

Pure Light

Developed with military objectives in mind, the laser is now a part of everyday life

BY LISA DE NIKE



Fifty years ago, the idea of using a slender, concentrated beam of light to scan supermarket groceries, play music, print documents, whiten teeth, remove unwanted body hair and even perform delicate eye surgery would have seemed like something straight out of a science fiction novel.

Today, however, we take lasers in their various forms almost for granted, giving little thought to the brilliant scientific and, as it turns out, legally tangled process that brought us these modern conveniences.

The story of the laser began, as do so many things in modern physics, with Albert Einstein, whose 1917 paper, “On the Quantum Theory of Radiation,” is said to have laid the groundwork for later work on the laser. Einstein posited that if certain kinds of atoms were mixed with radiation of the right wavelength, it would cause the release of more radiation of the same wavelength: a phenomenon that would basically double the strength of the wave.

This theory made sense to scientists, who imagined that such power might be eventually harnessed to accomplish certain tasks. But it wasn’t until after World War II—in 1948, to be exact—that work on such an invention began in earnest, when the U.S. Pentagon gathered and provided financial backing to a team of physicists at Columbia University.

On that team was Charles Townes, who came to New York from the

California Institute of Technology, where he had rubbed elbows with scientific luminaries such as Nobel laureate Linus Pauling and J. Robert Oppenheimer, scientific director of the U.S.-led Manhattan Project.

Townes and his team found that by stimulating molecules with microwaves, they could produce a pure, concentrated beam. In 1953, they designed a machine that did just that, the MASER, which stands for “microwave amplification by stimulated emission of radiation.” Townes then teamed up with Arthur Schawlow, his colleague at Bell Laboratories, who had ideas to contribute to the project. In 1959, the two men published a paper about their concept in *Physical Review* and were granted a patent for the invention of the laser (still called the “maser”) two years later.

Though it took some of the country’s greatest scientific minds to develop the laser, the concept behind the invention is pretty simple. While camping as a child, did you ever try to ignite a campfire using a magnifying glass to focus the sun’s rays on a pile of dry brush? If so, you were applying to the task of fire-building the same concept that makes a modern laser capable of such disparate tasks as cutting steel beams and reshaping the delicate tissues of the human eye.

In a nutshell, lasers work by bringing together and concentrating various wavelengths of light into one coherent beam. (In physics, “coherent” means that all of the various light beams’ energies—their

photons—are flowing in the same direction.) The result is a tool whose power can be varied for different tasks (from scanning groceries to improving eyesight) by altering the power source, the color of the lightwaves involved and even the source of light.

Interestingly enough, it wasn’t Townes who built the first working laser; that credit goes to Theodore H. Maiman of Howard Hughes Research Laboratories in Malibu, Calif., which had an Army Signal Corps contract to develop a laser (which stands for light amplification by stimulated emission of radiation), a maser that produced visible radiation, sometimes also called an optical maser. Maiman, who was familiar with Townes’ work, in 1960 invented a device that emitted a strong, ruby red light beam. It was a breakthrough, but still limited because Maiman’s model was only capable of pulsed operation. Later that same year, Ali Javan, an Iranian physicist, made the first gas laser, for which he won the 1993 Albert Einstein Award of Science.

In the end, the invention of the laser (which is now part of our everyday lives) was a collaborative effort, involving some of the giants of physics.

One wonders what they would have thought had someone told them that, someday, their hard-won invention would be used to scan gallons of milk, boxes of cereal and cans of tuna at their local grocery stores! ●