Closer to Truth: Science, Meaning, and the Future

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Acknowledgments

Closer To Truth, based on the pubic television/PBS television series of the same name, brings together leading scientists, scholars, artists, and thinkers to explore fundamental issues of life, sentience, universe, and meaning. We seek to make state-of-the-art ideas in science, philosophy, and human understanding accessible, intriguing, and absorbing to intelligent audiences.

There are many people to thank for supporting my lifelong process of imagining, creating, planning, producing, writing, editing, thinking about, talking about, wondering about, and worrying about *Closer To Truth*—the ideas, the television series, and the book. They are my friends, family, mentors, and associates. I particularly acknowledge Mel Rogers, president of KOCE-TV, the PBS station in Huntington Beach (Orange County), California, for taking a chance on the series and for helping with the name; Jack Martin, for offering the encouragement and providing the platform to produce the pilot; and Dr. Shigehisa Okawara, for being my first mentor when he encouraged a 16-year-old college freshman to work in his neurosurgical laboratory.

I am pleased to recognize those who worked on the *Closer To Truth* television series on which this book is based: Linda Fefferman, for directing and producing the specific shows; Bruce Murray, professor emeritus of planetary science and geology at Caltech, for his ideas and advice; Sharon (''Bunny'') Taveras for distributing and marketing the television series; and Pamela McFadden, for her competence and commitment in all manner of assistance.

I thank my wife Dora and now-grown children Aaron, Adam, and Daniella for their long-standing support, and my parents, Lee and Louis Kuhn, for appreciating (if not always understanding) my sometimes unorthodox activities. In an interesting turn of events, this book was published in China prior to its being published in English, and for this I thank my business partner (and friend) in China, Adam Zhu.

Closer To Truth, its ideas and energy, are the product of a passion to comprehend in a lifetime of wonder. I do not deny a continuing search for meaning or purpose while I do affirm that a personal predisposition to challenge current belief demands high standards of analytical rigor and critical thinking. This is the mission of *Closer To Truth*, which, when it works, may help explore the human condition and spotlight, if not decipher, ultimate issues.

Foreword

No End for Science Exploration

Since the Renaissance human beings have gradually shaken off the mentally constricting shackles of irrational ideas and have walked up the rational road of the experimental sciences. In the subsequent 400 years, humans drove the advancement of modern science and technology, thus enhancing their abilities to understand and deal with nature, and penetrated the profound depths of the physical world. Francis Bacon's motto "Knowledge is power" has become common wisdom. Before the twentieth century, motivations for scientific study were often personal curiosities, but much has changed in the past 100 years.

Since science has become the fundamental driving force for the prosperity of nations, the growth of economies, and the welfare of peoples, each government sets up scientific research systems, guides the cause of research endeavors, implements "Big Science" projects, conducts scientific education, and encourages applications. All these undertakings have generated rapid advances in science and technology, and thereby enabled human society to stride forward into the era of a knowledge-based, high-tech economy in which everyone can enjoy the fruits.

The emergence of modern human thinking took place no more than 10,000 years ago, a mere instant of time compared with the three billion years of life on earth. Furthermore, only 400 years have elapsed since modern science first appeared. Humans are still young in their quest for knowledge about Mother Nature. It is as if modern science and technology were born just last night.

However much knowledge we seem to have accumulated, our understanding about nature is still limited. Pluto, formerly one of the nine planets of our solar system, has only made one and half orbits around the Sun since

Copernicus published "On the Revolution of the Heavenly Orbs" (1543). The first mammals, the remote ancestors of human beings, appeared less than 200 million years ago, a duration not even sufficiently long for the Sun to complete a single rotation around the center of Milky Way.

Some scientific theories, classical or modern, are often recognized to be at best stunning improvisation. For example, the Big Bang Theory, the standard model of the origin of the universe as we know it today, a theory that is consistent with most laws of physics and astronomic observations, is still unable to explain the origin of the singularity from which the Big Bang sprung forth. Many scientists are not convinced that such a singular point could be the origin of the entire mass-energy of the universe. Some physicists claim there was nothing at all before the origin, and would, in their joking manner, "consign to Hell those who asked such 'stupid' questions."

Commencing in the latter part of the twentieth century, space technology offered the opportunity for human observation of the universe from outside the earth. Before then, all we knew about nature was gleaned from the surface of the earth. Manned and unmanned space observations have confirmed that, as far as we can see, most of the physical laws are as effective elsewhere in the universe as they are here on earth. But these observations have also challenged some old science paradigms. To my recollection, 50 years ago few people believed that life could exist in extrasolar systems. Although there still is no evidence for extraterrestrial life, mainstream science now recognizes the value of the new discipline of astrobiology.

The sun is only one among 100 billion stars in our own Milky Way galaxy. The earth, too, does not seem so special, nothing more than a fortunate planet. In spite of how magnificent modern science and technology seem, and how grand our science mansion looks, the underlying foundation of virtually all we know comes from living on the surface of the earth. We are bound by earth and solar system, and even reaching the nearest exostar, Proxima Centauri (as we call it), seems virtually impossible. To realize the long dream of mankind to travel into extrasolar space we need new ideas, concepts, theories, technologies, and mechanisms far beyond current frameworks. Nothing short of a revolution similar to what quantum mechanics did to Newtonian mechanics would be necessary to make such vast journeys possible.

