Rothwell, J. and E. Mallove, *Review of Profiles of the Future: An Inquiry into the Limits of the Possible, By Arthur C. Clarke.* Infinite Energy, 1998. **4**(22).

In memory of Arthur C. Clarke (1917 – 2008), a friend of cold fusion and visionary par excellence.

Arthur C. Clarke and his pet Tyrannosaurus rex, 2003

See also: Clarke, A.C., *2001: The Coming Age of Hydrogen Power.* Infinite Energy, 1998. **4**(22): p. 15. http://lenr-canr.org/acrobat/ClarkeACthecominga.pdf

Arthur C. Clarke:

The Man Who "Predicted" Cold Fusion and Modern Alchemy

Compiled by Eugene Mallove

"To predict the future we need logic, but we also need faith and imagination, which can sometimes defy logic itself."
—Arthur C. Clarke, *Profiles of the Future*

Arthur C. Clarke might not remember that he really did "predict" cold fusion, so successful have been his many other predictions of technological and scientific breakthroughs—notably many milestones in spaceflight, including his own invention (in 1945!) of the geosynchronous communications satellite. Yet there it is in my well-worn 1964 Bantam Books edition of Clarke's *Profiles of the Future*.

It appears on many pages, but its most startling form is on page 153: "We must remember, however, that nuclear engineering is in roughly the same position as chemical engineering at the beginning of the nineteenth century, when the laws governing reactions between compounds were just beginning to be understood. We now synthesize, on the largest scale, drugs and plastics which yesterday's chemists could not even have produced in their laboratories. Within a few generations, we will surely be able to do the same thing with the elements." Sorry, Arthur, you were a few generations too conservative—we'll forgive you for that! The catalytic transmutations that you predicted are occurring, in their most primitive forms, in cold fusion cells today.

Following this description in *Profiles*, Clarke describes the conventionally understood catalytic nuclear reactions that occur in the Sun, which convert ordinary hydrogen to helium—the first steps in what he says "might be christened 'nuclear chemistry.'" He continues: "But there are other ways of starting reactions, besides heat and pressure. The chemists have known this for years; they employ catalysts which speed up reactions or make them take place at far lower temperatures than they would otherwise do...Are there nuclear, as well as chemical, catalysts? Yes, in the Sun, carbon and nitrogen play this role. There may be many other nuclear catalysts, not necessarily elements. Among the legions of misnamed fundamental particles which now perplex the physicist—the mesons and positrons and neutrinos—there may be entities that can bring about fusion at temperatures and pressures that we can handle. Or there may be completely different ways of achieving nuclear synthesis, as unthinkable today as was the uranium reactor only thirty years ago. The seas of this planet contain 100,000,000,000,000,000 tons of hydrogen and 20,000,000,000,000 tons of deuterium. Soon we will learn to use these simplest of all atoms to yield unlimited power. Later—perhaps very much later—we will take the next step, and pile our nuclear building blocks on top of each other to create any element we please."

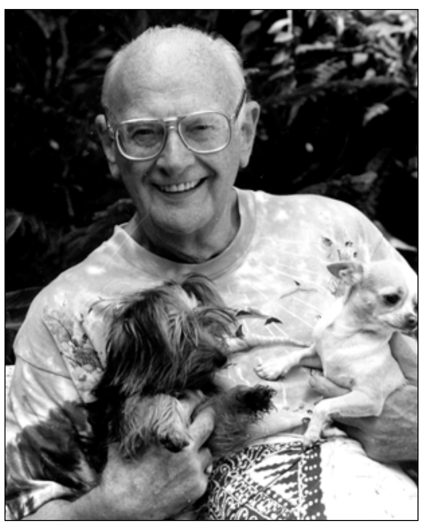
Photo: Courtesy of Arthur C. Clarke.

Well, we can't have expected Arthur to have predicted that palladium, much less ordinary nickel, would be the initiating catalysts of the cold fusion-transmutation revolution, but they are. He was thinking of exotic catalytic nuclear particles. Yet he did allow that there could be "unthinkable," "completely different ways" of achieving nuclear synthesis.

