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## Genetics May Be Terrorists' Next Tool

By JEREMY RIFKIN

**F**or the first few days, we worried about more commercial airplanes being hijacked and used as missiles. Now we are worried about a new, more deadly threat: bacteria and viruses raining from the sky over populated areas, infecting and killing millions of people.

Even more troubling is the fact that the genetic engineering technology being used commercially in the fields of agriculture, animal husbandry and medicine today is potentially convertible to the development of a wide range of pathogens that can attack plant, animal and human populations. Moreover, unlike nuclear bombs, the materials and tools required to create biological warfare agents are accessible and inexpensive, which is why this kind of weapon is often referred to as the poor man's nuclear bomb.

A state-of-the-art biological laboratory could be built and made operational with as little as \$10,000 worth of off-the-shelf equipment and could be housed in a small room. Equally frightening, graduate school students in laboratories around the world know enough about recombinant DNA and cloning technology to design and mass-produce such weapons.

Biological weapons can be viral, bacterial, fungal, rickettsial and protozoan. Biological agents can mutate, reproduce, multiply and spread over a large geographic terrain by wind, water, insect, animal and human transmission.

Once released, many biological pathogens can develop viable niches and maintain themselves indefinitely. Conventional biological agents include *Yersinia pestis* (plague), tularemia, Rift Valley fever, *Coxiella burnetii* (Q fever),

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### We could be facing a deadly new biological arms race.

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eastern equine encephalitis, anthrax and smallpox.

Biological weapons never have been widely used because of the danger and expense involved in processing and stockpiling large volumes of toxic materials and the difficulty in targeting their dissemination. Advances in genetic engineering technologies over the past decade, however, have made biological warfare more viable. Genes can be programmed into infectious microorganisms to increase their antibiotic resistance, virulence and stability.

Scientists even say they may be able to clone selective toxins to eliminate specific racial or ethnic groups whose genotypic makeup predisposes them to certain diseases. Or toxins can be cloned to destroy specific strains or species of agricultural plants or domestic animals, if the intent is to cripple the economy of a country. As a tool

of mass destruction, genetic weaponry rivals nuclear weaponry, and it can be developed at a fraction of the cost. These factors alone make genetic technology the ideal weapon of the future.

Iraq, long known as a threat for biological warfare, is not alone in its interest in developing biological weapons. In a 1995 study, the CIA reported that 16 other countries were suspected of researching and stockpiling germ warfare agents—Iran, Libya, Syria, North Korea, Taiwan, Israel, Egypt, Vietnam, Laos, Cuba, Bulgaria, India, South Korea, South Africa, China and Russia. As knowledge of gene splicing becomes more sophisticated and accessible throughout the world, we could be facing a deadly new biological arms race.

In the 20th century, modern science reached its apex with the splitting of the atom, followed shortly thereafter by the discovery of the DNA double helix. The first discovery led to the development of the atomic bomb, leaving humanity to ponder for the first time the prospect of an end to its own future on Earth.

Now, a growing number of military observers are fearful that the other great scientific breakthrough of our time could soon be used in a comparable manner, posing a similar threat to our very existence.

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