There is much evidence in palaeoanthropology that our human ancestors diverged from Hylobatidae and Pongidae, the fellow families of Hominoidea, many millions of years ago. As *Homo sapiens* became the first species capable of rational thinking, we are appreciative and justifiably proud of this remarkable increase in mind power. However, we should not be overly arrogant, because we can never disconnect ourselves from our humble biological origins; most of our behaviors and activities have seldom broken free from the instinctive, competitive rules of the animal kingdom. Even after two centuries of arduous campaigning for democracy around the world, there is little change in the Law of the Jungle.

In the history of science, we often observe the same strictures and rigidities appearing in diverse forms. For millennia human beings considered themselves to be the core and center of all purpose and principle. Before Copernicus even the most enlightened thinkers assumed without question that our sun and all other stars had to circle around the earth, and that the existence of all living things were here solely for the benefit of Adam's and Eve's offspring. The masses had to submit to the Son of Heaven, just as monkeys have to obey their king.

An elegant postulate in science is called the "anthropic principle," which means that all scientific laws and processes of Nature, the entire flow of universal history, must somehow exist to favor (or at least be compatible with) the emergence and sustained existence of human beings. Yet human history itself is rife with the absence of such harmony. We witness daily the gross violations of ethics and morality. Science itself has a long history of being resisted or attacked by politics, religion, and common customs. Bruno was burned; Galileo was persecuted for much of his long life; Martin Luther was assassinated; and Ma Yinchu was animadverted1. Does all this, too, come from the "anthropic principle?"

Fortunately, from the beginning of the twentieth century, general conditions for intellectuals, at least for scientists, began changing for the better. Physicists who discerned the mechanism of nuclear fusion and predicted the inevitable death of all stars, including our Sun, went free of punishment and won Nobel Prizes even though they were, in essence, the ultimate doomsayers. Their theoretical calculations proved that all life on earth including human beings will become unavoidably extinct along with the death of our Sun some billions of years from now, if we *Homo sapiens* are not able to find innovative solutions to change our destined fate.

Such annihilative forecasts, of course, are terribly discordant with mankind's long-range, fundamental interest. The fact that such a certain cataclysm could be accepted calmly by society would suggest that in some sense the impact of the "anthropic principle" is weakening. If human beings can evolve up into a higher state of being, perhaps we could penetrate deeper into the still-dark mysteries of scientific truth. However, human beings, dubbed Naked Apes by some anthropologists, are still biological members of the animal kingdom. Hence it would take a great period of time to divest ourselves of inherited habits. Or rather, we can never break away from our animal natures.

Throughout the entire history of mankind, a traditional culture of hierarchies dominated societies: young follow elders; son obeys father; populace submits to emperor; all yield to Heaven. Notwithstanding the magnificent social and psychological benefits of such hierarchies for maintaining order and stability, the rigidity of such structures work to suppress the talent of those few human beings who, for the sake of breakthrough scientific inquiry, are able to challenge current belief and change the status quo. Scientific

development, with its need for creativity, innovation, and for defying the accepted order, is often disadvantaged if children must always submit to their parents, if students must always believe what their teachers impart. When textbooks are sacrosanct, when sermons are as if from God, when authority is absolute, when it is forbidden to modify existing scientific theories or to buck authority, reject parts of standard answers, and find new solutions, true science can only be constrained. All these archaic ways of thinking, though they have their social graces, are incompatible with the modern scientific spirit.

The one and only correct way to develop frontier and beyond-the-frontier science and technology is to encourage young people to contribute new ideas without fear or favor, to experiment over and over and again and again, to observe from diverse points, to try to discover new phenomena, to put forward hypotheses no matter how strange, and to devise new theories no matter how different, odd, or unaccustomed.

All of our current scientific knowledge, theories, and laws, whatever we have believed and believe with good reason, must be deemed to be correct only relatively and conditionally. We should always be prepared for change. And we should never forget that our view and observations are largely gained from the surface of one planet. Such a perspective, no matter how impressed we are with what our contemporary science has achieved, is far too narrow, and our scientific experiences, measured in scant thousands of years, are far too brief. We know little about the deep ocean, the inner earth, the Kuiper Belt and Oort Cloud, the Milky Way Galaxy, and the multiple billions of galaxies breathtakingly far away in space and time.

It is not exceedingly rare that there may be different hypotheses to account for the same phenomena of nature, and it is only by repeated experiments and continued theoretical substantiation that one hypothesis will come to be favored over the others. For example, between the end of the nineteenth century and the first half of the twentieth, there emerged three kinds of atomic models, each derived from a different perspective (with different extrapolations), that seemed to account for the atomic nucleus: liquid-drop model, shell model, and collective model, each one overlapping, interacting with, and complementing the other two. We continue to use each of these models today. However, even if our current understanding of scientific theories, models, or laws seem perfect, they still may not ultimately hold up intact, because in many areas of human understanding the ultimate truth remains far, perhaps forever far, in the distance. All we humans should expect is to move "closer to truth," asymptotically closer and closer to our goal of ultimate knowledge, though never knowing for sure if we will ever arrive at the final destination of absolute, last Truth.

The age of the earth is proven to be 4.6 billion years, and if we are fortunate enough to escape devastation by impacting asteroids, human beings and our science could last another few billion years before our sun grows

old and begins to expand to swallow the earth in its fiery gases. Yet before that day of our inevitable obliteration, science and technology should be able to find ways for human beings to move to other oases in our vast universe, other habitable planets in our galaxy, so that the torch of human intelligence will continue to shine. Although science is unable to forecast accurately so far into the future, it is obliged to identify likely roads and suggest reliable directions.