It is interesting that on his chart of "The Future," on the very last page of *Profiles*, under "Physics," Clarke places the invention of "nuclear catalysts" somewhere between the years 2020 and 2030. (This is on page "235" no less, for those who are fond of numerological coincidences.) Under the "Materials and Manufacturing" column he has "Fusion power," meaning *hot* fusion, of course. Well, hot fusion didn't come in 1990 and will probably never come, because it will not be needed, but then again—a nice coincidence—1990 is just about 1989, the year of Cold Fusion Day, March 23.

Arthur may well have predicted even the *critics* of cold fusion. Concluding these nuclear catalyst passages, he writes: "In this inconceivably enormous universe, we can never run out of energy or matter. But we can easily run out of brains."

On page 19 of *Profiles*, Clarke writes: "...even when the existence of atomic energy was fully appreciated—say right up to 1940—almost all scientists would have laughed at the idea of liberating it by bringing pieces of metal together. Those who believed that the energy of the nucleus ever could be released almost certainly pictured complicated electrical devices—'atom smashers' and so forth doing the job. (In the long run, this will probably be the case; it seems that we will need such machines to fuse hydrogen nuclei on the industrial scale. But once again, who knows?)" There again is Clarke's openness to great possibilities—doubting the notion that a simple fusion reactor could be developed, but holding open the *possibility*. "Who knows?", indeed! Barely a quarter of a century after these lines were penned came Fleischmann and Pons.

On page 143 comes an oblique version of the cold fusion prediction: "Perhaps the forced draft of space technology will lead us fairly quickly to a lightweight power cell, holding as much energy per pound as gasoline; when we consider some of the other marvels of modern technology, it seems a modest enough demand." That remark was in the context of energy storage, not power generation. Furthermore, cold fusion cells will have enormously greater energy storage density than gasoline. Even Dr. Randell Mills' "superchemistry" explanation of cold fusion excess energy has a 200 HP automobile going 100,000 miles on a tankful of ordinary water (see *Infinite Energy*, No. 17).

Even a remarkable technological seer, such as Clarke, can sometimes fall short and pen remarks that contradict his more penetrating visions. He also writes (page 143): "It may well be—indeed, at the moment it appears very likely—that fusion plants can be built only in very large sizes, so that no more than a handful would be required to run an entire country. That they can be made small and portable—so that they could be used to drive vehicles, for example, appears most improbable. Their main function will be to produce huge quantities of thermal and electrical energy, and we will still be faced with the problem of getting this energy to the millions of places where it is needed."

Alas, no one is perfect, but Arthur C. Clarke had nearly perfectly clear vision of how to go about the business of technology prediction—as Jed Rothwell recounts in his more encompassing review of *Profiles of the Future.*

Review of *Profiles of the Future: An Inquiry into the Limits of the Possible*, By Arthur C. Clarke

By Jed Rothwell

How did Arthur C. Clarke come to believe that cold fusion is real, and why should anyone care? The answer can be found in an unforgettable nonfiction book he wrote in 1963. It is *Profiles of the Future,* one of the best books about the future ever written, and one of the finest short overviews of science and technology. Most readers know Clarke as a science fiction writer and the screenwriter of the acclaimed movie *2001: A Space Odyssey*. A mere science fiction writer might not be considered sufficiently qualified to judge the evidence for cold fusion. In the pages of this book, you meet Clarke anew as a scientist, historian and teacher. Those who, after reading this book, still doubt his qualifications for doing rigorous science should review his famous pioneering papers on geostationary satellites in *Wireless World* (1945) and *Spaceflight* (written May 1945, published in 1968).

I absorbed hundreds of lessons from this book which I take for granted: that mankind will eventually colonize the planets and stars; that computers will learn to think; that automobiles are absurdly dangerous and inefficient; and that any sufficiently advanced technology is indistinguishable from magic (Clarke's third law). Take automobiles: When I was growing up in the 1960s, widespread protests against air pollution and destructive highway construction were just beginning. I empathized with the environmental movement, but I felt a gnawing sense of helplessness, because I knew that our economy depended upon the automobile, people would starve without it, and Americans love automobiles. I could not imagine how we might escape this predicament. Then I chanced upon this book, and discovered an author who despised automobiles as much as I did, and who also understood how necessary they were. Imagine reading this at the height of postwar enthusiasm for highways and automobiles:

