

Here is the great voyage of scientific discovery to which we truly owe the MRI. As the result of early detection of cancer and other serious diseases, along with more exact monitoring of the effectiveness of treatment, the MRI confers countless thousands of medical benefits on humanity every day – in lives healed and saved worldwide. Enjoy what follows. It all happened in America – in fact, most of it in New York.

1 Dr. Damadian with Dr. Freeman Cope. Cope first introduced Damadian to the workings of the NMR machine in 1969 while they were performing spectroscopy experiments on potassium-rich bacteria at NMR Specialties in New Kensington, Pennsylvania.

2 Raymond V. Damadian, M.D., at the NMR in his Brooklyn laboratory, measuring the signals from human tissues. It's the same instrument model he used to make the "exciting discovery" (that opened the door for a complete new way of imaging the human body)."

3 Original data from Dr. Damadian's notebook on which he based his landmark paper in the journal *Science* (March 1971). In his paper, titled "Tumor Detection by Nuclear Magnetic Resonance," he reported the discovery of the cancer-tissue signal and the differences in signals from healthy tissue (T1 and T2) that made the MRI a goal worth pursuing.

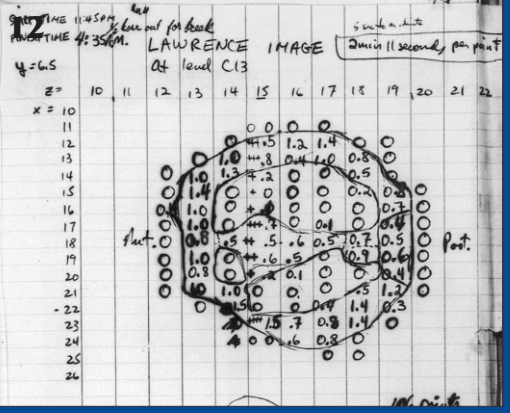
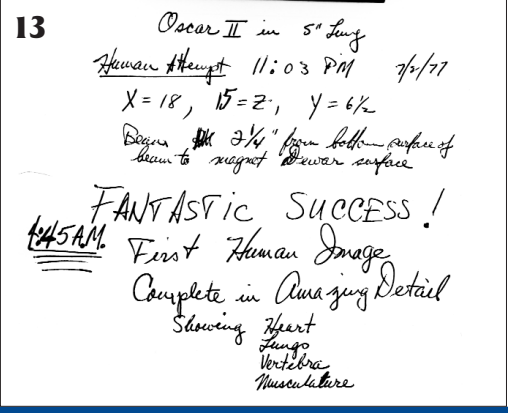
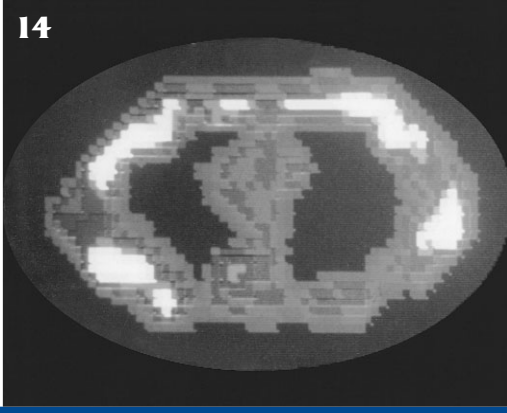
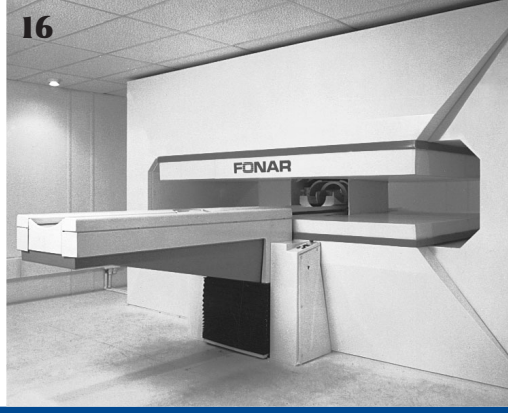
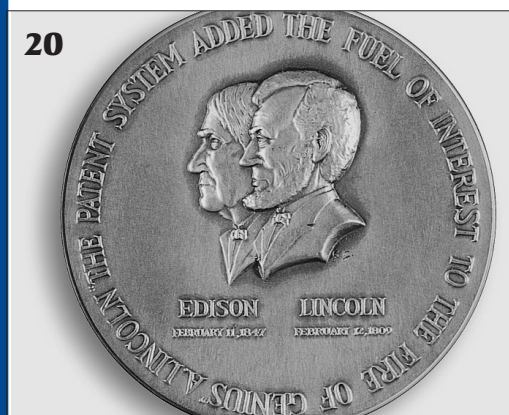
4 Although Dr. Damadian had never built a magnet before, he set about to build a 5,000-gauss superconducting magnet – at that time the ninth-largest in the world. He sought and received a computer program from Brookhaven National Laboratories to enable him to calculate the magnetic field of the magnet he was designing. Dr. Damadian's design called for the construction of three huge doughnut-shaped metal rings nested within one another. The smallest doughnut, made of polished stainless steel, contained the wire hoops comprising the magnet and the liquid helium. To reduce heat conduction, the magnet was prevented from touching its container with special supports made of material that was a poor conductor of heat.