Passion for science has become good fashion in almost all human cultures, and it is a particular virtue of oriental culture to respect and esteem forefather scientists. However, science belongs not to any one generation but to all human history. Individual human lifetimes are short and new generations will continue to rise and fall. This is the order of nature: as years pass, the young replace the old. Elder scientists, versed with vast knowledge in their fields, should not be too strict with younger scientists. It is an admirable virtue that elders care for their progeny; as the old saying goes, ''life is short, but caring is long.'' But such care must include the tolerance and respect for deeper annotation and interpretation about conventional wisdom, common understanding, and assumed truth. History has taught us repeatedly that what elders believe is not always correct, and what elders deny is not always wrong. For the long-term interest of human civilization, it is good for elders to create wider spaces for young scientists to explore, and, if they can, to also keep their own minds open.

The history of science also indicates that when a major scientific breakthrough occurs, people tend to regard it as an Ultimate Truth. During the twentieth century, quantum mechanics and particle physics made such remarkable advances so that by the 1980s some declared that ''science had ended'' and that Ultimate Truth—which could explain anything, a ''Theory of Everything''—was within our grasp. However, in less than 20 years, new mysteries emerged. Evidences of accelerating cosmic expansion, long believed to be impossible due to the inevitable and dominating power of gravity, were found by the satellite observations of COBE (Cosmic Background Explorer, 1989) and WAMP (Wilkinson Microwave Anisotropy Probe, 2001). In 1998, leading cosmologists and astronomers declared that there was some kind of ''dark energy'' existent throughout the universe, a kind of hidden power source which propels all matter in the universe to expand against the inward pull of gravitational attraction, and that such dark energy would have to account for an astounding 73 percent of the total mass-energy of the universe.

Physicists suddenly had no choice other than to realize that something heretofore no one knew existed now constitutes most of everything that exists. Moreover, the observational data indicated that only about four percent of all the energy-matter in the universe is ordinary matter, so that the remaining 23 percent of matter must be ''dark.'' It is a dark matter that reveals its presence by gravity, such as in the higher rotational speeds of stars

in galaxies, but it cannot be seen at all. Up to now, our best science cannot describe what dark energy and dark matter really are nor explain how they are generated. No wonder this latest astounding discovery silenced those advocates who were announcing the "end of science."

Modern science in China started in the twentieth century, 200 years later than it did in Europe, and in recent decades has begun to flourish. It took China a whole century to make up for its somnolence and end its long hiatus from the frontiers of contemporary science. Most science and technology China learned from the West. Yet at the beginning of the twenty-first century it has become apparent that China's science cannot follow the old paradigm of simply continuing to be a follower of the West. They must create a new paradigm so that not only does China come to rely on its indigenous intellectual strengths but also make original contributions to enrich all humanity and thereby benefit the entire world.

Scientists commonly accept the proposition that students may and must be as good as their teachers, standing on their shoulders, as it were, to reach higher into the knowledge firmament. Young generations must be encouraged to be innovative, creative, and imaginative in all sectors of society, especially in science and technology.

I am pleased that my friend, Dr. Robert Lawrence Kuhn, decided to publish *Closer To Truth: Science, Meaning, and the Future*, which brings together leading scientists, scholars, and artists to debate the fundamental issues of our times, including brain and mind, creativity and thinking, life and health, technology and society, and universe and meaning. The book aims at encouraging young people to create, innovate, and contribute to scientific progress for all humankind.

Dr. Kuhn and I often speak on the importance of science and the scientific way of thinking as crucial for the peace and prosperity of all countries and of all humankind. Entrusted by Dr. Kuhn, I am pleased to write this foreword. These are subjects I am thinking about these days, and it seemed to be a good opportunity, in the context of his book on the meaning and implications of frontier science, to communicate with fellow readers with similar interests. My hope is that such thinking might help catalyze a more flexible and innovative academic environment in China and throughout the world, and thus inspire greater progress in science and technology during the twenty-first century. Such is the origin of the above narration.

Dr. Song Jian
Chairman, Beijing Institute for Frontier Science
Past Chairman, State Science and Technology Commission
Past Chairman, Chinese Academy of Engineering
Beijing, People's Republic of China
March 2006

Note

1. Ma Yinchu (1882-1982) , the president of Beijing University (who had earned a master's degree in economics from Yale and a Ph.D. from Columbia), opposed the assertions that unchecked population growth was no longer a problem under socialism.

Introduction

What is *Closer To Truth*?

Closer To Truth: Science, Meaning, and the Future is a unique series of discussions about fundamental issues that explores the latest scientific research, philosophical thinking, and expressions of human creativity. Critical to the process, *Closer To Truth* tests conventional wisdom, seeks truth wherever it may change, sees the humor as well as the import of tradition-breaking ideas, and discerns what it means to be human in the twenty-first century with our continuing search for collective purpose and individual meaning.