> The automobile is so much a part of our existence that it seems hard to believe that it is a child of our century.
>
> Looked at dispassionately, it is an incredible device, which no sane society would tolerate. If anyone before 1900 could have seen the approaches to a modern city on a Monday morning or a Friday evening, he might have imagined that he was in hell – and he would not be far wrong.
>
> Here we have . . . millions of vehicles . . . hurtling in all directions under the impulse of anything up to two hundred horsepower. . . . In a lifetime they have consumed more irreplaceable fuel than has been used in the whole previous history of mankind. The roads to support them, inadequate as they are, cost as much as a small war; the analogy is a good one, for the casualties are on the same scale.

> Yet despite the appalling expense in spiritual as well as material values (look what Detroit has done to esthetics) our civilization would not survive for ten minutes without the automobile.

Where I saw no way to escape the culture of the automobile, Clarke described many ways in which we can improve automobiles, and even reduce or eliminate the need for them. He did not propose drastic or utopian schemes. He proposed engineering solutions coupled with political, economic and social reform. We can fix the problem and make life more convenient at the same time with innovations like telecommuting, computerized automobiles, and fusion energy. It will cost a lot of money, but not as much as letting the problem fester.

Clarke is not foolishly optimistic. He warns that we might be too stupid or stubborn to fix our problems. He warns that the solution will take as much hard work as building the highways did in the first place. He is not enamored of technology for its own sake; he warns of the horrors of the atom bomb, pollution, and technology run amuck. Clarke's message is that nature provides the means, and if we have intelligence and gumption we can deal with our problems. History since 1963 has proved him right. We reduced pollution and trimmed the population explosion. We have learned that it is not necessary to wipe out other species for us to live, and on the other hand we do not have to drastically limit people's freedom to preserve nature. We do not have to condemn the Chinese to a lifestyle less opulent than our own. That is a good thing, too, because the Chinese would not put up with it, and we could not restrain them even if we wanted to.

A person can learn more from this slim volume than from a semester of college, and the lessons will last a lifetime: several lifetimes, probably. Most books about the future seem dated after a few years. This one will still be a source of revelations, lessons and a guide to the unfinished business of mankind four centuries from now, like Francis Bacon's *Novum Organum*, which was published in 1620 and which ought to be required reading for scientists today. Bacon prophesied the scientific revolution. Clarke foretells the ultimate effect that revolution will have on society. From Clarke's long view of history the revolution has just begun. It has barely touched the lives of most people on earth, who still lack basic medicine, transportation and communications. The industrial revolution has produced many marvels and many horrors too, but it is only the prelude to a much longer, richer, and more challenging revolution that will continue for thousands of years. It will open interplanetary space and finally interstellar space for exploration and colonization, and give us godlike power for good or evil.

I do not know another book like *Profiles*. Strategic studies by research organizations and books about the near future of computers, like Bill Gates' *The Road Ahead* (1995), describe only an acre where Clarke maps out a continent. They lack Clarke's magic; his imagination, humor and sense of awe. A book like *Future Shock* (1970) does not compare. Toffler does not have Clarke's imagination or technical training, and his knowledge of society, language, anthropology and literature are shallow. I recall a passage from *Future Shock* that led me to dismiss the book and its author. It was something to the effect that in the future we will be free to choose our own culture. For example, he said, an airline can offer a selection of cultures by decking out stewardesses in western uniforms or kimono and offering different meal plans. The statement rubbed me the wrong way because I read it while I was struggling to learn Japanese. Michio Kaku's recent book *Visions* (1997) is insipid compared to *Profiles*. On one hand it covers far-out, speculative possibilities like antimatter rockets, which he predicts we may have in 2050. On the other hand he describes trivial innovations like "shoes that think." These would allow executives to trade computer data by shaking hands, "because skin is salty and conducts electricity, a résumé can travel electrically from shoe to hands and then to one's acquaintance's hand and shoe." This frivolous gadget would have no impact on people's lives. It would not contribute towards the worldwide provision of food, medicine, energy or education. Clarke concentrates on things that matter. Today's scientists and futurists have a constricted horizon. As Clarke says, the future is not what it used to be.

