature' is in fact a complex system of far greater subtlety than we are willing to accept. We make a simplified image of nature and then we botch it up. I'm no environmentalist, but you have to understand what you don't understand. How many times must the point be made? How many times must we see the evidence? We build the Aswan Dam and claim it is going to revitalize the country. Instead, it destroys the fertile Nile Delta, produces parasitic infestation, and wrecks the Egyptian economy." (Crichton, 1991: 91)

Crichton's models are supported by the paleobiologists' steady flow of information on the complexity and dynamics of zoological and botanical systems. It leads to the overall suggestion of an immense super-system created by ecological interaction, the powers and dynamics of which exceed all human control.

As the chapters go by, one notices that Malcolm's chaos-fractal theory thematizes the chapters in consecutive ominous sequences. Each chapter is introduced by the drawing of a fractal expanding step by step so its plane-covering pattern becomes more and more clear. The idea of the sequence is further clarified by Malcolm's short lectures on complexity, chaos, fractals, etc. that at the same time provide a modern transdisciplinary view of the sciences (Brier, 2000).

The book thus opens with the first minor deviation that occurs in remote Guatemala, in a jungle even more remote from true civilization and its important techno-economic centers. This deviation consists of strange small dinosaurs (compsognati) that in unguarded moments snatch babies from their cradles and eat them. Then, we are introduced to the sincere paleontologist, who is excavating dinosaur fossils, and the entrepreneur, who is backing the

Table 1. The disagreement between the old and new paradigms of natural science. Hammond personifies the mechanistic philosophy of control optimism and Malcolm, aided by the paleobiologists, represents the chaos/complexity paradigm

	Mechanistic philosophy	Chaos/complexity
Nature	Simple and governed by law	Complex with chaotic aspects
Causality	Linear, deterministic	Non-linear, non-deterministic
Predictability	Certain and precise	Uncertain and approximate
Scientific knowledge	Results in full control	Results in lack of control

park with his optimistic visions of control and profit. Then follow Malcolm's first prophecies; we are introduced to the evil forces, the competing genetic engineering company and its failed researchers, who now obey money laws because they did not succeed in their personal scientific careers. Little by little, irregularities in and the inadequacy of the computer system are revealed until the final collapse and the catastrophe set in. The last scene of the book describes how the entrepreneur sprains his ankle and falls prey to the small compognati that are now also swallowing the big industrialists raw.

Slowly the reader who looks a little beyond the elementary chilling story about being hunted by a dinosaur will discover that the main plot is about shifts of scientific paradigms. Simplicity, linearity, determinism and control are contrasted with a new realization: nature is non-linear, fractal and complex. According to the mechanistic view, nature is governed by a set of transcendent natural laws, resulting in total predictability and control as opposed to an understanding of the existence of a superior boundary level that cannot be directly controlled (see Table 1). Crichton thus presents two opposing scientific paradigms in a dramatized case study.

The reversed Actant model of Jurassic Park

When regarding the composition of the novel from a structural perspective, one notices the possibility of creating a reversed Actant model. The Actant model was developed by the French structuralist A.J. Greimas. On the basis of Propp's analysis of Russian folkloristic stories, Greimas identified the minimum of basic elements that form a story. He also created a model of their interaction (Figure 1).

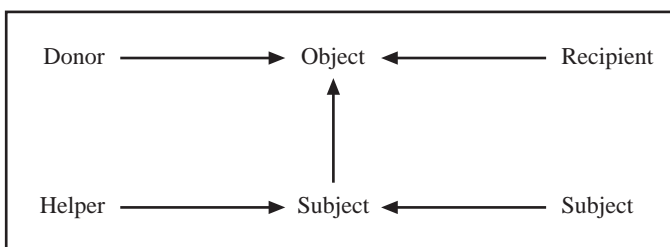


Figure 1. The Actant model starts with the subject. The subject is taking action in the story, and is most often the main character. The subject has a goal or a wish—often called the object(s)—which is pursued or desired. These goals can be persons, things, or ideas that can be desired. Thus the arrow from subject to object is called the desire axis or the project axis. The object is often linked with the donor, who provides the object to the recipient, who is mostly the subject itself.