We confront the mysteries of mind, matter, and meaning, bringing together prominent thinkers to discuss what is happening at the leading edge of science and its broad implications for human understanding. Some of the world's most esteemed experts, including Nobel laureates, best-selling authors, and renowned scholars, engage in a series of spontaneous and intimate conversations that combine leading-edge science and informed intuition. *Closer To Truth* is an inside opportunity to witness how the pioneers in humanity's quest for knowledge chart their expeditions into the unknown, journeys that are marked by a rigorous pursuit of truth, a readiness to challenge current belief, a willingness to overturn dogma, an open-minded exploration of inferences and implications, and a tough-minded reliance on critical thinking.

I seek multi-faceted perspectives on some of the most exciting and controversial "big issues" of our time. Areas of inquiry are brain and mind, cosmos and astrobiology, biology and medicine, science and religion, and science and our world.

What organizing theme brings together such topics? My own personal, perhaps idiosyncratic take on the human condition. Whenever and wherever

new knowledge challenges accepted principles, I find topics. I sometimes use three "C words" to mark *Closer To Truth*—consciousness, cosmology, creativity. My bet is that what I like, you like.

The contributors to this book—participants in the *Closer To Truth* public television series—are among the leaders in their fields; these informal, unrehearsed discussions, derived from the show's transcripts, give a good sense of state-of-the-art thinking at our intellectual frontiers. We can't talk about science's role in our lives without including its effect on morality, philosophy, religion, and human ingenuity. This is why religious scholars, philosophers, and science fiction authors as well as psychologists, molecular biologists, and astronomers participate in the dialogues.

Closer To Truth is feel and flavor more than fact and logic, experience and emotion more than reason and analysis. It's not *the* Truth, not even Closest to Truth. It's more process than conclusion; the discussions reflect educated opinion but no certainty, no smugness. There is a welcome measure of ambiguity, complexity, and even occasional confusion.

Topics do not develop linearly; arguments do not flow smoothly. The books our contributors have written are linear and smooth, but these conversations are not. The dialogues in *Closer To Truth* complement our participant's more canonical works, which I commend to you for further reading.

In each chapter, we follow two to four experts from diverse fields or perspectives as they engage one another in the competitive marketplace of ideas. The transcripts are presented essentially raw, except for verbal clean-ups, to preserve the head-to-head spontaneity and the tang of the original discourse. It is fascinating how the group dynamics move these leading thinkers to express themselves in ways dissimilar from their carefully polished writings, revealing strong passions and subtle nuances not commonly heard. What emerges is personality; it's fun to meet the people who are challenging truth, changing truth, making truth—to watch them navigating with less control than they normally have when they speak in symposia or craft their elegant books.

My role as host of the *Closer To Truth* television programs was broadbrush—picking the topics, selecting the guests, moving the talk along. My introductions and conclusions to each of the chapters in the *Closer To Truth* book are more personal mini-essays than analytical outlines; they position or summarize the topic and reflect my particular, perhaps peculiar, orientation. I have fun, and so do the participants, taking the topics seriously but (we hope) not ourselves.

Closer To Truth is work in progress, with no artificial deadline. Forget canned surety or cosmetic harmony. Though the book proceeds linearly, the reader need not. Enter and exit at any point. Select by personal interest, not numerical order. Each chapter stands more or less on its own, presenting the take of its diverse contributors. Comments do not fit together neatly as if pieces in a puzzle. *Closer To Truth* may mean pieces too few or pieces too

many; chapters are not manicured or neat, but reflect the real-time thinking of real-world thinkers. Look for greater dimension and deeper grain; see subjects from various viewpoints; watch for twists and curves.

A primary characteristic of the modern world is science and technology. Knowledge-related changes have a profound effect on our daily lives and on how we perceive ourselves as individuals. Understanding state-of-the-art science can help us to make more informed decisions about the choices the world presents to us.

The biggest challenge facing scientists, scholars and artists today is to get the public to come to new knowledge with an open mind, to acknowledge that many of the advances brought about by scientific research have changed our lives beyond imagination and ultimately, if we are wise, for the better. We invite readers to visit our two websites—www.pbs.org/closertotruth and www.closertotruth.com—where we provide further resources for exploring these topics, including personal information from our guest experts. We also recommend www.scitechdaily.com, a daily resource for intelligent, informed science and technology coverage and analysis.

I hope *Closer To Truth* encourages readers to become more informed and more passionate about the fundamental issues of human existence. *Closer To Truth* seeks to become the resource of record for the meaning and implications of scientific discovery and for critical thinking about who we are, why we are here, and where we are going. *Closer To Truth* will return.[1]

Robert Lawrence Kuhn
Pasadena, California
New York, New York
October 27, 2006

Note

1. As we go to press, we have begun production of our new season of *Closer To Truth*, which will focus on cosmology and fundamental physics, the philosophy of cosmology, the philosophy of religion, and philosophical theology.

Chapter 1

Is Science Fiction Science?

Is science fiction scientific? How about diseases from distant galaxies; wormholes in space; fractures and travels in time; black holes with bad attitudes; weird life forms of every variety; telepaths creating superhumans; minds uploaded into silicon chips; souls downloaded from disposable slaves; "carbon copies" of yourself to expand your experiences in multiple lives; and baby universes created on desktops? Those are some of the ideas conjured up by our expert participants and their science fiction colleagues.

But science fiction can be conceived as an artistic look at human history, society, and even human nature. In this chapter, three distinguished authors of popular science fiction spar over exactly how science fiction is constrained by known science and then question the value of science fiction. The authors describe the way in which science fiction can inspire scientific research and at the same time serve as a warning against our potential misuse of the awesome power of science (citing the novels *Soylent Green* and *On the Beach*). They also good-naturedly point out its limitations—e.g., no science fiction author predicted the personal computer—and wonder why its appeal is not as strong in some countries as in others.