Clarke's genius is in telling us what we already know, or ought to know. He brings out the profundity in commonsense observations and lets us see the world anew. Here is a banal thought that must occur to anyone by age nine: Suppose you had a time machine and you could bring a genius like Archimedes or Leonardo da Vinci into the present. You might show him a Diesel engine, an automobile, or a helicopter. He would be astounded by our modern materials, but he would understand the physical principles made such devices work. "Leonardo, in fact, would recognize several [designs] from his notebooks," Clarke comments. Now suppose you showed him "a television set, an electronic computer, a nuclear reactor, a radar installation." He would be utterly baffled. No ancient genius, even the most farsighted, could have predicted them. Some of these breakthroughs could not have been predicted ten years before they were made. They are radically different from all that has gone before, which makes them effectively "indistinguishable from magic." Clarke describes how Leonardo might devise a manually operated long distance black-and-white television. He might have used a camera obscura to project the image onto a 500 x 500 grid, and semaphores. With 80 assistants, he could send one frame per day, whereas an electronic television does this task thirty times a second. Leonardo was "perhaps the most farseeing man who ever lived" but he would have found this "an absolute and unquestionable impossibility." That may seem obvious, but when Clarke explains it in a few pages, you begin to think of television with the sense of awe Leonardo would feel.

It is distressing how few people understand how television works and why it is so amazing. Many have no idea how the cathode ray tube deflects a beam of electrons. The average person knows so little about the inner workings, television might as well be magic to him, yet he derives no appropriate sense of awe from that magic. Clarke wants to remove the mystery from technology while he restores the sense of wonder people felt when the machines were first invented, and the sense of power they gave us.

The concepts explained in this book are not complicated. They are profound yet easy to grasp. Most are not original to Clarke; his genius is in knowing which ideas ring true and how they fit together in a larger pattern. Clarke teaches a mental attitude rather than a set of facts or precepts. He wants the reader to see our civilization anew, to appreciate our amazing accomplishments, and to feel upset at the waste and foolishness of our excesses.

Profiles, Not One Profile

This book is not about how the future is likely to develop; it is about the multitudinous ways it might develop. Clarke emphasizes that he is talking about many profiles, many potentials, some wonderful, some dreadful. This book teaches you how to think about the future. It does not predict the future, it delineates different ways in which the future might unfold. Clarke says in the Introduction:

> It is impossible to predict the future, and all attempts to do so in any detail appear ludicrous within a very few years. This book has a more realistic yet at the same time more ambitious aim. It does not try to describe *the* future, but to define the boundaries within which possible futures must lie . . .

No one could agree with all of the opinions and ideas expressed in this book because Clarke loves to contradict himself and look at all sides of the problem, including many sides that most people never dream of. He predicts something and then he predicts the opposite. After carefully explaining that terrestrial transportation may reach fantastic speeds, he doubles back and says maybe it won't, because improved communications might eliminate most travel. After predicting we will raid the whole solar system for raw materials and precious metals, he says maybe we will learn to transmute elements on an industrial scale, and learn to replicate any object down to the last atom, so we will no longer need to transport raw materials or finished goods.

Clarke disavows any intention of predicting the one and only future, and he does not try to make short term predictions that will soon turn ludicrous. He says it is easier to predict how things will ultimately be in a thousand years than it is to know how far they will progress in twenty years. Yet he did make many short term predictions, and many have turned out to be correct. Naturally, some were wrong. He predicted that supersonic transport aircraft (SST) would be commonplace by the 1970s, but only the Concorde was built back then, and it is not an economical mode of transport. He devoted a chapter to hovercraft and predicted they might replace automobiles for land transport. He did not realize the drawbacks: they are noisy and difficult to control on a grade, although they do work well over oceans and marshes, and make excellent ice breakers. He correctly notes that they have limited commercial potential because they use more energy than competing systems, but he anticipates energy is bound to become cheaper and cheaper, thereby making the use of hovercraft more financially competitive.

