



# Book The Coming Biotech Age

## The Business of Bio-Materials

Richard W. Oliver  
McGraw-Hill, 2000

### Recommendation

The convergence of genetics and materials science is about to change everything fast. Author Richard Oliver describes himself as a disciple of the brilliant Canadian futurist Marshall McLuhan, so you can expect a book rife with sweeping predictions and neologisms. Parental advisory: In this book, buzzwords proliferate like that lab experiment you started in high school and just couldn't stop. To cut to the "bio" bottom line: The world as you know it will basically cease to exist in about five years. (Oh, that's no surprise, but how can you make a buck off of it, right?) Well, give Oliver credit: He backs up his bio-ideas with solid bio-research, and you get the uncanny feeling that his bio-predictions are probably accurate, in spite of the annoying prefixes. After all, it wasn't too long ago that a certain don north of the border was ridiculed for his zany description of an impending "Global Village." *BooksInShort* recommends this book for anyone who could benefit from a user's manual on the future. Indeed, you could say it's a veritable bio-crystal ball.

### Take-Aways

- The distinction between inorganic and organic materials is blurring, leading to technologies that will transform our lives in unimaginable ways.
- This change will revolutionize the global economy in one very brief, intense explosion.
- Things like organic computers, organic memory devices and organic integrated circuits will become commonplace.
- The largest markets for biotechnology products are pharmaceutical, agricultural, and environmental.
- The biotech industry has four segments: Health care, agricultural biotechnologies, instruments and lab products, and chemical and environmental.
- By the middle of the 21st century, all business will in some sense be "bioterials" business.
- Although the speed of personal computers is constantly accelerating, these speeds fall far short of biological transmission speeds.
- The discoveries in biotechnology will affect all other fields.
- No one really knows what will stem from bioterials. The potential of the discoveries will be so overwhelming that no political system will be able to constrain them.

# Summary

## The Brave New World of Bioterials

Red Alert! The Bioterials Age is coming fast, arriving in just about the time it takes you to, oh, say, dissect a frog. While chemistry and physics drove the technological revolution of the 20th century, the secrets of biology, genetics, and advanced materials science will create a new world you can barely imagine. Who cares about the genetic map of the fruit fly? Soon, you will. The changes to come will challenge nothing less than our very definition of life. Like it or not, it will confront you with decisions about your loved ones, your health, the environment, finances and business, the likes of which you never imagined. Within a single generation, virtually all companies will be transformed into bioterials companies, as cells trump electrons in the marketplace. The nearly completed mapping of the human genome, some 100,000 genes, will provide a "periodic table" of biology that will create economic opportunities of unimagined proportions. So hang on to your cell phone (which may soon actually be a cell phone) and get ready for a crash course in remedial high school biology.

## The Rise and Fall of Information

If you're still trying to figure out just what the Information Age really means, forget it - it's already on the way out. And you know what that means: You'll soon have to learn a whole new array of buzzwords! There are three technologies at the heart of today's information economy: the digital conversion of information (cell phone, television); the rise of software that allows you to manipulate data, and the rapid evolution of the microprocessor chip.

“In the Industrial Age we conquered space, in the Information Age we conquered time, and in the Bioterials Age, we will conquer matter.”

Every product or technology follows a natural life cycle during which it grows and later ebbs. A good signal that a product is maturing in its life cycle is when it becomes a commodity, commonly available, accessible, with a low and stable price. That would seem to be a fitting description of the personal computer market.

“Everyone will make a 'genetic decision' in the next five years.”

You are about to see a "flip" from the Information Age, which lasted only about 50 years, to the Bioterials Age, which will last about half as long. Two leading indicators are R&D spending and intellectual property in the form of patents. Industrial age companies spend about 5% on R&D, Information Age companies spend 10% to 15%, while bioterials companies spend at least 15% and usually more. New patent approvals for information companies are slowing, even while they accelerate for bioterials firms.

## What's A Bioterial?

The term bioterials blends biotechnology and materials science. It emphasizes the blurring of the distinction between organic and inorganic. Where biotechnology aims at conquering all questions related to organic materials, materials science studies the inorganic, including efforts to create smart materials, and nanomaterials. Combining these two fields holds the promise of conquering or controlling all matter in ways we never imagined possible before.

“Like the Industrial Age, the economics of the networked economy are driven by two fundamental laws, only this time they worked in concert: continuous decreases in the cost of information and its increasing value when shared in a network.”

## The Three Laws of BioEconomics

1. The first law of BioEconomics states that knowledge in the industry will double on a daily basis. (Everyone will have a ready-made excuse for being dumber than they were the day before).
2. The second law of BioEconomics holds that the global reach of bioterials is inversely proportionate to its subatomic scale. It

will have a massive global effect.

3. The third law of BioEconomics holds that its economic returns will dwarf everything that has come before. Although this era will only last 15 to 30 years, the commercial benefit will be exponentially greater than what we have seen from the Information Age.

## Consider the Bio-Possibilities

What are some of these new possibilities emerging from bioterials?

- Repair of damaged brain and spinal cords.
- Predetermination of gender and genetic makeup of offspring.
- Pharmagenomics, the tailoring of drugs most suitable for people with certain genetic make-ups.
- Control of aging.
- Control of obesity.
- The growth of human replacement organs within the bodies of animals.
- Trees that will grow to maturity in two years instead of 50 or 100, changing the economics of anything made of wood.
- A protein-based computer thousands of times faster than those of our era.
- New packaging materials that repair themselves and adjust to their environment.
- New energy sources that are pollution-free and cost almost nothing.