Scenario forecasting has been a military tool for thousands of years but only in science fiction is the limit the writer's imagination. Can science fiction predict the future? Or prevent it? Writer/physicist David Brin argues that George Orwell prevented the 1984 scenario by making people aware of it. But best-selling author Michael Crichton questions why the omnipresence of cameras in society in anyone's hands is "a good thing?" MacArthur Fellow Octavia Butler thinks we have more pressing things to worry about: "Global warming, for one."

Although the history of science fiction writing has always reflected the science of the times, it is perhaps most telling that although the times and worlds change, the behavior of people—and aliens—across each fictional society has remained constant. This chapter is a virtual salon with celebrated inventors of alternative futures.

Expert Participants

David Brin
Author, *Kiln People*, *The Postman*, *Earth*; Ph.D. Space Science

Octavia Butler
Author, *Survivor*, *Parable of the Sower*, *Parable of the Talents* (Nebula Award); MacArthur Fellow

Michael Crichton
Author, *Jurassic Park*, *The Lost World*, *Sphere*, *The Andromeda Strain*; creator, *ER* Television series; medical doctor.

Robert Kuhn: How is science fiction constrained by known science?

Michael Crichton: It's fiction; it's not constrained.

Robert Kuhn: Should it be?

Michael Crichton: No, I don't think so. Science fiction should make sense; it should be internally consistent; it should relate to contemporary reality in some fashion that's recognizable—these are more important than whether or not every bit of the physics really works right. I'm very troubled if something really can't possibly occur. I don't mind if there's theoretical running room, but if it's very clear that something really can't happen, can never happen, and is never going to happen, then that's a problem for me. In general, I try and avoid that.

Octavia Butler: If there are no constraints, I think it's fantasy, not science fiction.

Robert Kuhn: How would you differentiate science fiction from fantasy? It seems that science fiction describes how the world or the universe might look one day, for better or worse, and technology, real or fanciful, plays an important part. Fantasy, on the other hand, takes place in an alternative world, often in an era that has similarities to the Middle Ages where magic is often an important ingredient and technology is seldom very much developed.

Octavia Butler: I think the only requirement for fantasy is that it be internally consistent. As for science fiction, if you're going to use science, you should make some effort to use it intelligently, not necessarily correctly, but intelligently. This means that if you want to do something odd, you are at least aware of it and justifying it.

Robert Kuhn: Take mental telepathy, mind reading. Most scientists would say it doesn't exist, can't exist. How do you deal with that?

Octavia Butler I had a series of books in which people were communicating telepathically. I didn't care whether it was real or not, possible or not. What I was looking at was how that kind of communication, how a deeper form of communication, would affect people and their relationships. They get involved in war because they understand each other far too well. So, with me, I wasn't using telepathy as science; I was simply using it as a tool to take a fresh look at the human condition.

Robert Kuhn: Do you ever feel the compulsion to push science, to prod science or to predict science?

David Brin: Sure, all of the above. Maybe I feel a little bit more liberated because I write hardcore science fiction, about physics and stuff like that some of the time, so I feel at liberty to press the envelope in any direction I choose. Even if my science is implausible, even if it's impossible. But I feel a compact with the reader to make it clear which kind of science fiction I'm presenting. If we're taking a vacation from reality in this short story, I try to make it obvious. If in one novel I'm going to try to play with scientific reality, what I write will fit within the plausible range of human science. Of all science fiction authors, only a small minority was trained scientifically, but almost all science fiction authors have enjoyed reading history while growing up. And so, perhaps an alternative name for science fiction should be "speculative history" (including future histories) because we deal with different pasts, alternative presents, and extensions of the human drama into the future.

Octavia Butler: I have a problem with alternative histories. So many of them seem to figure out how to lead us to where we are now, in one way or another, instead of going anyplace else. Maybe different people are in charge, but the same basic things are happening I have an ambition to write an alternative history in which things truly do turn out as they haven't.

Robert Kuhn: Can science fiction, though, enable us to deal with alternative futures in a rational way? "Jurassic Park" in a sense is an alternative future, something that may happen. Is this a vehicle for dealing with alternative futures?

Michael Crichton: There's no question that the kinds of things that we're doing, broadly speaking, are alternative scenarios and that the value of alternative scenarios is to explore futures in a way that's safe and to say something about what they might mean.

Robert Kuhn: When you say "safe," you mean in a fictional world.

David Brin: Einstein used the word *gedanken* experiment, thought experiment, a term he coined. He said that just sitting on a streetcar in Bern, leaving the clock tower and imagining he was riding on a beam of light, was 50% of the creative work that led to his Theory of Relativity. And we all do these kinds of thought experiments with these little nubs of brain above our eyes called the prefrontal lobes, which the Bible refers to as lamps on the brow, to look into the future, to do these kinds of thought experiments. We imagine, "What might happen if. . .?" But, our failures are obvious: no science fiction author predicted the home computer. Murray Leinster and John Brunner came close, but backed away at the last moment because each thought, "computers in the home, it seems logical, it's heading that way, but people will laugh at me."

Octavia Butler: Or, what possibly could we do with computers in the home?

Robert Kuhn: "Jurassic Park" is great entertainment, but is it more? You're probably the wrong person to ask, but I'll ask anyway.