5 It was up to Michael Goldsmith, Ph. D. (who was Dr. Damadian's postdoctoral research fellow and former graduate student), with the help of other graduate students of Dr. Damadian's, to wind the wire for the two magnet hoops. Niobium-titanium wire obtained at the "miraculous" price of ten cents on the dollar from Westinghouse Corporation was tightly and precisely wound off a wooden spool into two 53-inch-diameter hoops, each containing 30 miles of wire, an almost trace-producing process that went on for weeks at six days a week, 16 hours a day.

6 The second doughnut, to be filled with liquid nitrogen to help cool the helium, was made of aluminum wrapped with 85 layers of super-insulating aluminized Mylar to bounce off unwanted heat radiation.

7 The third and largest doughnut, a half-inch-thick aluminum can visible in the finished machine on the next page, contained the other two doughnuts surrounded by a 10 exp-9 TORR vacuum. Though surrounded by liquid nitrogen and encased in a vacuum atmosphere, the liquid helium for the magnet had to be replenished daily. To store liquid helium, Dr. Damadian and Larry Minkoff had to build a reservoir tank to sit astride the huge magnet. Unfortunately, it leaked intolerably and it took weeks of valuable time to find and fix the microscopic leaks in the porous metal.

8 Drs. Damadian, Minkoff and Goldsmith and the completed Indomitable. Although it was built to operate at 5,000 gauss, some of the wire in the magnet had to be bypassed through a special access sleeve designed by Dr. Goldsmith. Along with the bypassed wire went the field strength. The team would have to try producing a human image at only 500 gauss.



THIS YEAR'S NOBEL

PRIZE IN MEDICINE

This is the great voyage of scientific discovery that gave the world the MRI. It will be ignored on the shameful night of December 10th.

The Nobel Prize will make itself irrelevant to the true history of the MRI. It will also lose its credibility as an award for scientific achievement.

This Wednesday evening, the Nobel Prize for Medicine will be awarded for the MRI.

The prize pretends to honor "discoveries concerning the development of magnetic resonance imaging." Yet the Nobel Committee for Physiology or Medicine decided to exclude from recognition the foundational scientific history in magnetic resonance imaging you see before you – scientific history that has been before the Committee during the many years Dr. Raymond Damadian has been nominated for the prize for the MRI.

They have chosen, instead, to award the prize to two men who contributed nothing more than improved ways to image the MR signals from cancer tissue and healthy tissue that Raymond Damadian discovered – the signals that continue to drive every MRI in the world. To put MRI technology briefly: no signal, no image.