In order to accomplish the goals, the main character is accompanied by several elements that, in various ways, help or hinder the subject (helper/adversary). Thus, the hero is expected to gain possession of some kind of object that will enable him to complete the good mission; preferably, helpers will assist him in his battle against the villains/the evil. But in this Ficta novel there is no object or skill for the hero to acquire in his battle against villains together with helpers. The hero, in the form of the chaos theorist Malcolm, is struggling against the use of the power to reconstruct extinct species through genetic manipulation, since these animals now will not have the original ecosystem to which they were once adapted to live in. He is struggling for the builders of the dinosaurs and the park to realize the limits of their knowledge and what it is possible to control—and to realize that they cannot get what they want, part of that being a huge profit. The business people striving for profit by using scientific knowledge to construct and control the dinosaurs constitute the villains. The good scientists—the paleobiologists—oppose this, while the corrupt computer assistant supports the villains. Everything leads up to the final catastrophe, which is staged to provide a setting for the bitter know-it-all remark from the chaos theorist with his own leg broken: “I told you so?” It has also similarities to Greek tragedy, but our heroes do not die in the end. In a dramatic form, Crichton thus presents a profound difference between scientific paradigms, by for example personifying the paradigms and involving the persons in a sad drama about human hubris and greed.

The scientific plot

One main conflict presented in the book is centered on the possibility of attaining scientific control over biological organisms and their ecosystems. Is that what our science is meant to do? Is that what we want? Is that what it is actually capable of? Or is it a presumptuous extrapolation from a few simple and idealized linear mechanical systems into a real world based upon non-linearity and chaos, as was suggested by winner of the Nobel Prize in chemistry, Ilya Prigogine and philosopher of science, Isabelle Stengers (Prigogine and Stengers, 1984). They argue that the classical physico-mechanistic science only applies to a very limited number of ideal situations, where it is possible to maintain a state function because the system rests in equilibrium.⁷ Only in such cases does the mechanistic paradigm apply, and thereby the assumption that behind the apparent complexity of a system lies a relatively simple mathematical formalism, whereby it is mathematically possible to precisely predict its actions and, accordingly, to construct surveillance systems to monitor and control it as we see them in *Jurassic Park*. But in most of the existing world, one must realize that the complexity is real and scientifically irreducible. The time factor and the non-linear functions interact in genuine, inscrutable complexity far from equilibrium, which cannot be comprehended in a mathematical–deterministic manner and/or controlled with acceptable precision. Classical determinism, with its absolute ideal of knowledge and optimism about control, is thus dismissed. Here is Malcolm’s highly concentrated interpretation of the conflict, presented in the light of intellectual history:

“You know what we are really talking about here,” Malcolm said. “All this attempt to control . . . We are talking about Western attitudes that are five hundred years old. They began at the time when Florence, Italy, was the most important city in the world. The basic idea of science—that there was a new way to look at reality, that it was objective, that it did not depend on your beliefs or your nationality, that it was *rational*—that idea was fresh and exciting back then. It offered promise and hope for the future, and it swept away the old medieval system, which was hundreds of years old. The medieval world of feudal politics and religious dogma and hateful superstitions fell before

science. But, in truth, this was because the medieval world didn't really work any more. It didn't work economically, it didn't work intellectually, and it didn't fit the new world that was emerging." (Crichton, 1991: 312)

This perspective on intellectual history with regard to models of reality and their relation to power puts our own time into perspective and suggests a very particular idea to the reader: that perhaps the present situation is a sign that our models have once again become too restricting for reality. On this background, Crichton sketches the present problem. The great command science has of nature does not tell us how we ought to live our lives. Traditional science is becoming too narrow in the world of complexity and non-linear dynamics we now inhabit, just as the medieval worldview fell short as society developed at that time. Crichton writes:

"But now," he continued, "science is the belief system that is hundreds of years old. And, like the medieval system before it, science is starting not to fit the world any more. Science has attained so much power that its practical limits begin to be apparent. Largely through science, billions of us live in one small world, densely packed and intercommunicating. But science cannot help us decide what to do with that world, or how to live. Science can make a nuclear reactor, but it cannot tell us not to build it. And our world starts to seem polluted in fundamental ways—air, and water, and land—because of ungovernable science." (Crichton, 1991: 312)

The problem concerning apparently value-free science becomes evident when light is shed on the enormous impact it has on society and the difficulties associated with the control of its products. Science does not provide us with any knowledge that allows us to combine our control and exploitation of nature with our way of living—not, in any case, a way of living that is based on developing and refining the very same nature as it manifests itself in human form. Our knowledge concerning our own inner nature, which is our phenomenological insight into our own existential circumstances, has not developed at the same rate as our ability to exploit the outer nature. Furthermore, the same people do not possess both kinds of knowledge. As a consequence, results are not combined via critical analysis and synthesis into a new absolute insight. The sum of knowledge is unevenly distributed among a range of specialists within different power structures and with very different goals concerning the development of nature. Malcolm continues—in line with some of the best passages in Tor Nørretranders' book, *The User Illusion*—with a formidable ideological analysis of the relation between the scientific self-image and the consequences of a number of new discoveries:

"At the same time, the great intellectual justification of science has vanished. Ever since Newton and Descartes, science has explicitly offered us the vision of total control. Science has claimed the power to eventually control everything, through its understanding of natural laws. But in the twentieth century, that claim has been shattered beyond repair. First, Heisenberg's uncertainty principle set limits on what we could know about the subatomic world. Oh well, we say. None of us lives in a subatomic world. It doesn't make any practical difference as we go through our lives. Then Gödel's theorem set similar limits to mathematics, the formal language of science. Mathematicians used to think that their language had some special inherent trueness that derived from the laws of logic. Now we know that what we call 'reason' is just an arbitrary game, it's not special in the way we thought it was. And now chaos theory proves that unpredictability is built into our daily lives. It is as mundane as the rainstorm we cannot predict. And so the grand vision of science, hundreds of years

old—the dream of total control—has died, in our century. And with it much of the justification, the rationale for science to do what it does. And for us to listen to it. Science has always said that it may not know everything now but it will know, eventually. But now we see that isn't true. It is an idle boast. As foolish, and as misguided, as the child who jumps off a building because he believes he can fly." (Crichton, 1991: 313)

The novel form is used to demonstrate the limits of scientific control in practice, by giving a fictional example of genetically re-engineered dinosaurs inhabiting a computer-controlled park. This is the dream of obtaining total control over nature for profit and entertainment purposes. The example—where the limitations of the computer system with respect to handling new and unexpected problems play a key role—is a showdown between the past four hundred years' mechanistic way of understanding science and the new vistas of chaos theory. This example clearly sheds light on the consequences of research results within non-linear systems, chaos, fractals and odd attractors. It is an extremely powerful renouncement of the deterministic control paradigm. It beseeches us to understand that we are at the end of an epoch, so we had better hurry up and learn some new tricks if we wish to survive. As such, fiction also incorporates important themes from the science fiction genre.

Malcolm finds himself in the middle of the catastrophe he predicted. The control system of the park has suffered a breakdown. The *Tyrannosaurus rex* and a flock of raptors are roaming about freely, and he has fractured a leg. With great emphasis and clarity, he continues to sketch the social changes that will be the outcome of lacking control of new technologies. Their own situation, while they wait for the raptors to get to them, illustrates what is bound to happen on the large scale.

