What follows is excerpted from an exchange of e-mails between Jack Roberts, Institute Professor of Chemistry, Emeritus; Doug Smith, managing editor of *E&S*; and Mike Tyszka, visiting associate in biology regarding one of the Core 1 science-writing essays published in the last issue, "The Promise of Portable MRI," by John Ferguson.

Jane:

I was rather embarrassed to read in *E&S* that the writer of the NMR article placed one of the greatest of Harvard's physicists, Edward Purcell, as leader of a team from of all places, MIT, and "discovered" (more appropriate would be "demonstrated") NMR in condensed matter. It was discovered by I. I. Rabi quite a few years before in the gas phase and earned him a Nobel prize....

Perhaps the student papers might be better at least read by someone working in the field.

Jack

Dear Professor Roberts,

I apologize for the misaffiliation of Edward Purcell with MIT instead of Harvard. That, alas, was my error, not the student's. The original sentence in John Ferguson's essay read:

"The official birthday of NMR was in 1946 when two American teams led by Bloch and Purcell independently discovered that by adding another, smaller field to the original, larger magnetic field interesting results would follow."

E&S style is, where practical, to include people's full names and affiliations the first time they are mentioned in an article. So in the process of (lightly) editing the piece to conform to our style, I supplied the missing information. In this case, I went to the Nobel Prize Internet Archive, and pulled out his biography <http://www.nobel.se/physics/laureates/1952/purcell-bio.html>, where I found the following:

"He returned to the United States in 1934 to enter Harvard University, where he received the Ph.D. degree in 1938. After serving two years as instructor in physics at Harvard, he joined the Radiation Laboratory, Massachusetts Institute of Technology, which was organized in 1940 for military research and development of microwave radar....

"The discovery of nuclear magnetic resonance absorption was made just after the end of the War, and at about that time Purcell returned to Harvard as Associate Professor of Physics."

I interpreted that last sentence to mean that he made the discovery (or demonstration) at MIT, and then promptly returned to Harvard, where, as the bio goes on to say, he remained for the rest of his career....

Ferguson's paper was read by his mentor, Michael Tyszka, who is a visiting associate in biology here and a clinical MRI researcher.

sincerely,

doug

Thanks for your clarification....

The distinction between discovery and demonstration is an interesting one and to me often neglected. In my view the official birthday of NMR was NOT actually in 1946.

In 1946, the physics of NMR was well known, but the problem of detecting resonances in condensed matter was really a matter of guesswork, because no one was sure how long the relaxation times would be, possibly too long or possibly too short. Purcell used paraffin and Bloch used water and fortunately both worked. So they discovered that it was practical, but it was hardly a basic discovery of the phenomenon, which had been done earlier by Rabi. There was a Dutch physicist, named Gortner, who had all the right ideas ahead of Bloch and Purcell, but who missed, possibly on the relaxation-time front, when he tried the experiment with less-favorable compounds.

There is always a potential problem when the young people review an old field: the writers of the historical articles that are consulted often do not know themselves what actually transpired. For NMR, there is an encyclopedia, the first volume of which is devoted to stories by many of the living early participants telling what they think happened. Perhaps a lot of those are not wholly accurate, but at least they were there!

Best wishes,

Jack Roberts

Dear Doug and Prof. Roberts,

There's actually a paper about the Purcell issue which reveals how close Harvard came to missing out: "Purcell's Role in the Discovery of NMR: Contingency versus Inevitability," by Mark Gerstein, American Journal of Physics, 62: (7), 596-601, July 1994.

You can find a web copy at: http://bioinfo.mbb.yale.edu/hyper/mbg/Purcell/Purcell.txt

Sorry I missed this during proofing. On reflection, I agree with Prof. Roberts regarding the NMR birthday. If I was to make a call, I'd add Torrey and Pound to the Harvard/MIT venture and Hansen and Packard to the Stanford group. I always like to credit Stern and Gerlach (1933) for the molecular beam nuclear magnetic moment demonstrations, which ultimately led to the NMR of Rabi et al. in 1939....

Many thanks for bringing these points up. Education continues indefinitely.