## Architecting Matter

For most of history, scientists and engineers had to work with whatever materials were available. Chemists, armed with the periodic table, could mix elements to find new chemicals to use. Bioterials scientists will progress in great leaps when it comes to the discovery of new materials. They will conceive of a need for a particular quality in a material, and then will go out aggressively to create it. Where the Information Age saw the transition from the macro world to the micro world, the Bioterials Age will cause a greater shift. An electron on a computer chip follows a path about one micro wide. A micro is one-millionth of a meter. The nano measurement of bioterials is one-thousandth of a micron. Scientists will soon be working on an even smaller scale than that. In the next decade, organic materials may be used to create a biological computer many times faster than today's devices.

## Organic: Dead or Alive?

As science delves into atomic-sized structures, the organic or inorganic composition becomes less relevant. The line between the two blurs. Some of the new materials that await us in the not-too-distant future:

- Smart sensors. These change color after a certain period of time, or adjust their size to changes in information, or remember their original size even after they undergo heat fluctuations.
- New fibers. Currently, the light transmissions carried by optical fibers must be translated back into electronic or digital format before they can be used by today's equipment. Once a way is found for a computer chip to generate a light signal, this translation will no longer be necessary.
- Ceramics. New ceramic materials may emit electrical charges, or change their shape as electricity is applied to them. Ceramics is expected to become a \$30 billion business by 2010.

## Re-engineering Humanity

The impact of bioterials will be tremendous in the field of medical science. Some of the breakthroughs waiting in the wings:

- The development of techniques to grow replacement human body parts in the bodies of animals.
- Solutions to the genetic causes of obesity and cancer.
- Angiogenesis, the insertion of a growth gene into the heart, will enable the heart to grow its own bypass.
- Overcoming or replacing the gene that triggers the addictive response to nicotine.
- An end to cystic fibrosis and muscular dystrophy.
- Pharmacogenomics, the matching of medicines best suited to your genetic makeup.

“Predicting the final shape, direction, and impact of bioterials is akin to attempting, in 1947, to predict the power and influence of the Internet based solely on the discovery of the transistor.”

Plants and animals will be re-engineered in a way that makes the current controversy over genetically modified foodstuffs seem trivial by comparison. Food supplies are expected to fall short of demand in the first half of the new century. Agbio may become critical to a world population expected to grow to more than 12 billion by 2050. Agbio is already creating seeds that are resistant to insects and disease. Consider that rice is a staple of many nations, and that half of the world’s rice crop is lost each year to bacteria and fungus diseases. Agbio also carries with it important concerns and controversies that will play an important role. There is fear that new organisms created by science might develop into infectious forms that could cause crop epidemics worldwide and create growing resistance to bioengineered food.

## **Bioethics**

In the future it would seem that almost every word will carry the prefix "bio," and ethics is no exception. No less than Prince Charles and Paul McCartney have gotten involved in the dispute between bioengineering firms and some facets of the public, while the legal implications of DNA testing have become more apparent in the wake of the O.J. Simpson trial. The debate of bioethics will include these issues:

- **Bioliteracy.** This is the growing awareness that without an understanding of biological principles and terms, one is disadvantaged in the future marketplace. Put it this way: Without bioliteracy, your kid may be bio-jobless. Got it?
- **Genetic manipulation of plants and animals.** There is a growing schism between European and American publics over genetically altered food. The Europeans are much more informed on the issue. Did you know that there are plans underway to consider using genetic manipulation to augment the nutritional value of vegetables; to increase breeding yields; to enhance resistance to insects, viruses and disease, and even to build in weed-control measures?
- **Bioengineering of Animals.** Researchers are working to alter livestock genes to make animals able to gain weight more rapidly so they can be brought to market more quickly. Salmon have been altered with a gene from cod that allows them to survive in colder climates.
- **Human Health.** Genetic research is being used to contribute to human health already. Much of the research depends on genetic testing, and the emerging standard seems to be for informed consent to be granted by the individual being tested.

## **Designer Babies**

With all of these changes approaching rapidly, can the era of the designer baby be far behind? Consider the prospect of multiple persons contributing genetic material to a given infant, for example. It is already possible to have five persons involved: an ovum donor, the donor of sperm, the woman who carries the infant to term, and two adoptive parents who rear the child. Perhaps the day is not far off when parents will choose desirable traits for their infant from a genetic catalog. As Dorothy might have observed, "We're not in bio-Kansas anymore, Toto."

## **Reading the GM Tea Leaves**

Don't be misled - you need to prepare for the bioterials revolution. It is already upon us and it is already happening. What will be its final shape and direction? That would be akin to predicting in 1947 that the discovery of the transistor would help lead to the Internet. However, there are a few trends you can count on:

- **Global change.** Bioterials will create the first truly global economy. Countries will not be able to avoid participation, because the technology will be too powerful. The overwhelming economic force of bioterials will transcend political attempts to constrain them.
- **Immediate change.** With the Internet, the lag between discovery and implementation will be negligible. Prepare for greater change, coming more quickly.
- **Unbounded change.** Because cells constantly regenerate, the impact of bioterials is virtually infinite. It will fuel itself in a never-ending spiral of new creations.
- **Workforce Dislocations.** The dimensions of the need for lifetime learning are just now becoming clear. The Bioterials Age will force workers to develop radically new job skills. There will be a major dislocation of the workforce.

- **Profound Effects.** Developments in biotechnology will have a multiplier effect that will spread through other social institutions and industries, ultimately affecting international economies and cultures in ways that test the imagination.

## About the Author

**Richard W. Oliver** is a professor at Vanderbilt University's business school, and prior to that was vice president of marketing at Nortel. He serves on the Boards of Directors of six U.S. companies and maintains a worldwide consulting practice.

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