

OBITUARY

Theodore H. Maiman (1927–2007)

Maker of the first laser.

The physicist Theodore (Ted) Maiman died on 5 May in Vancouver, British Columbia, at the age of 79. As creator of the first operating laser, he has left an enduring mark on science and technology.

Maiman was born in Los Angeles, California, and showed an early aptitude for electrical engineering which took him first to the University of Colorado and then to Stanford University, where he was awarded a PhD in 1955. Subsequently, as a young scientist at Hughes Aircraft Company in Malibu, California, he worked on the amplification of microwaves by masers, and was eager to produce similar amplification at light wavelengths. His superiors at Hughes were wary of such work, wanting Maiman to do “something useful”. But on his insistence, they let him proceed.

His breakthrough involved the use of a ruby crystal, which others interested in lasers thought would probably not work. However, Maiman introduced a technique that had not been considered, the excitation of ruby with an intense flash lamp. And it worked! A powerful red light beam was produced, lasting only the short time of the exciting flash, but nevertheless providing remarkably high intensity — many orders of magnitude more intense than any previous light source. And it formed a coherent, highly directed beam. Because the laser pulses produced lasted only a short time, others were eager to produce continuously operating lasers, which they soon did. But the very short pulses that lasers produce are themselves now exciting tools used in science and for wireless communication systems.

Maiman initially sent a description of his device to *Physical Review Letters*. But it was rejected because so many manuscripts on masers had been submitted to the journal that its editors made the unusual decision to accept no more papers in the field. So Maiman sent it to *Nature*, where his now famous paper, “Stimulated optical radiation in ruby”, appeared on 6 August 1960 (T. H. Maiman *Nature* **187**, 493–494; 1960). It was very brief, and I have previously commented that this article was probably more important per word than any of the papers published by *Nature* over the past century. The device was quickly replicated by many other scientists, still other types were invented, and soon the word laser — for ‘light amplification by stimulated emission of radiation’ — was common currency.

Few applications for lasers were initially envisaged by most scientists; it was sometimes referred to as “a solution looking

for a problem”. But the ensuing development of the principle produced many forms of laser — ranging in size from the minuscule to the enormous — and they have now permeated almost all fields of science and technology. Lasers are widespread in industry and are tools for much new science: their use underlies the award of several Nobel prizes. They are now exploited in cutting and welding; in communications; for high-precision measurements and convenient directional control; in nanotechnology; in innovative forms of microscopy and for manipulating microorganisms; in computing; and in medicine.

Precise measurement of the distance between Earth and the Moon has been provided by lasers, and some scientists are looking for possible laser signals from planets around distant stars, guessing that intelligent extraterrestrial beings would use them to signal to us. Maiman himself was particularly pleased with the medical applications of lasers, such as reattachment of detached retinas. He did not like, and played down, their use as weapons. This was a popular idea for a while after the tremendous potential power of the technology was recognized.

Infrared lasers (wavelength 30–1,000 μm) have found application in detecting explosives and in chemical-warfare agents. If the word ‘erasers’ were not already in use, perhaps infrared amplification by stimulated emission would be produced by ‘irasers’. But the term laser actually refers to such systems with wavelengths up to 1 mm (above which the name maser takes over), and also to much shorter wavelengths: X-ray and γ -ray lasers are now with us, and their likely further development may prompt yet further scientific progress.

Stimulated emission of radiation, the critical process behind the laser, was first recognized by Albert Einstein as early as 1918. But it was only in 1951 that its use for practical amplification of electromagnetic waves was recognized, and in 1954 the first such device, the maser (for ‘microwave amplification by stimulated emission’), operating at centimetre wavelengths, was constructed. Art Schawlow and I pointed out in 1958 how the same process could be made to work for light waves, which then set off a flurry of work in many places to actually build such a device.

All the earliest types of laser were invented in industry by recently hired young physicists who came from university work



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in radio or microwave spectroscopy. This appropriately brought together engineering and spectroscopy. Maiman’s background was just such a case: at Stanford he had been a student of Willis Lamb, a Nobel laureate for his research on the spectrum of hydrogen. The next type of laser, similar to Maiman’s but using a different type of crystal, was made by Peter Sorokin and Mirek Stevenson at IBM in Yorktown Heights, New York. The next was a continuously operating laser produced by an electrical discharge, created by Ali Javan, William Bennett and Don Herriott at the Bell Telephone Labs in Murray Hill, New Jersey.

After his invention, Maiman did early research in nonlinear optics, a field made possible by intense laser beams. He also formed several companies devoted to laser development and applications, including, in 1962, the Korad Corporation. His own account of his discovery was published in his book *The Laser Odyssey*, which was published in 2000.

Theodore Maiman’s contribution, the first operating laser on Earth (they have now been found to occur naturally in astronomical objects) was truly historic, and has been widely recognized. He was chosen to be a member of the National Inventors Hall of Fame and of the US National Academies, and received many awards, including the Wolf Prize in Physics, the Oliver Buckley Prize and the Japan Prize.

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