The authoritative medical textbook *MRI from Picture to Proton* (Cambridge University Press, UK, 2003) describes the landmark importance of Damadian's discovery in this way:

"The initial concept for the medical application of NMR, as it [MRI] was then called, originated with the discovery by Raymond Damadian in 1971 that certain



President Reagan presenting Dr. Raymond Damadian with The National Medal of Technology on July 15, 1983 (jointly with Lauterbur) "For their independent contributions in conceiving and developing the application of magnetic resonance technology to medical uses including whole-body scanning and diagnostic imaging."

mouse tumours displayed elevated relaxation times compared with normal tissues in vitro. This exciting discovery opened the door for a complete new way of imaging the human body where the potential contrast between tissues and disease was many times greater than that offered by X-ray technology and ultrasound."

While the inventions of the two men being honored do have some place in the history of the MRI, they were essentially replaced in 1980 by a technique called spin warp. Meanwhile, the signals discovered by Dr. Damadian continue to help save thousands of lives around the world every day.

When it comes to the two winners – one an NMR chemist and the other one an NMR physicist – we can ask the same question that the textbook asks: "So what were NMR researchers doing between the forties and the seventies – that's a long time in cultural and scientific terms. The answer: they were doing chemistry, including Lauterbur, a professor of chemistry at the same institution as Damadian. NMR developed into a laboratory spectroscopic technique capable of examining the molecular structure of compounds, until Damadian's ground-breaking discovery in 1971."

A PRIZE SHOULD RECOGNIZE SCIENTIFIC HISTORY. NOT ATTEMPT TO REWRITE IT

A prize in science, or any other field, exists for only one credible reason: to recognize the history of achievement. It must never attempt to rewrite it. The very effort demonstrates contempt for the truth of science.

Yet that is what the Nobel Committee for Physiology or Medicine has attempted to do.

They will fail, regardless of whether or not the Committee or the Assembly makes a last-minute emendation. They will fail because the truth is not so malleable as they would like and Dr. Damadian's achievements are far too significant for any credible historian to overlook.

THE DAMAGE TO THE PRIZE WILL BE LASTING

If the trustees into whose hands the prize has fallen can maneuver their way around the undeniable evidence of scientific achievement you see here, how can their selections in years to come be regarded with anything but skepticism?

The people responsible have no one to blame but themselves.

Yet the present situation makes us and all people who had hoped for better inexpressibly sad.

OVER 500 MILLION MRI SCANS AND COUNTING

Since Dr. Damadian's "exciting discovery opened the door to a complete new way of imaging the human body," along with his persistence in building the first MRI in the face of nearly universal skepticism (called at the time such idiotic things as "visionary nonsense"), and his achievement of the first scan of the human body, over 500 million MRI scans have been performed around the world.

Thanks to his discovery and will, the MRI has spared millions of patients untold agony and saved millions of lives. Is he not one of the greatest living benefactors of humanity? Imagine the characters who decided such a person could be bypassed and hurt!

ALFRED NOBEL WOULD NOT QUALIFY FOR HIS OWN AWARD

The decision-making process in Stockholm has become so wrongheaded as to exclude – as a matter of spoken policy and almost without exception – inventors who hold patents in favor of academic researchers. They feel the inventors will make money, but the academic researchers need it. Sorry, we didn't think the Nobel Prize is about money. We thought it is about the unprejudiced recognition of scientific achievement. So egregiously flawed is this policy that Alfred Nobel himself, who held 355 patents, would not qualify for his own prize!

TO THOSE WHO HAVE RAISED THEIR VOICES

We would like to dedicate this final effort to right the shameful wrong that has been done to Raymond Damadian to all those people of good conscience who have raised their voices in protest. It is your unwavering ethical sense that allows people who are wronged to hope that they may yet find justice in the unbiased court of public opinion.



Dr. Raymond Damadian at his induction into The National Inventors Hall of Fame (Established by the U. S. Patent Office), February 12, 1985, for the invention of magnetic resonance scanning.