Clarke was too optimistic about the near future. He predicted we would begin colonizing planets by the year 2000, and we would develop fusion power by 1990 and translating machines by 1970. He was careful to add caveats that it might take much longer, perhaps a century or more. Perhaps the difference between a generation and a century is not significant. After Columbus discovered America, British colonization was, in some sense, inevitable, although it did not begin for 115 years. From our point of view, the world did not change much between 1492 and 1607. After the piston steam engine was developed by Newcomen in 1712, the steam locomotive was inevitable, although 117 years passed before the first locomotive was built. Rockets may not last long, but some form of spacecraft will inevitably lead to manned exploration and colonization of the moon, mars, and other planets, perhaps on the same time scale as North American colonization. Some form of nuclear energy must inevitably replace fossil fuel, because the advantages are so great, although it may take as long to develop as the steam locomotive did.

We do not know enough about language or intelligence to build a translating machine yet. Artificial intelligence is still controversial. Many believe it will never come to pass, but Clarke confidently sticks to his prediction that it is inevitable, and I agree with him. This too might take as long as the steam locomotive. Machines will be at least as intelligent as a rat, where intelligence is defined as the ability to react to and deal with the environment. It is inconceivable to me that no computer will ever be smart enough to drive an automobile in traffic, answer factual questions, or lay bricks. I doubt that computers will ever write novels, but they will write technical manuals. They will probably never develop emotions, and possibly not self awareness, but Clarke rejects the argument that the brain is a special state of matter which machinery cannot emulate.

Information Still Current

I combed this book for errors and out-of-date information. The only substantial error I found was the statement that fire walking might reflect the power of the mind over matter. This was widely believed in 1963, but as early as 1935 experiments at the University of London revealed the physical reasons why fire walkers are not hurt.

Predictions about Resources and Energy

Long before cold fusion was discovered, Clarke, Von Neumann and a few other farsighted people said that energy costs were bound to fall, and they will eventually drop to negligible levels. When the energy crisis struck, Clarke was the only person with the guts to say “the age of cheap energy is over, the age of free energy is fifty years in the future.” Critics call this utopian nonsense, but I think they are ignoring the nature of energy and the trends of history. The nature of energy is simple: it is the most abundant resource in the universe. Clarke points out that the sun produces 5×10^{23} horsepower, and the ocean has enough deuterium to run all of the industries on earth for hundreds of millions of years with fusion. The cost of energy has steadily fallen throughout industrial history. It is now thousands of times cheaper than it was before the industrial revolution. Taking into account energy used in industry, every person in the first world has at his beck and call hundreds of horsepower. In 1798, a family might have had a horse or an ox, and perhaps a two-horsepower mill stream. Many people had no mechanical assistance. They walked. They lifted, cut and hoed by hand. That every person would someday have at his command the equivalent of five hundred horses would have seemed beyond imagination.

Clarke is no Dr. Pangloss, and no cheerleader for the latest fad. Recently he has written in support of nuclear fission as a necessary evil, because coal pollution kills even more people than Chernobyl did. In *Profiles* he came out squarely against it, a daring position in 1963:

> It is not likely that fission reactions . . . will play more than a temporary role in terrestrial affairs. One hopes they will not, for fission is the dirtiest and most unpleasant method of releasing energy that man has ever discovered. Some of the radioisotopes from today's reactors will still be causing trouble, and perhaps injuring unwary archeologists, a thousand years from now.
>
> But beyond fission lies fusion . . .

Again and again, Clarke says open your eyes, look at the longer view of history, think of how much we have accomplished already. Do not despair or imagine that we have reached the limits of our abilities. He sees miraculous ingenuity where most of us take things for granted. He is right of course; we have merely forgotten how amazing the mundane artifacts of our civilization are. Clarke continually reminds us, and I wish people would heed the message. He also reminds us not to be sanguine about our prospects. "If, as is perfectly possible, we are short of energy two generations from now, it will be through our own incompetence. We will be like Stone age men freezing to death on top of a coal bed."

Clarke demolishes the idea that we are running out of natural resources. Pollution is the only danger caused by exploiting raw materials. He points out, for example, that one hundred tons of average igneous rock contains 8 tons of aluminum, 5 tons of iron, 1,200 pounds of titanium . . . It would take a great deal of energy to process the rock and extract these raw materials, but the rock also includes uranium and thorium with the potential energy of 50 tons of coal. "All the energy we need for the processing is there in the rock itself." A cubic mile of seawater contains 18 million tons of magnesium, "enough to supply the world's needs, at the present rate, for several centuries." If that is not enough, we could eventually bring in resources from other planets and asteroids. He concludes:

> This survey should be enough to indicate – though not to prove – that there need never be any permanent shortage of raw materials. Yet Sir George Darwin's prediction that ours would be a golden age compared with the aeons of poverty to follow, may well be perfectly correct. In this inconceivably enormous universe, we can never run out of energy or matter. But we can all too easily run out of brains.

