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# The MRI Inventors: Who Was Responsible?

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# The MRI Inventors: Who Was Responsible?

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(Chemistry 105)

The Assignment: Write a research paper by choosing a contemporary topic directly or indirectly related to chemistry: food, medicine, drugs, environment, scientific research, industry, manufacturing, etc. Emphasize those aspects of the topic that impact chemistry. Your article can be polemical, making an argument for a particular policy or strategy; it can also be expository, giving an account of a chemical development.

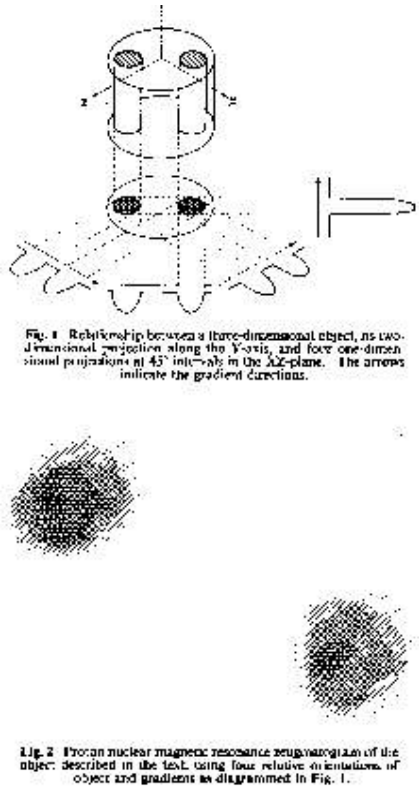
On October 6, 2003 Paul Lauterbur, a University of Illinois professor, and Peter Mansfield from the University of Nottingham, were awarded the 2003 Nobel Prize for Physiology and Medicine for their part in developing the MRI (Magnetic Resonance Imaging). However, there is controversy over who was first to demonstrate this concept. A scientist named Raymond Damadian also had a claim in inventing the idea with his patented model in 1974 of the first human body scanner.

In order to determine why professors Lauterbur and Mansfield were credited for their discoveries as opposed to Damadian, it is important to trace the MRI's roots and how these three men contributed to its evolution.

The MRI scanner came into being because of work of scientists dating back to the 1930s. Nuclear magnetic resonance or NMR is a technique in which magnetic fields and radio waves cause atoms to give off tiny radio signals. For years scientists used this technology for important analytic methods in studying chemical compounds.

Paul Lauterbur was such a scientist who, in the early 1970s, was experimenting with NMR technology, but was often frustrated when his data were ruined by what seemed to be meaningless signals. However, during an experiment he had a flash of insight and realized that the signals he was observing were precise locations of the atoms in a mixture he was studying in a test-tube. He further concluded that with variations of signals he could provide imaging information about locations of different atoms and their densities.

Upon further successful experimentation, Lauterbur produced the very first magnetic images by using a back projection method, which moved from a single dimension image to a spatial dimension image. In 1973 he published a short paper in *Nature* describing a technique, which he termed zeugmatography, (which comes from the Greek word zeugmo meaning yoke or joining together). The first images published were two tubes of water. A year later, Lauterbur published images of a clam, and in 1974 he provided an image of thoracic cavity of a mouse.

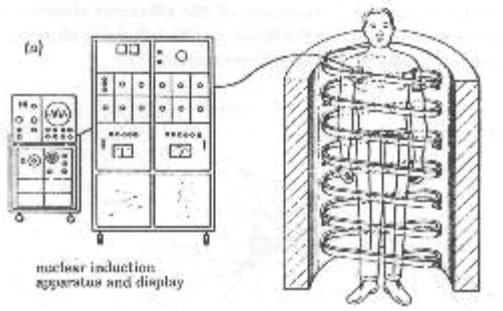


Lauterbur's first images and ideas published in *Nature*.

Lauterbur's ideas opened up the field of imaging, and many scientists tried to develop this theory. Peter Mansfield headed up a group in Nottingham, which experimented a great deal with NMR. He developed a technique referred to "echo planar," which enhanced NMR images by utilizing gradients in the magnetic field. Through mathematically analyzing signals, he increased the speed of imaging, thus allowing for larger images to be constructed in "real time" from consecutive slices across a human body. His first images were a cross section through a finger in 1977, and an image through a human abdomen in 1978.