WE HAVE DONE ALL WE CAN

We have now done all we can to right the shameful wrong that has been done to Raymond Damadian, M. D. The rest resides in Stockholm. As the Nobel trustees know, three winners can still be named for the prize in medicine. Yet, at this late date, what hope is there that a sufficient number of them can find within themselves the ethics to step forward?

We find it more logical to be consoled by certain verities – among them that, regardless of any prize, the MRI will continue to bestow its many benefactions on humanity, and the medical doctor who has been considered its inventor for over 30 years will continue to be regarded as such. He will also no doubt continue to be what he is so impressively: the most innovative mind in MRI – from the day he first conceived the possibility of such a machine to today and on into tomorrow.

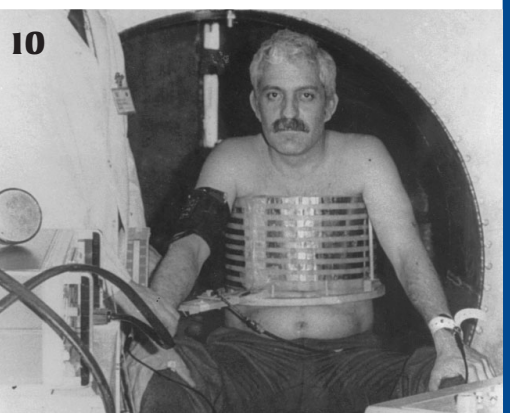
This visionary man has recently invented the first Stand-UpTM MRI, which spinal surgeons are finding invaluable for more accurate assessment of problems and the treatment of them.

TIMELINE OF MRI

1969 Original Concept Damadian conceives of and proposes a whole-body MR scanner for the first time ever. "I will make every effort myself through collaborators to establish that all tumors can be recognized by their potassium relaxation times or water-proton spectra and proceed with the development of instrumentation and probes that can be used to scan the human body externally for early signs of malignancy. Detection of internal tumors during the early stages of their genesis should bring us very close to the total eradication of this disease." Grant application, Health Research Council of The City of New York, September 17, 1969.	1970 Key Discovery Makes the MRI Possible Damadian identifies the T1 and T2 signal differences (that is, the signal strength differences) between cancer tissue and normal tissue	March 1971 First paper published Damadian publishes his first paper about his findings in the journal <i>Science</i> (March 19).	Spring 1971 Scanning Method Proposed Damadian outlines his voxel-by-voxel scanning method, recorded in his 1972 patent. "Already Dr. Damadian is planning to build a much larger nuclear magnetic resonance device, one that will be big enough to hold a human being, that machine, Dr. Damadian believes, will prove that nuclear magnetic resonance (NMR) is the tool that doctors have been looking for in their quest for a method of detecting cancer early when treatment is most effective. The proposed NMR device for detecting cancer in humans would not have to be highly elaborate," Dr. Damadian says. "It would consist of a large coil to emit radio waves and a movable magnet to create the magnetic field required. The coil would be wrapped around the patient's chest while the magnet passed back and forth across the body. A detector would pick up NMR emissions for analysis." <i>The Downstate Reporter</i> , Vol. 2, No. 2, Spring 1971	September 1971 Gradient Method Proposed Lauterbur's notebook proposal of the gradient method of Gabillard, Purcell & Carr to scan 1 dimension, as Gabillard did. It's incomplete; 3 dimensions are needed.	March 1972 First Patent Filed Damadian files a patent for his 3-dimensional voxel-by-voxel scan method (patent issued in 1974)	October 1972 2D Scan (image) Achieved Lauterbur submits a 2-dimensional MR scan (image) method with scan of 1mm tubes for publication.	March 1973 2nd Paper Published Lauterbur's paper (2D image) published in <i>Nature</i> (March 16).	1974 3D Scan Method Proposed Garraway, Grannell & Mansfield publish a 3-dimensional scan method	1975 Phase Coding Introduced Kumar, Welit & Ernst introduce phase coding scan method.	1977 First Human Scan Achieved Damadian and two of his coworkers, Minkoff and Goldsmith, achieve the first scan (image) of the human body, using Damadian's voxel method. It is a cross-section of Minkoff's chest, completed 4:45 AM, July 3, 1977.	1980 Phase Coding Applied Aberdeen group of Hutchison, Edelstein and Mallard achieves successful spin-warp technique in use throughout the world today to make MRI images.	1980 First Commercial MRI Damadian – and the company he forms for the practical application of MRI technology to medicine – introduces the first commercial MRI scanner, utilizing his patented voxel method.	1997 Patent Upheld High Court on U. S. Patents and the U. S. Supreme Court enforce Damadian's patent, finding "insubstantial differences" between the way modern MRI's output signals and his patented use of the signals to detect cancer.
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1. *MRI from Picture to Proton*, Cambridge University Press, UK, 2003