Crichton presents us with a profound analysis of the compelling potential and unpredictable force that biology possesses. In the following extract, he tries to make us realize what radical changes the new biological forces will inflict on our culture and our self-knowledge:

"We are witnessing the end of the scientific era. Science, like other outmoded systems, is destroying itself. As it gains in power, it proves itself incapable of handling the power. Because things are going very fast now. Fifty years ago, everyone was gaga over the atomic bomb. That was power. No one could imagine anything more. Yet, a bare decade after the bomb, we began to have genetic power. And genetic power is far more potent than atomic power. And it will be in everyone's hands. It will be in kits for backyard gardeners. Experiments for schoolchildren. Cheap labs for terrorists and dictators. And that will force everyone to ask the same question—What should I do with my power?—which is the very question science says it cannot answer."

"So, what will happen?" Ellie said.

Malcolm shrugged. "A change."

"What kind of change?"

"All major changes are like death," he said. "You can't see to the other side until you are there." And he closed his eyes. (Crichton, 1991: 313–14)

This is just the situation in the park. They are not sure they will survive. The civilizing systems that should restrain a dangerous nature are not functioning and the human expertise that could have repaired them is lost to the belly of a dinosaur. The practical as well as theoretical moral is: never underestimate the complexity and dynamics of living systems. Systems of a certain complexity will inevitably become chaotic and subject to

“strange attractors,” drawing the system into a pattern that is never exactly the same. As a result of this ecosystems become uncontrollable in the long run. They overflow the banks. They develop and expand. They finally destroy all the technological controls, including modern genetic and information technologies, that are really quite simplistic when weighed against nature.

Malcolm provides a perspective on a drama that is based on a cybernetic and evolutionary understanding of the activities of complex systems over the past 20 years; the ecologists have noted sudden changes in the internal dynamics of the entire biosphere. Malcolm, so to speak, illustrates the whole dramatic perspective with this brief account that would make any biologist green with envy in terms of presentation. This setting of the principal drama within our scientific theory is, regrettably, almost lost in the film version of the drama, with its focus on action-horror and computer generated special effects instead of the inherent scientific drama.

The theme of how people commit hubris when they believe they can/should rule over living nature is also present in a classic novel like *Frankenstein*. Within the field of cybernetic anthropology, it was especially expressed by Gregory Bateson during the 1960s and 1970s, in his book *Steps to an Ecology of Mind* (1973). Here Bateson describes our culture as a hubris-culture. The ecological movement’s thematization of the increasing global environmental crisis further emphasized this approach. It is thus in the light of the ecological realization that Crichton, using the fiction-horror genre as fuel, delivers the past 20 years’ paradigmatic shift of our basic understanding of scientific self and nature. As shown in Table 2, it is possible to view the conflict between the two sets of opinion in the light of technological knowledge and the underlying scientific orientations.

The novel also describes the impact of the human factor. No matter how good technology becomes, it will never be able to counteract human criminality or human flaws such as, for instance, the accident at the Three Mile Island nuclear power plant in Pennsylvania, US. The book is filled with a sense of technological pessimism pertaining to the belief that technology may provide final power and control over nature. There is a pure eco-ethics theme throughout the book pondering what the order of things is and to what degree we can trust it (Brier, 1996). Here follows Malcolm’s powerful speech about the ridiculousness of prediction and the uncontrollability of ecosystems:

“Computers were built in the late 1940s because mathematicians like John von Neumann thought that if you had a computer—a machine to handle a lot of variables simultaneously—you would be able to predict the weather. Weather would finally fall to human understanding. And men believed that dream for the next forty years. They

Table 2. The differences between the old physical-technological optimistic paradigm and the bio-ecological technological pessimistic paradigm

Paradigm	Technological optimism	Technological pessimism
Fundamental sciences	Physics and chemistry	Ecology, thermodynamics and chaos research
Focus	Technology and power	Environmental issues and sustainability, development
Examples	Nuclear power, trip to the Moon, computers, genetic engineering	Aswan Dam, Three Mile Island, the ozone hole
Main orientation	Centered around humans	Centered around the biosphere

believed that prediction was just a function of keeping track of things. If you know enough, you could predict anything. That's been a cherished scientific belief since Newton." . . .