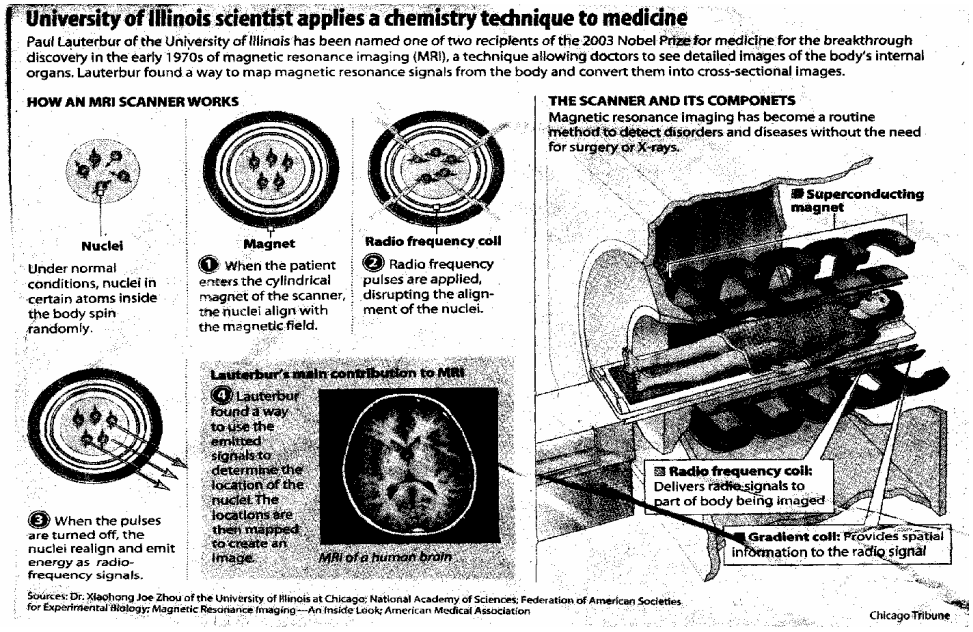
During the early 1970s, another scientist named Raymond Damadian had a different perspective on NMR. He earned a medical degree at Albert Einstein College of Medicine and pursued a medical research career. Upon working with NMR technology, he experimented with electrically-charged particles in the body. He devised an idea that using an antenna wrapped around a human body, one can look from atom to atom, and tissue to tissue without ever invading the body. He felt this would be useful for detecting abnormalities such as cancerous tissues. He tested his hypothesis on cancerous liver samples from rats using NMR equipment, basing his research on the fact that cancerous tissue has higher water content than healthy tissue. His experiments proved to be successful and in 1971 published his findings in the journal *Science*. He concluded in his writings that cancerous tissues could be detected in humans if a large-scale scanner could be built. In 1974 he filed for a patent of such a machine.

He and his colleagues built such a machine in 1977, which Damadian named the "Indomitable." This same machine produced a crude image revealing through computer data points, which were filled in with colored pencils, a two-dimensional view of a human chest including the heart and lungs.




Damadian's model patented in 1974.

The modern MRI scanner of today uses all of the techniques and ideas these three men worked on so diligently. Images are produced using powerful magnets to enclose around portions of a body non-invasively. This in turn causes the nuclei of the hydrogen atoms in body tissues to act as microscopic needles. When exposed to a strong magnetic field, the hydrogen atoms stand "at attention." When small radio signals submit pulses to their nuclei, the energy content of the nuclei changes. After the pulse, a resonance wave is emitted and the nuclei return to their original state. This allows the location of the atoms to be mapped and an image is created.




Reprinted from Chicago Tribune, October 7, 2003

The human body is comprised of about two-thirds water, and this is highly useful in producing MRI images for medicinal applications. Each year more than 60 million MRI scans are conducted worldwide. The MRI has been instrumental in the diagnosis and treatment of cancer. It has also been extremely useful in determining abnormalities of the brain and spinal cord, and for diagnosing inflammation due to multiple sclerosis.

The controversy remains after both Lauterbur and Mansfield were awarded the Nobel Prize. Given the dates of the early thoughts and inventions it is difficult to distinguish which scientist was the true inventor of the MRI.

Damadian in 1971 accomplished an enormous benefit to the medical world by exposing his ideas of using magnetic resonance technology to show that cancer cells differ in their resonance signals to that of normal cells. He also is responsible for coining the acronym MRI. Lauterbur claims that Damadian's work had no influence on his, when also in 1971 he wrote in a notebook his use of NMR images and had a friend sign it, which is a common practice when a scientist believes he has made a patentable discovery. Many accredited scientists and members of the Nobel Prize nominating committee feel that Lauterbur and Mansfield were well deserved of receiving their Nobel Prize awards.

Mike Smith, a specialist in MRI research at the University of Leeds, UK, feels that Lauterbur was the first to obtain crude images using NMR. He states, "Before that, NMR was only used for analyzing chemical compounds."

Other supporters of Lauterbur include Dr. Alexander Margulis, chairman of the department of radiology at UC San Francisco, and he states "Damadian made words. But Lauterbur made an image, and that is the true difference."

Andy Coghlin, writer for NewScientist.com news service, writes that Mansfield is considered to be responsible for innovative techniques that made MRI widely available. Mr. Coghlin also writes that his "echo-planar" technique is the bedrock of 22,000 MRI scanners worldwide.

Damadian was overlooked for the Nobel Prize for various reasons according to some experts. His patent that he filed for in 1972 included the idea but no description of a method or technique of using NMR to scan the human body. The EMRF Foundation feels that using his techniques for diagnosing cancer or characterizing malignancies would be impossible using his apparatus. In a report published this year by this same foundation, it states that his apparatus was not an imaging device and could not be used for imaging.

It is my opinion that both Professors Lauterbur and Mansfield were the proper recipients to be awarded the Nobel Prize. It was Lauterbur's findings that led to the creations of imaging using variations in magnetic fields. Mansfield's mathematical analysis work took the images even further, thus enabling the world today to use modern MRI scans for incredible purposes.

I feel that Damadian's inventions and contributions were also important, but were not the true forerunners of the MRI scanners used today. The company FONAR, which Damadian himself started, is a seller of MRI scanners. This same company adopted the techniques of Lauterbur's imaging for its own machines.

The decision that had to be made for who would be nominated for the recent Nobel Prize had to be difficult. All three men were enormous contributors to the evolution of the MRI scanners used today.

FONAR, Damadian's company is currently working on new scanners and filing patents related to MRI. On September 16, 2003 he filed a patent, along with other inventors for an open-entry MRI scanner to provide easier access to the patient.

Small scanners are being developed which would be simply placed on parts of the human body such as an arm, knee or foot. MRI research is being done on brain mapping, which refers to scanning a person's brain while performing tasks such as squeezing a ball, to better understand how the brain works. Researchers are also developing new ways to image strokes in their earliest stages using MRI.

MRI has only been used for medical purposes for the last 20 years, and the future is incredibly exciting. It is a limitless field and many new developments will surely come about in the years to come.

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