Paid for by The Friends of Raymond Damadian. Contact DanielCulver@aol.com or call him at 631-694-2929. All facts are public knowledge. Documentation may be found at www.fonar.com



9 To go from an NMR machine which analyzed test-tube-size samples of single compounds in pure solutions to electronically mapping the inside of the human body was, as Dr. Damadian described it, "Like going from a paper glider that you tossed across the classroom to a 747." The above machine, an example of one such NMR spectrometer, was smaller and less sophisticated than the machine used at NMR Specialties. It was ordered by Dr. Damadian in 1971 to perform ongoing tissue biopsy studies at Brooklyn's Downstate Medical Center after his discovery of the cancer-tissue signal at NMR Specialties in New Kensington, Pennsylvania.

10 The first attempt for a human scan was with Dr. Damadian sitting in Indomitable, the world's first MR scanner, which he and his colleagues built. A blood-pressure gauge was affixed to his right arm; an EKG was wired to his chest, and oxygen was kept handy. The cardiologist (standing at left in photo) was there in case the magnetic field produced any strange cardiac effect on Dr. Damadian. No signal was received from the scanner. The team decided that Dr. Damadian was over-sized for the cardboard vest housing the antenna and that he must have deflated it. A thinner "guinea pig" was needed.

11 The "perfect-sized" Larry Minkoff finally agreed to be scanned.

12 The data from Michael Goldsmith's notebook where he and Dr. Damadian recorded the oscilloscope measurements of signals received from Larry Minkoff's chest on the night of the first human MR scan. Each of the 106 numeric values was given a corresponding color which, when sketched with colored pencils on a sheet of graph paper, indicated a rough but otherwise accurate representation of Minkoff's chest – the body wall, the right and left lungs, the heart (the right atrium and one of its ventricles), and the descending aorta.

13 Dr. Damadian's jubilant hand-written notation, "Fantastic Success!" marked the historic accomplishment in his notebook.

14 The data was fed into a computer and interpolated to produce the finished image.

15 Dr. Damadian in the early days of Fonar Corporation conducting MRI experiments during the development of the medical industry's first commercial scanner, Fonar's QED 80.

16 An early Fonar scanner (1982).

17 Dr. Raymond V. Damadian, inventor of MR scanning, with the history-making prototype named Indomitable, used to make the first MR image of a human on July 3, 1977. The machine is permanent display at The Smithsonian Institution's Hall of Medical Sciences. (It is now on loan to The National Inventors Hall of Fame.)

18 MR imaging, once fast becoming the cornerstone of modern radiology, shows detail never shown before by diagnostic imaging.

19 Dr. Raymond Damadian with his wife, Donna, on the 1989 Presidential Inaugural Ball.

Dr. Damadian credits much of his achievement in inventing MR scanning to the gentle and quiet strength of Donna, who kept the home fires burning during Dr. Damadian's long, often discouraging struggle to see his dream machine become reality.

20 In 1989, Dr. Damadian was inducted into The National Inventors Hall of Fame, joining the ranks of Thomas Alva Edison, Alexander Graham Bell, the Wright Brothers, and Henry Ford. The Lincoln-Edison Medal award those inducted into the Hall acknowledges the importance of the U.S. Patent System with a quotation by Abraham Lincoln: "The Patent System added the fuel of interest to the fire of genius."