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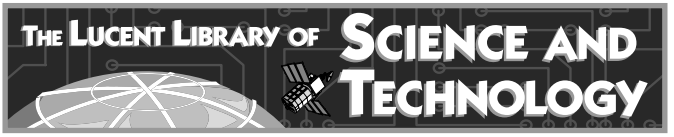
Energy Alternatives

Gabriel Cruden



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by Gabriel Cruden

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Foreword

"The world has changed far more in the past 100 years than in any other century in history. The reason is not political or economic, but technological—technologies that flowed directly from advances in basic science."

— Stephen Hawking, "A Brief History of Relativity," *Time,* 2000

The twentieth-century scientific and technological revolution that British physicist Stephen Hawking describes in the above quote has transformed virtually every aspect of human life at an unprecedented pace. Inventions unimaginable a century ago have not only become commonplace but are now considered necessities of daily life. As science historian James Burke writes, "We live surrounded by objects and systems that we take for granted, but which profoundly affect the way we behave, think, work, play, and in general conduct our lives."

For example, in just one hundred years, transportation systems have dramatically changed. In 1900 the first gasoline-powered motorcar had just been introduced, and only 144 miles of U.S. roads were hard-surfaced. Horse-drawn trolleys still filled the streets of American cities. The airplane had yet to be invented. Today 217 million vehicles speed along 4 million miles of U.S. roads. Humans have flown to the moon and commercial aircraft are capable of transporting passengers across the Atlantic Ocean in less than three hours.

The transformation of communications has been just as dramatic. In 1900 most Americans lived and worked on farms without electricity or mail delivery. Few people had ever heard a radio or spoken on a telephone. A hundred years later, 98 percent of American homes have

telephones and televisions and more than 50 percent have personal computers. Some families even have more than one television and computer, and cell phones are now commonplace, even among the young. Data beamed from communication satellites routinely predict global weather conditions and fiber-optic cable, e-mail, and the Internet have made worldwide telecommunication instantaneous.

Perhaps the most striking measure of scientific and technological change can be seen in medicine and public health. At the beginning of the twentieth century, the average American life span was forty-seven years. By the end of the century the average life span was approaching eighty years, thanks to advances in medicine including the development of vaccines and antibiotics, the discovery of powerful diagnostic tools such as X rays, the life-saving technology of cardiac and neonatal care, and improvements in nutrition and the control of infectious disease.

Rapid change is likely to continue throughout the twenty-first century as science reveals more about physical and biological processes such as global warming, viral replication, and electrical conductivity, and as people apply that new knowledge to personal decisions and government policy. Already, for example, an international treaty calls for immediate reductions in industrial and automobile emissions in response to studies that show a potentially dangerous rise in global temperatures is caused by human activity. Taking an active role in determining the direction of future changes depends on education; people must understand the possible uses of scientific research and the effects of the technology that surrounds them.

The Lucent Books Library of Science and Technology profiles key innovations and discoveries that have transformed the modern world. Each title strives to make a complex scientific discovery, technology, or phenomenon understandable and relevant to the reader. Because scientific discovery is rarely straightforward, each title

explains the dead ends, fortunate accidents, and basic scientific methods by which the research into the subject proceeded. And every book examines the practical applications of an invention, branch of science, or scientific principle in industry, public health, and personal life, as well as potential future uses and effects based on ongoing research. Fully documented quotations, annotated bibliographies that include both print and electronic sources, glossaries, indexes, and technical illustrations are among the supplemental features designed to point researchers to further exploration of the subject.

Introduction

New Energy Sources

All living systems require energy to survive. A person requires energy in the form of food. A plant requires energy in the form of sunlight. All mechanical systems also require energy to function. A car needs gasoline to run. A sailboat needs wind to move across the water. Energy, in one form or another, is needed for all living and nonliving activity on the planet. Energy does not actually exist as a thing itself, however. Instead, energy is an idea describing various sources of power.

Long ago, humans relied upon the natural systems of the earth to meet their energy needs. Cliff dwellers of the Southwest built their homes to capture the heat of winter sunlight. Ancient Greeks bathed in water warmed by geothermal vents. Humans around the world used wood to cook their meals and warm their homes. The natural systems of the planet met all of these needs.

The pursuit of more powerful and consistent energy sources came about during the Industrial Revolution, which began in the late eighteenth century and continued through the beginning of the nineteenth century. For the first time, humans began burning fossil fuels in great quantities to meet their energy needs. Fossil fuels powered the factories they worked in, the farm equipment needed to produce large crops, and eventually, the cars they drove. It seemed as if fossil fuels