Michael Crichton: I'll give you an anecdote. The book came out, and I was at a resort in Hawai with a lot of physicians from my old alma mater. One of these guys, who was also a bioengineer, read it, slapped it down and said, "It can be done!" And I thought, this is exactly the opposite of what I'm trying to accomplish here.

Robert Kuhn: What was your motivation for writing the book?

Michael Crichton: At that time, I was concerned about two things, which remain concerns: the first is that, in my lifetime, one of the biggest changes that has occurred in science is that it has become commercialized. When I was a student, the majority of scientists worked in academic settings or they worked in places where research was freely available unless you were in a classified, military situation. Now, more and more that's not the case, more and more science is private, more and more of it is secret for financial reasons, and more and more of it is rushed. The problem with biotechnology in particular is, unlike nuclear technology, you don't need a tremendous amount of money, you don't need an Oak Ridge Processing Plant, you can get a little kit and start doing it yourself.

Robert Kuhn: So "Jurassic Park" is a warning?

Michael Crichton: Yes. A warning about incautious research.

Octavia Butler: Do you think you seduced a lot of young people into thinking about paleontology?

Michael Crichton: I think it's great if kids become interested in science as a result.

Robert Kuhn: So science fiction writers are stimulating more scientists who can work for more of those secret companies to do more of these dangerous biotechnology things.

David Brin: If you take my sunny attitude, my sunny interpretation is that the more educated and enthusiastic a public we have, then the harder it is going to be for a small conspiracy to keep things secret.

Octavia Butler: I don't think that a conspiracy is the real problem. There is a serious problem with people knowing, for instance, what is science? Creationism in the science classroom, that kind of thing.

Michael Crichton: Most people don't have any idea about what constitutes scientific information. 15 years ago, many people I know (particularly from San Francisco) were having experts walk around their house with these little meters to check the electromagnetic fields because of the health hazard [of radon]. Today, those people are now buying, at great expense, magnet devices that they stick in their back and on their arms because they now think that these provide a health benefit. So, in 15 years we've gone from a health hazard to a health benefit.

Robert Kuhn: *Jurassic Park* probably taught more people about DNA than most colleges. Is that a way science fiction can influence society?

Michael Crichton: There has been much criticism that *Jurassic Park* is anti-science. The reason is that it took a critical posture to a new technology. At one point, a congressman was going to introduce legislation to ban dinosaur-creating research. I wish it had come to the floor, but someone apparently whispered in his ear that this was not likely to happen.

Octavia Butler: People tend to believe the movies because they see it. I remember having an argument with somebody who was insisting that a tornado was the greatest storm the world could ever know, and there was nothing I could say that would convince her otherwise.

David Brin: Let's beware of our anecdotes, because if there's anything that we need to watch out for as writers, it is clichés—and the biggest cliché in our civilization is that everybody else is stupid. I don't know anybody who calls himself a member of the masses.

Octavia Butler: Not that everybody else is stupid, but that it's terribly easy to fool people. We've all been fooled.

Daivd Brin: As authors, there are some very serious issues we have to think about. Our job is to keep a character, or several characters (with whom the reader or the viewer identifies closely) in peril or in jeopardy for 90 minutes of film or 400 pages of a book. The easiest way to do that is to simply posit that they're not members of a civilization filled with skilled professionals who will help them if they're in trouble. Or to have a really plausible excuse for why your heroes must remain in jeopardy. This is one of the things I liked in *Jurassic Park* in that the characters were very isolated, they had taken precautions, but somebody had deliberately destroyed the precautions. So you have the ridiculous situation of people running away from dinosaurs who should be properly penned up, really having been fairly well explicated how you can have 90 heart-thumping minutes, even though help should be on the way; well, it is on the way, but it's going to arrive too late.

Robert Kuhn: Do you desire to use future fiction to deal with the lack of scientific knowledge in society?

Michael Crichton: I don't know in what way we can help people to understand, when they see a number, how that number is arrived at, unless you've been doing some experiments yourself.

David Brin: My wife is a science teacher and she finds it appalling that so much of the testing going on focuses on memorization. The latest big fad is attempting to emulate what foreign kids do to enable them to test well on standardized exams. So we are stressing memorization, when the font of our success, the reason why 90 out of the 100 best universities on the planet are in the United States, is not our memorization of past facts but our creativity and innovation to pioneer new thinking. But that's not what our kids are now being taught. This emphasis on memorizing facts from lists, from worksheets, undermines the entire basis of science. Where my wife enjoys her best teaching is in conducting experiments and getting her students to draw conclusions and then criticize each other's conclusions and come up with new experiments to settle the matter between them.

Robert Kuhn: Are there issues in the world that you would like to see handled in a science fiction kind of model?

David Brin: I think the most powerful science fiction stories are not those that accurately predict the future, but, rather, those that have prevented futures, the self-preventing prophecy that came across so chilling, and so many people read it and were so moved, that the very scenario that might have plausibly happened didn't happen. The best two examples that really prevented the terrible futures they described are *1984* by George Orwell and *Das Kapital* by Karl Marx, who was probably the greatest science

fiction author who ever lived. Both books utterly and thankfully prevented the scenario that they described.

Michael Crichton: I actually think that *1984* came to pass. Orwell was writing about a totalitarian state, but even though that part isn't the case, the notion that you might live in a society that rather rigorously limits your available behavior, and that watches you to make sure that you do what is desired, is the case. I think we are increasingly seeing behavioral control, but it's not Big Brother doing it to us, we're doing it to ourselves.