"Chaos theory throws it right out the window. It says that you can never predict certain phenomena at all. You can never predict the weather more than a few days away. All the money that has been spent on long-range forecasting—about half a billion dollars in the last few decades—is money wasted. It's a fool's errand. It's as pointless as trying to turn lead into gold. We look back at the alchemists and laugh at what they were trying to do, but future generations will laugh at us the same way. We've tried the impossible—and spent a lot of money doing it. Because in fact there are great categories of phenomena that are inherently unpredictable."

"Chaos says that?"

"Yes, and it is astonishing how few people care to hear it," Malcolm said. "I gave all this information to Hammond long before he broke ground on this place. You're going to engineer a bunch of prehistoric animals and set them on an island? Fine. A lovely dream. Charming. But it won't go as planned. It is inherently unpredictable, just as the weather is." (Crichton, 1991: 158–9)

This is an amazingly effective, correct and dramatic introduction to some of the most significant insights of modern science and their consequences in relation to a number of technological problems that flood industrialized societies. Other writers have approached these topics using popular science, such as Gleick (1987) with his book on chaos. But I have never seen it carried out with such dramatic effect and scientific sobriety. This kind of hyper-complexity view and analysis has now also reached the social sciences (see for instance Qvortrup's book *The Hypercomplex Society* from 2003).

The plot and scenario of *Jurassic Park* are continued in the successor *The Lost World*; this time, however, the focus is on theories about what factors may cause the extinction of a species. The dinosaurs constitute the working example but, obviously, the implications are directed toward the human race. This becomes even clearer when the scientists focus on the fact that behavioral changes of a species can lead to extinction if they go against the eco-foundation of that particular species. The artificially hatched raptors lack herd instinct because they are all "test-tube babies." *The Lost World* deals especially with Stephen Jay Gould's theories. They, too, express a new rupture in evolutionary research, which can be seen in Gould's book *Wonderful Life: The Burgess Shale and the Nature of History* (1989). Here he suggests how the reinterpretation of some paleontological fossil finds might influence our perception of evolutionary mechanisms. It is a fine and justly famous popular science book that, even though it is written in a personifying and dramatizing language, can never match the combination of information and entertainment Crichton presents. Here is the theme from Gould that Crichton further elaborated on in *The Lost World*: "The history of life is a story of massive removal followed by differentiation within a few surviving stocks, not the conventional tale of steadily increasing excellence, complexity, and diversity" (Gould, 1989: 25). The main plot of the book is, in fact, the researchers' investigation of factors that might have caused the extinction of the dinosaurs with special focus on the effect that behavioral changes have on a species' survival capacity. This theme is almost lost in the film version, which, by the way, mixes parts of the first book with the plot and completely changes the ending relative to the book.

Crichton here applies a form of communication that only very few scientific writers can match, with problems that are certainly very abstract.⁸ In fact, they are scientific and

philosophical problems dealing with something as theoretical as what kind of knowledge science really is and how it may interplay with other knowledge types. They are the problems already mentioned in the introduction of this article as our society's "symbolic generalized media" (Luhmann, 1995) such as power, money, art and love.

4. Conclusion

Developments within the fictionalization of scientific subjects in the 1990s are so unique that I believe it is safe to talk about a new type of literature, which I have chosen to call *Ficta*.

I conclude that with regard to *Jurassic Park*, and its successor *The Lost World*, we are not dealing with simple popular scientific information or faction. Here we are talking about the new knowledge information type, *Ficta*, which we have analyzed. It is one of the new types of fictionalized popularized science that have been developed in the past 20 years. I have made a small schema of them in Figure 2.

If we place the mentioned genres from popular science and fiction on a scale ranging from the factual non-fiction at the bottom and the fictional on top, I would like to suggest the following order: the popular communication of scientific facts, the popular scientific essay, faction, science in fiction, *Ficta*, and, finally, science fiction, because this last is sometimes turned into a literary genre that does not aim at communicating anything scientific, but aims simply to be entertaining. However, in its serious form, science fiction enters the range of serious *Ficta* as in *Star Trek* and a film like *Contact*. This movie combines science in fiction, with *Ficta* and science fiction in an unusual way where the role of faith in science, religion and politics is discussed together with the proper goals of science and its relation to power and money in a democratic society. Thus, the main difference between science fiction and *Ficta* is that science fiction puts more emphasis on technology and social consequences than the actual communication of a scientific understanding of the underlying theories.

