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American and Briton Win Nobel for Using Chemists' Test for M.R.I.'s

By NICHOLAS WADE OCT. 7, 2003

This year's Nobel prize for medicine has been awarded to two pioneers of magnetic resonance imaging, a widely used procedure to visualize the body's tissues without using radiation.

The recipients are Paul C. Lauterbur of the University of Illinois and Sir Peter Mansfield of the University of Nottingham in England.

The researchers took a chemists' technique to study solutions and developed it into a way to image the body, which, appearances to the contrary, is mostly water. Unlike CAT scanners, which use radiation, magnetic resonance imaging examines the body only with magnetic fields and the pulses of radio waves.

M.R.I. has replaced invasive techniques for examining joints, the brain and other vital organs. The technique is now so sensitive that it can locate the site where different mental tasks are performed in the brain, essentially by tracking the extra blood flow to the active regions.

Dr. Lauterbur, a physical chemist who was at the State University of New York at Stony Brook, published his crucial paper on the technique in 1973. In the traditional fate of truly innovative ideas, it was at first rejected by Nature, a leading journal, but Dr. Lauterbur persuaded the editors to reverse their decision.

His idea concerned a technique called nuclear magnetic resonance, or N.M.R., spectroscopy. In that process, molecules are entrained in a strong magnetic field and

zapped with radio waves. Chemists went to great pains to create a uniform magnetic field, under which the molecules gave the clearest signal.

Dr. Lauterbur realized that the fuzziness in the signal in fact contained information about the spatial distribution of the contributing molecules. By applying a varying magnetic field, he could obtain the spatial information to build an image of molecules arranged in some structure.

At the time, the best N.M.R. machine on the Stony Brook campus belonged to the chemists. Dr. Lauterbur visited their laboratory at night, altering the settings to give the varying magnetic field he needed. He had to take great care to restore conditions for a uniform field before he left, said David Hanson, a colleague at the university.

Among the first images that Dr. Lauterbur made were of a clam and two test tubes of heavy water in a beaker of ordinary water, Dr. Hanson said. No other imaging technique at the time could distinguish between the two kinds of water, one made with normal hydrogen atoms and the other with deuterium atoms, which carry an extra neutron.

Dr. Lauterbur said he had realized in 1971 that his idea could result in medical imaging, including for the brain.

"I had observed very invasive procedures in animals," he said, "and it was clear to me that these were unlikely to be transferable to humans."

It was disappointing when Nature rejected his article, but he said he bore no grudge.

"You could write the entire history of science in the last 50 years in terms of papers rejected by Science or Nature," he said.

N.M.R. spectroscopy began in 1946, and Dr. Lauterbur, one of its first practitioners, was able to read every article written on the subject. In addition, he brought "tremendous insight and intuition" to bear, said Charles S. Springer Jr., a former colleague at Stony Brook who is at the Oregon Health and Science University in Portland.

The other recipient, Sir Peter, supplied a major step to make Dr. Lauterbur's concept a practical reality.

"Peter was as close to Paul as anyone else in understanding how you get spatial information out of these signals," Dr. Springer said.

Sir Peter showed how to speed the imaging process by developing new mathematical techniques to analyze the information from rapidly varying the magnetic field.

Both principal contributions were decades ago. Dr. Lauterbur was born in 1929 in Sidney, Ohio, and Sir Peter in 1933. According to the Karolinksa Institute in Stockholm, which chooses the winners of the medicine Nobel, by last year, 22,000 M.R.I. cameras were in use worldwide, and more than 60 million scans had been performed.

Magnetic resonance imaging is based on nuclear magnetic resonance spectroscopy. When the medical imaging use of the technique was developed, the word "nuclear" was dropped, for purely cosmetic reasons, for fear that the public might think "nuclear" implied radioactive. In fact, it refers not to the disintegration of atomic nuclei, but to their harmless behavior in the presence of a magnetic field.

Certain nuclei like those of hydrogen, which is ubiquitous in the water molecules in the body, absorb and emit radio waves of precise frequency when they are aligned in a strong magnetic field. It is these signals that are used to build an image of the tissues.