David Brin: But that's a major distinction. We are not falling into Orwell's failure mode of allowing the cameras to just look one way in a pyramidal social structure, which is what he feared, the ancient elites lording it over those languishing below. My point is that we've gotten our freedom from elites. Instead, most of the cameras are now in the hands of private people. Governments can install cameras but private people will have many more of them.

Michael Crichton: Why is that a good thing?

David Brin: What we're talking about is evading Orwell's failure mode of the elites staring at us and us not staring back.

Michael Crichton: The notion that every single thing we do is recorded, that every purchase, even every mouse click, can be tracked in every way, that there is no part of our lives where we can truly be alone and where we can say that what we are doing is not available for observation—except maybe going to the bathroom and that's soon to change (how about intelligent toilets that test your excreted fluids and solids). I think the notion that we're all on camera now is going to cause a subtle shift in our natural behaviors. If we were having a conversation before the camera started, we experience some subtle but genuine difference now that the cameras are rolling. I'm on the air, I'm being broadcast, and I'm not being my normal self. I'm concerned that there isn't going to be any part of my life where I can be my normal self.

Robert Kuhn: Isn't science fiction a vehicle for sharpening our perspective of contemporary problems, the technique being to move those problems to a radically different environment so that by stripping away the trappings of normal society, those problems become dissected out and exposed in all their purity?

David Brin: One hopes that this is so, but the problem is this: Orwell warned us about the State looking at us without us looking back at the State, so we're working on a society that might prevent such a situation. Where is science fiction's warning about the kind of society Michael was just describing, a society in which everybody has the cameras—all right, so now we're

free from spying elites, but we all spy on one another incessantly and nobody has any privacy.

Michael Crichton: Let me tell you a story. A friend of mine's husband works in the State Department and since he was about to retire they wanted to have a farewell party for this person. So this friend of mine, she cooks the dinner herself, she has her son serve it, and she has her son's school friend also serve it, because she knows that if she brings in an outside person, a catering person, that no one at the table will talk. And I said to her, "This is a travesty: how is this different from living in the old Soviet Union?"

David Brin: In all of history, no government ever knew as much about its people, as does ours. And in all of history, I contend, no people have ever been quite as free as ours. And both are still true after 9/11.

Michael Crichton: I'm not sure of this at all.

David Brin: We can argue about this, but you find me the historical counter-examples.

Michael Crichton: Just to start, I can give you an easy one. When Bork was nominated for the Supreme Court and it appeared that it was going to be difficult to knock him down on intellectual content alone, one of the mechanisms that was suggested was that they might introduce his videotape rentals.

David Brin: And there's a law that resulted from that.

Michael Crichton: But, the fact is it's recorded!

Octavia Butler: I have a feeling that some of the things that we're doing environmentally, for instance, are going to hurt us a lot worse than the fact that we've got cameras trained on each other.

Robert Kuhn: Have you dealt with that in your fiction?

Octavia Butler: Yes, particularly global warming. In my books *Parable of the Sower* and *Parable of the Talents* global warming is a character. It's there doing things while people are trying to live their lives. And it's not a very popular notion. Global warming is something that people can still forget about, ignore, and, no matter how many novels come out, it's just not that important to most people right now.

Robert Kuhn: David, in your latest book, *Kiln People*, do you look beyond pure entertainment? Do you see an alternative future? Do you seek to push science?

David Brin: *Kiln People* is one of my less plausible ideas. Most science fiction has fallen into the cliché of extending human life by extending it serially, tacking on more years at the end. In contrast, *Kiln People* is founded

on the notion that instead of extending human life serially, how about doing it in parallel, having more life, multiple lives, at the same time—when you are young, when you could really use it. Every morning you lie down on a fanciful "home copier," which then turns out five or six clay copies of yourself (Golems) with your memory, your motivation, your personality, so that you can be in multiple places at once. You then collect the memories at the end of the day and integrate them together in your psyche. The next day, another five places at once—you can work out the enormous permutations. It's a real science fiction novel in the sense that it works out what such a society might be like.

Octavia Butler: Do you really think that five or six parallel lives would be enough?

David Brin: People will never have enough, but I believe that human sanity is based, to some degree, on satiability: if you get what you want, assuming that you're fairly sane, it should at least make you a little bit happier. And it should shift your ambitions from what they were to something else.

Octavia Butler: I think one of the worst things that could happen to you is you get what you want. Then you're finished, you might as well cut your throat now, your life is done.

David Brin: Humans are monkeys; that's not going to happen. People complain that 30% of Americans watch 40, 50 hours a week of television; 100 years ago, that same 30% of Americans watched the fire burning in their fireplace for 40 hours a week.

Michael Crichton: They had better programming back then.

Octavia Butler: When I was a kid, I got to live a nineteenth century existence for a little while. My grandmother had a chicken ranch and there was no electricity, we used a well for water. We told stories. I think they enjoyed scaring the heck out of me. Some of them were true, some of them weren't.

Robert Kuhn: It enriched your life.

Octavia Butler: It did. For one thing, I developed a real love for stories.

Robert Kuhn: Why has science fiction become more mainstream now? What's happened?