Faction represents a fictionalized presentation of events that have taken place and are recorded, but without adequate documentary film material or recorded first-hand accounts to generate a pure *non-fiction* product. The journalist may also choose to employ a more personal and fictional angle when telling the story.⁹

Fiction

Science fiction

Ficta

Science in fiction

Faction

The popular scientific essay

The popular communication of scientific facts: Non-fiction

Facts

Figure 2. Ranking of old and new fictional popular scientific communication forms on a scale between the facts- and the fictional-influenced communication forms.

Contrary to this, Ficta is a dramatization of the actual scientific theory or competing theories on a problem. It is this problem that is staged, dressed in flesh and blood, as a fictive interpersonal drama to present, illustrate and explain its perspectives in order to make the presentation fascinating for non-scientists and perhaps non-scientifically educated persons or people educated within other knowledge fields.

The fact that the actual scientific core problem of the subject matter is fictionalized is most typical for Ficta. We are dealing with a fiction that constructs factual material. Fiction is the vehicle and the plot is based on facts of the matter. No one believes the story is factual. Everyone knows that it is fiction, a novel, but the facts play a leading role and are introduced in the form of scientific theories. But since Crichton also includes technology, especially genetic engineering and its social consequences, *Jurassic Park* also has science fiction traits.

The central plot of the novels is constructed by way of the new understanding of important aspects of reality that scientific theories provide—i.e. competing scientific theories that aim to provide the best description and solution to some problem. This should be considered as opposed to the *faction* concept.

Still, I think that Crichton takes the prize with his maybe most ambitious book, *Prey*, where he describes and combines genetic engineering, nanotechnology and distributed programming, theories of self-organization and swarm-intelligence at a very high level combining them into a horror science fiction thriller story about what can happen when these fields are combined by reckless scientists and business people. But it also raises the foundational problems of what life, intelligence and consciousness are and what the difference is between machines and embodied living beings (Brier, 2003),¹⁰ which are ongoing problems in a culture like ours, lacking a broadly accepted theory of consciousness.¹¹

Prey has a section with highly relevant scientific reference works, which is quite unusual for this genre. I think this is a good idea, however, as it sends a clear signal that this book is based on the best present day scientific knowledge about the subject area.

The problem of the mixed genres is that lay people, as with all popular science, do not have a real chance to evaluate the quality of the scientific knowledge the book is based on. Talking to librarians, I find a concern about lack of clear indications of this kind; when are we dealing with fiction and when are we dealing with serious popular science that is responsible to its roots in the scientific community? Many students that have read the present analysis of Crichton's books in my courses have told me that they had not seen the majority of the aspects I identify on the first reading of the novels. They were not prepared and they could not evaluate the seriousness of the books. So, the librarians' concern seems to be warranted. The quality criteria and ethical rules that apply to standard popular science should also be used—even more rigidly—for Ficta. For Ficta to really work, there has to be a clear sign and code of scientific ethics, as in the traditional popular science books, to make the serious foundation of the novel clear to the consumer.

Just recently I realized that the American author, Greg Egan, also writes Ficta novels as I mentioned in the introduction. His book *Distress* is full of discussions of philosophy of science, ethics, and spiritual matters, personified by various combating political and spiritual movements. Even though this is complicated material, it is a very entertaining book. There are probably more writers that I do not know about. This short article has not been a comprehensive study of Ficta writers or the historical development of Ficta, but an argument for the concept of Ficta as a new genre and analytical instrument.