Gives Life a Sense of Déjà Vu

Translation computers have not yet come to pass, but Clarke predicted much else successfully. I sometimes get a sense of déjà vu when I read the latest breathless pronouncements in newspapers and trade magazines. For example, Clarke predicted that an "orbital newspaper" would be delivered by facsimile. Today national editions of newspapers like the *New York Times* and *USA Today* are distributed by electronic mail and printed in local plants near major cities. The *Satellite Edition* of the *Yomiuri* newspaper is printed in Georgia and delivered to my house a few hours after it hits the streets in Tokyo. Thanks to the international date line, I read the August 2nd edition on August 1st. With a satellite dish I could also tune into 24 hour broadcasts of Japanese television, available in North America by subscription.

Clarke did not get every detail right, naturally. The paper *Satellite Edition* is not quite what he had in mind. He thought you would print the newspaper yourself at home, printing only the sections you want. He described a "personalized" newspaper much like an Internet "zine." Compare Clarke's description of the Orbital Newspaper to the "zines." He begins by explaining that a facsimile machine will be capable of printing the image that appears on a TV screen:

> When you want your daily paper, you will switch to the appropriate [TV] channel, press the right button – and collect the latest edition as it emerges from the slot. It may be merely a one-page news sheet; the editorials will be available on another channel – sports, book reviews . . . etc. We will select what we need, and ignore the rest, thus saving whole forests for posterity . . .
>
> Nor will the matter end here. Over the same circuits we will be able to conjure up, from central libraries and information banks, copies of any document we desire from Magna Charta to the current Earth-Moon passenger schedules. Even books may one day be "distributed" in this manner . . .

In two short paragraphs you have: the Internet; the web; interactive, personalized "zines"; sophisticated printing at home; and informed concern for conservation long before it became fashionable. Some people were surprised by the Internet, but I read about it thirty years ago. I knew it was coming. I feel almost jaded.

Clarke was not the first to come up with these ideas. Computer experts were discussing them in 1963, although my textbook from that era describes only timesharing and centralized government information databases. The point is, Clarke is not a computer expert. He did not limit himself to speculation in one narrow specialty such as telecommunications and computer data bases. He read the technical literature, picked the right ideas and added a number of original ideas of his own. He makes equally good prognostications about energy, food production, and transportation. Not many computer experts in the 1950s and '60s would have made such bold, accurate predictions anticipating the Internet. None, except perhaps Von Neumann himself, were such polymaths they could have written another authoritative article dealing with energy, and another about space exploration. And none, I think, would have written speculative articles about time travel, immortality or invisible men. Most scientists and computer engineers would be embarrassed to discuss about such far-out topics. Clarke knows as well anyone how far-out they are. He thinks time travel into the past is probably impossible, but a one-way trip into the distant future may be possible with hibernation or near-light speed space travel. He explains that we cannot be sure these are impossible because they are so far beyond our current understanding. Then, after carefully establishing caveats, he lets himself go and speculates to his heart's content. He is not afraid to have a good time even at the risk of making a fool of himself.

When cold fusion was announced in the *Wall Street Journal* I was surprised but not profoundly shocked because I recalled these passages from *Profiles* describing the development of the atom bomb:

> Suppose you went to any scientist up to the late nineteenth century and told him: "Here are two pieces of a substance called uranium 235. If you hold them apart, nothing will happen. But if you bring them together suddenly, you will liberate as much energy as you could obtain from burning ten thousand tons of coal." No matter how farsighted and imaginative he might be, your pre-twentieth century scientist would have said: "What utter nonsense! That's magic, not science. Such things can't happen in the real world." Around 1890, when the foundations of physics and thermodynamics had (it seemed) been securely laid, he could have told you exactly why it was nonsense.
>
> "Energy cannot be created out of nowhere," he might have said. "It has to come from chemical reactions, electrical batteries, coiled springs, compressed gas, spinning flywheels, or some other clearly defined source. All such sources are ruled out in this case – and even if they were not, the energy output you mention is absurd. Why, it is more than a *million* times that available from the most powerful chemical reaction!"
>
> The fascinating thing about this particular example is that, even when the existence of atomic energy was fully appreciated – say right up to 1940 – almost all scientists would still have laughed at the idea of liberating it by bringing pieces of metal together. Those who believed that the energy of the nucleus ever could be released almost certainly pictured complicated electrical devices – "atom smashers" and so forth – doing the job. (In the long run, this will probably be the case; it seems that we will need such machines to fuse hydrogen nuclei on the industrial scale. But once again, who knows?)
>
> The wholly unexpected discovery of uranium fission in 1939 made possible such absurdly simple (in principle, if not in practice) devices as the atomic bomb and the nuclear chain reactor. No scientist could ever have predicted them; if he had, all his colleagues would have laughed at him.

What do we learn from this? Clarke never imagined cold fusion, and he knew nothing about the 1930s cold fusion experiments by Paneth and Peters or the ideas Martin Fleischmann had been secretly pondering for a decade, yet Clarke managed to predict many key aspects of cold fusion:

That it would be a complete surprise. Only Fleischmann anticipated cold fusion.

That it would be a departure from methods conventional fusion energy scientists were working on.

That it would be simpler than anyone anticipated. Clarke gives many other examples of surprisingly simple revolutionary devices, including: the phonograph, which is so simple the ancient Greeks might have made one; and spectroscopic analysis of starlight, which is the basis of astrophysics.

That it would be tantamount to magic. Cold fusion does not merely defy existing theories. It seems to supercede them. It makes them irrelevant, because nuclear reactions in metal lattices apparently bear little resemblance to reactions in the sun. Soon after the discovery of fission in 1938, theories were rapidly developed and adjusted to account for the new phenomenon. Some experts predict that cold fusion will also be explained by conventional theory, but at the moment it seems alien to what we have previously learned.

Clarke also predicted that cold fusion would be angrily rejected by the establishment. He devotes the first chapters of the book to elegant essays describing similar events, as he formulates his First Law:

> When a distinguished but elderly scientist states that something is possible he is almost certainly right. When he states that something is impossible, he is very probably wrong.

Anyone could have predicted this reflexive rejection. Most people know stories of martyrs like Galileo and Semmelweis. Yet despite these well-known examples and the lip service paid to this important topic, it is neglected by most historians of science. Clarke is one of the few people to look closely at history and came up with memorable examples of the syndrome. Once the argument is settled, controversy in science tends to be swept under the rug. The battles for acceptance are forgotten, heros are elevated, the opposition is caricatured, and in general people forget the extent to which irrational opposition must be overcome every time someone with an innovation appears on the scene.

An Easy Book to Read

Clarke is well read. His enthusiasm for ideas is contagious. This book will introduce a young reader to dozens of people, and inspire him to learn more. It quotes Roger Bacon, Francis Bacon, Charles Babbage, August Compte, Ernest Rutherford, George Darwin, James Conant, H. G. Wells, Vannevar Bush, Arnold Toynbee, J. B. S. Haldane, Norbert Weiner, and several people Clarke disagrees with, including Lewis Mumford.

Clarke quotes and describes people you will not meet in an ordinary futurist book, including Hu Shih, Peter Arno, H. P. Lovecraft, Madame Blavatsky, Freud, Swift, Orwell, Shakespeare, Matthew Brady, Nikolai Ivanovich Lobachevski and his nemesis Tom Lehrer, and many others. With this crowd jostling through the pages of the book you might wonder where Clarke manages to squeeze in his own point of view. Not to worry: He is never reticent about expressing himself, and he discusses many of his own personal tastes. He inserts forthright, sometimes opinionated, often hilarious views on subjects not related to the central themes of the book, Beatniks, modern art, lawyers (“parasites”), capitalism versus communism, AM radio stations in small towns in the deep south of the U.S. (“harrowing”), evolution, the “obvious” necessity of death but not aging for biological and social progress, the strange evocative power of poetry to stir the imagination and stick in memory, the “appalling” esthetics of Detroit automobiles (see above quote), friendship, craftsmanship, and love. Returning to his main subject, Clarke compares Homer, Shakespeare, Melville, Conrad and Twain. He says their work is characteristic of an age of discovery, and the opening of new frontiers. Here is an irresistible quote about weightlessness, dreams, sports and erotica:

> The absence of gravity – a sensation which no human being has ever experienced since the beginning of time, yet which is mysteriously familiar in dreams – will have a profound impact upon every type of human activity. It will make possible a whole constellation of new sports and games and transform many existing ones. This final prediction we can make with confidence, if some impatience: Weightlessness will open up novel and hitherto unsuspected realms of erotica. And about time too.

In the midst of these serendipitous excursions, he manages to review laws of physics like the conservation of energy and the reason objects are weightless in an orbiting spacecraft. He includes many technical details such as the fact that televisions transmit 250,000 bits in one-thirtieth of a second, the melting point of hafnium carbide is 7,500 deg F, and the names of various newly discovered (as of 1963) specialized instruments used to probe the structure and atomic distribution of matter. “Neutron activation analyzers, infrared and X-ray spectrometers, gas chromatographs can perform, in a matter of seconds, detailed analysis of complex materials over which the chemists of a generation ago could have labored in vain for weeks.”

With all the information packed into the 232 pages of this book, you might suppose it is tough to read. I have seen textbooks with fewer facts per page. Every page confronts you with a novel idea; a fascinating juxtaposition; or another inventor, scientist, philosopher, author or cartoonist. If you expect reading this will be a mental chore, it will come as a pleasant surprise to learn that some of the chapters in the book originally appeared as articles in popular magazines, including *Holiday Magazine, Horizon, Science Digest,* and *Playboy*. This is not difficult writing. It is fun, witty, literate. It is like browsing through old *New Yorker* cartoons. It resembles Clarke’s science fiction stories. Indeed, he reveals the basic technical ideas that inspired many of the stories. You can enjoy this book on the train commuting to work, or lolling in the bathtub. (Clarke advocates browsing and lolling, although he never seems to slow down himself. He thinks it would be a good idea for the human race to rediscover the ancient pace of life, the leisure and the joys of peace and quiet, and walking in the garden.) I recommend you read the book three times. Once for the pleasure of good writing and wit, once for a quick review of physics you may have forgotten, and once more to look into the future, near and distant, stretching even to the ultimate fate of the human race.

Note to readers

Notes from 1998

Profiles was originally published 1963. It has been reprinted many times, most recently in 1985. Unfortunately, it is now out of print. You can find a copy in the library, a used book store, or on the Internet. Clarke says he has been thinking of reissuing the book in CD ROM format.

As of 1992 Clarke had published 23 other of nonfiction books and essay collections. Here are two I highly recommend: *The View from Serendip* (Dell Ray, 1977) which covers themes similar to *Profiles,* and *How the World Was One* (Bantam, 1992), about telecommunications. I also recommend his many science fiction stories. As he says in the introduction to *Profiles*: “A critical — the adjective is important — reading of science fiction is essential training for anyone wishing to look more than ten years ahead. The facts of the future can hardly be imagined *ab initio* by those who are unfamiliar with the fantasies of the past.”

Note from 2008

In 1999, *Profiles* was republished in a “Millennium Edition,” which unfortunately only appears to available in England, from the publisher Indigo, ISBN 0-575-40277-6. This edition has been extensively revised and brought up to date, and it includes a great deal of new material about cold fusion. I am pleased to note that I am listed in the Acknowledgements:

ACKNOWLEDGEMENTS

This book could not have been written without countless inputs from many friends over my entire life.

I would like to pay a special tribute to the memory — and the influence — of Louis Alvarez, Wernher von Braun, Val Cleaver, Bucky Fuller and Ralph Smith.

It is a pleasure to thank the following magazines for permission to reprint material which they originally published: *Holiday Magazine, Horizon, Science Digest* and *Playboy* magazine. I would also like to express thanks to the British Council and the United States Information Service, for the use of their library facilities in Colombo.

And my particular gratitude to Jed Rothwell, who by OCR'ing the original 1962 edition removed my last feeble excuse for not going Back to the Future ...