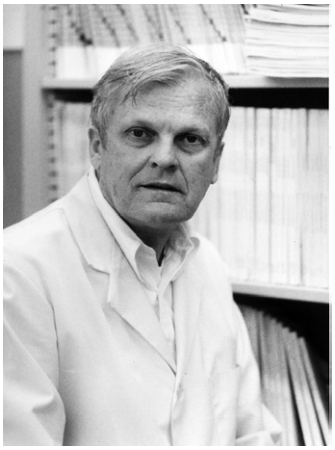
Mike Tyszka

Biological Imaging Center

And here's the relevant passage from that paper:

"During World War II, Purcell, [Robert V.] Pound, and [Henry C.] Torrey were members of the MIT Radiation Laboratory, henceforth referred to as the Rad Lab, where they worked developing better radar for the military.... Shortly after the end of the war in August 1945, Purcell, Pound, and Torrey got together at a restaurant on Massachusetts Avenue in Cambridge for lunch. The Rad Lab was closing, and

James O. McCaldin
1922 – 2001



James O. McCaldin, professor of applied physics and electrical engineering, emeritus, died November 23.

McCaldin earned his BA in mathematics from the University of Texas in 1944 and his PhD in engineering from Caltech in 1954. He spent the early decades of his career in industry. He worked in telemetry at Arabian American Oil Co. of New York in 1952, in physical metallurgy at General Motors Corp. from 1954 to 1956, at Hughes Aircraft Co. as head of the semiconductor materials department from 1956 to 1961, and at North American Aviation Science Center as semiconductor leader from 1961 to 1968.

He joined Caltech in 1968 as an associate professor of applied science, was named professor of applied science and electrical engineering in 1973, and professor of applied physics and electrical engineering in 1976. He had been professor, emeritus, since 1983. McCaldin was known for his carefully thought-through advice to both graduate and undergraduate students and for making the freshman Solid-State Electronics Laboratory course one of the more enjoyable academic possibilities of the freshman year.

McCaldin was one of the pioneers in some of the technology that made the semiconductor revolution possible. He did early work on semiconductor interfaces, on thin film growth, on planar construction for silicon devices, and on ion-implantation doping of silicon, which has been of great practical importance. In a 1973 issue of *Engineering and Science*, McCaldin and his coauthor, James W. Mayer, discussed the ways in which crystal growth was revolutionizing the electronics industry, noting that the structures giving rise to metal-semiconductor contacts were smaller than anticipated—in some cases a few hundred Angstroms in thickness. "With improvements in instrumentation and fabrication skills, it may soon be possible to reduce this thickness to, perhaps, atomic dimensions," they wrote.

At the time of McCaldin's retirement, Professor of Applied Physics Thomas McGill wrote: "His research has always been characterized by an adventuresome but scholarly development of a new concept that has frequently later become one of the keys to important technological developments."

McCaldin was editor of the journal *Progress in Solid State Chemistry* from 1969 to 1976, and invented several patented technologies. He was a member of the American Physical Society, a former chairman of the Southern California section of the American Institute of Mining, Metallurgical, and Petroleum Engineers, and a former secretary of the Southern California and Nevada section of the Electrochemical Society.

He is survived by a brother, Roy McCaldin. □

Purcell, Pound, and Torrey remained there only to contribute reports to a twenty-eight-volume series on the advances made during the war. It was a hot summer day and their discussion turned to possible areas of postwar research. Purcell brought up the idea of using a magnetic field to split the energy levels of a hydrogen nucleus (i.e., a proton) and using the resonance frequency of a radio signal to measure the nuclear magnetic moment of a proton.…

The first order of business was to assemble the apparatus necessary to carry out the experiment. In particular, they needed to get a magnet strong enough to split the energy levels. Purcell initially wanted to use the one in the MIT cyclotron, but the MIT authorities were not too enthusiastic about this. Their frugal attitude was quite a change from the generosity of the Rad-Lab administrators during the war. Purcell then managed to persuade J Curry Street to let him use the magnet with which Street had discovered the muon in 1937 at Harvard. □