Thus, the functionally differentiated media are remixing in the mass media of the new Agora. This is the literature of a mode 2 society. It is no longer publish or perish, it is *Agora or agony*. Popularize and tell your story in the Agora, or lose the game of knowledge and

power. I am considering presenting my next book on philosophy of science as a crime story: *The death of scientific truth*. A “whodunnit,” of course.

I have only had time to discover a limited number of the short stories, novels, movies, plays and television series that can be categorized under the heading Ficta. But my work with this concept makes me see more and more examples, such as for instance the mixed media work *Radiant Cool: A Novel Theory of Consciousness* by Dan Lloyd. This book combines Ficta with “fiction in science” and a part that is straight classical popular science.¹²

I hope that those scholars who find this new genre-classification useful will report new and old works that fall under this heading and that investigations of its impact on public understanding of science can also be carried out in future research projects.

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Notes

- 1 The main part of the present analysis was published as Chapter 6 in my Danish book *From Facts to Ficta: Science Communication and Popular Science in the Age of Entertainment* (Brier, 2002).
- 2 I have personally asked around 20 students who read my analysis of these books and who had read the books before if they had noticed the Ficta aspects. Most of them answered that they had seen some parts, but only clearly now, after they had it conceptualized. I have also talked to librarians who did not like this mixture of genres because they thought it was too difficult for the public to judge what was reliable knowledge and what not. (The unraveling of the fraud in the sources of the *Da Vinci Code* comes to mind.) This is clearly a topic for further empirical study.
- 3 (John) Michael Crichton was born in Chicago, Illinois, on 23 October 1942 as the eldest of four children. He was educated at Harvard University, A.B. (*summa cum laude*) 1964 and was a visiting lecturer in Anthropology at Cambridge University, in 1965. After being a Henry Russell Shaw Travelling Fellow, 1964–5, he entered Harvard Medical School, M.D. and completed his M.D. in 1969; he spent one year as a postdoctoral fellow at the Salk Institute for Biological Sciences, La Jolla, California, 1969–70. In 1988, he became a visiting writer at the Massachusetts Institute of Technology. He is the recipient of numerous awards, such as the Mystery Writers of America’s Edgar Allan Poe Award, 1968 (*A Case of Need*, written under the pseudonym Jeffery Hudson) and 1980 (*The Great Train Robbery*); the Association of American Medical Writers Award, 1970 (*Five Patients*); the Academy of Motion Picture Arts and Sciences Technical Achievement Award, 1995 (“for pioneering computerized motion picture budgeting and scheduling”); the George Foster Peabody Award, 1995 (for *ER*); the Writers’ Guild of America Award, Best Long Form Television Script of 1995 (for *ER*); the Emmy, Best Dramatic Series, 1996 (for *ER*). In 2000, a new ankylosaurus species was named after him (*Crichtonsaurus bohlini*).
- 4 To get an overview of Michael Crichton’s book production see Trembley (1996). Here is a list of his works.

Novels: *The Andromeda Strain*, Knopf, 1969; *The Terminal Man*, Knopf, 1972; *The Great Train Robbery*, Knopf, 1975; *Eaters of the Dead*, Knopf, 1976; *Congo*, Knopf, 1980; *Sphere*, Knopf, 1987; *Jurassic Park*, Knopf, 1990; *Rising Sun*, Knopf, 1992; *Disclosure*, Knopf, 1994; *The Lost World*, Knopf, 1995; *Airframe*, Knopf, 1996; *Timeline*, Knopf, 1999; *Prey*, Harper Collins, 2002.

Films: *Pursuit*, ABC Movie of the Week, 1972 (director); *Westworld*, Metro-Goldwyn-Mayer, 1973 (writer/director); *Coma*, Metro-Goldwyn-Mayer, 1978 (writer/director); *The Great Train Robbery*, United Artists, 1979 (writer/director); *Looker*, The Ladd Company, 1981 (writer/director); *Runaway*, Tri-Star Pictures, 1984 (writer/director); *Physical Evidence*, Columbia Pictures, 1989 (director); *Jurassic Park*, Universal, 1993 (co-writer); *Rising Sun*, Twentieth Century Fox, 1993 (co-writer); *Disclosure*, Warner Brothers, 1994 (co-producer); *Twister*, Warner Brothers/Universal, 1996 (co-writer, co-producer); *Sphere*, Warner Brothers, 1998 (co-producer); *The 13th Warrior*, Touchstone, 1999 (co-producer).