Michael Crichton: I think that technology is phenomenally important in our lives. And it's developing at a much more rapid rate. I was born in 1942, so I spent 10 years without television, in the way that Octavia is talking about, and then the arrival of television made an enormously different world. And, a few years after that, the arrival of jet aircraft made an enormously different world. And, by the time you get to personal computers

and the internet, life has become very, very different. Talking about an early book I wrote, *The Andromeda Strain*, today's kids say to me, ''Well, why did you write it that way?'' meaning that old way with all those old things. They can't conceive of the world just 35 years ago, it's such a totally different world today.

Robert Kuhn: Some people say that *The Andromeda Strain* helped prepare us for bio-terrorism, how we would react to an anthrax attack.

Michael Crichton: I always thought it was a remake of *War of the Worlds*.

Robert Kuhn: Does science fiction in other cultures have a different character?

David Brin: Japanese science fiction, Brazilian science fiction are very different than American science fiction. There was very different, and very interesting, science fiction literature that arose out of the old Soviet Union, written by enthusiastic socialists. But if you travel around the world as a science fiction author, you know the difference between those countries in which science fiction is popular and those in which it isn't. In Japan, people pick me up at the airport; in India they don't.

Octavia Butler: I remember a conference in New York for ''African Women of the Diaspora,'' called The Yari Yari Conference, actually, The Future of the Future. There were a lot of people from third world countries where it wasn't as much a matter of press freedom so much as finding the necessities for publishing, such as a printing press, paying for paper, figuring out how to distribute your book, and often all by yourself.

David Brin: But there is another essential point why science fiction is an American literature to some degree, and that is because most of the propaganda coming out of the American experience promote suspicion of authority and, to some degree, tolerance. As Octavia was saying, there are a lot of cultures in which authority is a much more revered thing, or much more of a problematical thing in day-to-day life.

Octavia Butler: Or cultures where there are a lot more needs that aren't being met.

Robert Kuhn: If we had somebody here from China or India or Africa, how do you think they would react to our discussion about science fiction?

Octavia Butler: I think they probably would want us to focus on topics that were more important to them. Take the writer Arundhati Roy who has been arrested in India because she went beyond her writing fiction and criticized something that her government was doing which was very worthy of criticism. People in third world countries would want us to pay more attention to what's really going on in their countries and what shouldn't be.

Robert Kuhn: Theoretically though, all of your fiction is non-culturally based, if you're in a different era, a different galaxy, a different dimension . . .

Octavia Butler: But, really, it's all culturally based, of course.

Robert Kuhn: Though the environment may be different superficially, the characters think and act as if they are in the current culture of the author. Because most science fiction is generated in the United States, does the genre reflect a cultural bias?

Michael Crichton: Or building into our stories a bias that has to do with the level and nature of technological sophistication—which is not worldwide—but it's a technology bias as opposed to a social one.

Octavia Butler: I don't think you can have this level of technology without it affecting the social, and therefore the bias is social as well.

Robert Kuhn: What are some of the issues you'd like to see discussed in the science fiction in the future?

Octavia Butler: We don't have a focus now that was like, for instance, the Cold War or the space race; we don't have anything that grabs everybody. And since we don't have such an overriding cause, what we write probably seems more scattered than we intend it to be. The future of science fiction is not what we thought it would be years ago.

David Brin: This is especially true since the best science fiction is about the human response to change. And since change is a salient feature of our civilization, I think that science fiction has, logically speaking, philosophically speaking, an important role to play. The issue is whether or not it's playing that role well.

Michael Crichton: To do these kinds of scenarios in our science fiction is valuable, but it is not the same as holding a newborn child, it is not the same as holding a parent while they die in your arms. How you explain that feeling is orders of magnitude more important than what we do.

Robert Kuhn End Commentary:

It doesn't matter whether science fiction is really scientific; here are three reasons why it can be important.

First, science fiction can break free from the scientific method: if your imagination doesn't have to worry about verification, just maybe you'll discover something truly original.

Second, science fiction can explore contemporary issues in different environments, so that when all normal trappings of society are stripped away, just maybe real problems will be exposed.

Third, science fiction can examine a vast number of alternative futures, which just maybe can prepare humanity for all eventualities, like, say, marauding asteroids or malevolent aliens.

Only theology claims greater reach, and I'll let you decide how science fiction, religion, and science can each explain the world, predict the future, and bring us Closer To Truth.

Interviews with Expert Participants

Michael Crichton

Why did you become a science fiction writer?

Because when I was a kid I loved the Arthur Conan Doyle stories of Sherlock Holmes. And one of the things that really impressed me about them was the sense of how real they were, how true to life they were. People go to London and look for Holmes's famous address, 221B Baker Street. I always aspired to have that quality of realism in my writings, trying to make people think it was true.

What's changed in your field since you were a kid?

Storytelling has enormously changed in my lifetime as a result of two new kinds of storytelling which have emerged. The first is commercials and the second is cartoons. And they have produced an enormous change: in commercials in terms of pace and rapid change; and in cartoons in terms of the kind of exaggeration in storytelling that people have come to expect.

Does the general public appreciate science?

In the last survey that I saw people were asked what scientific instrument or what technological device they appreciated most in their house, and the overwhelming majority named the microwave.

Any advice for young people?

It's my strong belief that people who are engaged in any kind of technology should not fall too much in love with it. Do not lose your human characteristics.

How would you like to be remembered?

I would like to be remembered by the people that knew me as a good person who made a difference in their lives.