Other films from Crichton’s books: *The Andromeda Strain*, Universal, 1971; *The Carey Treatment*, MGM, 1972; *Dealing: Or the Berkeley to Boston Forty-Brick Lost Bag Blues*, Warner Brothers, 1972; *The Terminal Man*,

Warner Brothers, 1974; *Congo*, Paramount, 1995; *Lost World: Jurassic Park*, Universal, 1997; *Timeline*, Paramount, 2003.

Television: *ER*, NBC, 1994 creator (co-executive producer).

Computer games: *Amazon*, Tellarium, 1982; *Timeline*, Eidos, 2000.

- 5 New Journalism is a type of writing where the journalist presents factual information in a fictional form often with his own person as the subjective storyteller emphasizing description, narration, and character development to bring readers closer to the human element of the story. It is often used in in-depth feature articles. Well-known New Journalists are Hunter S. Thompson, Gay Talese, Thomas Wolfe, Joan Didion, and John McPhee. Articles in the New Journalism tend not to be found in newspapers, but rather in magazines such as *The New Yorker*, *New York Magazine*, and *Esquire Magazine*. But, at least in Denmark, it was taken up in some of the more intellectual newspapers.
- 6 A part of this sequence is included in the film *The Lost World*.
- 7 Isabelle Stengers earnestly and most successfully argued against a couple of physicists at the scientific conference, “Time, Heat and Order—Conference on Metaphysics and History of Science and Nature” at Aarhus University (Denmark), 8–11 November 1997. Regrettably, Prigogine could not join the conference, but I had talked to him some years earlier when I was on a panel at one of his talks in Denmark. However, a lengthy conversation with Stengers confirmed that they both stick to the viewpoints they originally published in their book in spite of many critical attacks from physicists of classical training. See also Prigogine (1997).
- 8 In the present analysis, I have not given any kind of literary quality analysis, which is outside my expertise. These books are highly popular thrillers, employing a very compact and visual language that makes it easy to construct movies based on them. They are certainly not high literature from a humanistic scholarly point of view. But, nevertheless, they are very effective from the popular science dissemination point of view.
- 9 When Harms Larsen thus writes (in my translation):

I will, in the following, use the description name *faction* as a leading concept covering all types of media productions where the mix of “facta” and “fiction” is interesting and problematic and where this particular mix may influence—either the way the audience receives the message—or the way the transmitter produces and presents the message—or, most often, both ways. (Harms Larsen, 1995: 12)

it is then safe to say that Ficta is a subgenre of faction, or—which I am more willing to state—that Harms Larsen’s definition here becomes too broad to be useful for distinguishing the various communication forms. As well as Ficta, the scientific essay is also included. I would, however, like to keep the scientific essay within popular science when it has the form that is used both by Hawking and by Nørretranders (1999). It is not a question of actual fictionalization but just the use of the faction perception, such as personal conclusions, viewpoints, and, perhaps, a few biographical angles. Within Ficta fictionalization is done in a different way than in standard faction.

- 10 See for instance Richard Mateosian’s (2003) reflections on it.
- 11 For more than 10 years an international conference series with the title “Towards a Science of Consciousness” has organized interdisciplinary debates about this problem and the *Journal of Consciousness Studies* has attempted to bring philosophy, science, religion, Buddhism and mysticism together in a discussion of this great unknowing in our culture.
- 12 Allan Combs is not too happy with the final result of mixing all these genres in his review on the “Towards a Science of Consciousness” Conference home page <http://www.sci-con.org/reviews/20050702.html>. But as a principle the attempt is interesting. And a part of the development of *Edutainment*.

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