

CONYERS HERRING

Those of you here who are non-scientists probably know Conyers best as an unassuming, intelligent, friendly man who could extemporaneously come up with a funny appropriate limerick. Those of us who are scientists would agree with that. But we also know him as a gentle genius who contributed to the entire field of solid-state physics starting as a graduate student at Princeton. There, Eugene Wigner, with his graduate students John Bardeen, Frederick Seitz and Conyers created the modern band theory of solids. Conyers went on and invented the Orthogonalized Plane Wave Method for calculating the electronic energy bands in solids, a giant step to our understanding of semiconductors and metals. He continued for the rest of his career to make substantial contributions to condensed matter and materials science, the sciences that underpin the digital age we now live in. In addition he found time to write masterful reviews that collected, corrected, organized and clarified ideas and provided useful guidelines that are still often cited

Perhaps unique in the field of physics was his remarkable ability to assimilate the important theoretical and experimental advances as they emerged in the literature. He abstracted their content in an ever-growing file of many thousands of 3x5 cards with terse, perceptive comments. He generously shared the information. He was a one-man Google before the net was dreamed of, but he was actually more useful because he had already filtered out the wheat from the chaff. Conyers was aware of the innovative work being done by the Russian Theorists and to keep abreast during those cold war days when translations were slow or non-existent he simply learned to read Russian.

Like most of his generation, including me, Conyers was not at home with the digital world. His good friend Chape Cutler was an exception. Chape, a distinguished electrical engineer, followed Conyers from Bell to Stanford. At Chape's retirement Conyers wrote:

‘Tho his years pile up at Oak Creek
Chape still can't be called an antique
He grows ever astuter
And does more with the computer
In a minute that once took a week.’

Conyers was always approachable, I found out during soon after I arrived at Bell as a fresh PhD. In one of my first experiments I was puzzled by the unexpectedly large voltage in a bar of very pure germanium that appeared when placed in a thermal gradient, and my boss Joe Burton suggested that I go see Conyers. Voltages that appear under such circumstances had long been known and named for their 19th century discoverer Thomas Seebeck. but they had never before been found to have such large and temperature dependent magnitudes. Conyers soon arrived a plausible explanation but wasn't satisfied until he found a completely independent solution to the problem of simultaneous flow of electrical and heat currents. It was simpler and more transparent and as a consequence I was able to carry out a series of investigations in higher frequency ranges that previously had not been possible. This episode illustrates two of Conyer's outstanding qualities. First he exposed the physics underlying the phonon drag effect in a beautifully clear way that influenced my research, and the same will be evident from the excerpts of letters I will soon read. The second characteristic was his care in seeking to confirm his model with an independent approach before publishing. One result of this self-imposed discipline is that he

published a relatively few number of papers, but ones that were consistently of high quality and influential.

Conyers was an active parent in events at the Lincoln school in Summit. After one field day, where as I recall he served as a judge he prepared this limerick for Lois, maybe a 3rd or 4th grader:

This Mr. Geballe you call Ted
He must have a hole in his head
When the teams tug-of-warred
I pulled on my cord
But he told me to push it instead.

Conyers was an avid and competitive tennis player, and not surprisingly a student of the game. He and I battled throughout the year, usually continuing until election-day, Nov 4, when the snow gusts and swirling leaves finally chilled our enthusiasm. One year Conyers ran the mixed doubles tournament at the local club. He set a new standard when he used the famous solution to the traveling salesman problem to arrange for each person to partner with each of the opposite sex with a minimum number of switches.

For Conyers 80th birthday a special session of his famous Journal Clug was held at Stanford. I'd like to read a few excerpts from messages sent by some world famous colleagues who were unable to attend.

“Conyers- congratulations on your 2600th (more or less) Journal Club. I can best describe the massive impact you have had on solid state physics by visualizing a tree structure of the scientific literature of solid state physics. I colored red all the branches which originate in papers which were either yours or had (or should have had) an acknowledgement of your invaluable help. My conclusion is that the whole tree would have ended up being

bright red. Perhaps the least known is the function you served in keeping our heads straight. If I or anyone at Bell was confused we knew we could get straightened out by you.” Phil Anderson. (Princeton University)

“Conyers --For me you have been a great example, first on the fact that metal physics and electronic structures on the one hand, and metallurgy and crystal defects on the other could be attacked usefully by the same man, and were complementary. But perhaps more important, I took from my early contact with you the idea that physics had to be strict in its reasoning but could be great fun: Thank you.” Jacques Friedel (Academie des Sciences de Institiut de France)

“Conyers, those many summers at Bell Labs when I and Quin [Luttinger] used to come to our Solid State Mecca, and learn the difference between real science and the typical Phys. Rev. papers, where barely 40, you were already the wise old man, to whom we all went for advice and information, those were among the best and most stimulating times of my life. Great science, great hospitality, unbearable heat and humidity, yes, those were the days.” Walter Kohn (UC Santa Barbara)

“Conyers is one of the theorists whom I most admire. With John Bardeen he made the key pioneering contribution to the theory of correlation effects in solid-state diffusion. His theory for equilibrium configurations of surfaces is still a landmark in materials science.” David Turnbull, (Harvard)

“I have had papers rejected on the grounds that if the results were true they would have been discovered 20 years ago. On replying to the editor my request was always send it to a smarter referee, and I only had one to suggest. The new referee would come back with ideas on how to clarify and improve the manuscript. I have

often remarked to my friends that you should become the patron saint of referees.“ Albert Overhauser (Purdue)

The wide range of Conyer's contributions have been recognized by his peers with many honors. These include the Oliver Buckley Prize of the American Physical Society (1959), the Von Hippel Award (1980) of the Materials Research Society, the Wolf Prize (1984) , and memberships in National Academy of Science and the American Academy of Arts and Science. His monumental review “Exchange interactions among itinerant electrons” that started out to be a chapter kept getting larger as he unified concepts and corrected errors in the original literature and finally turned into a highly valued book that was primarily responsible for his being given the James Murray Luck award by the NAS.

Near the end of his scientific career Conyers was engaged in preparing one final review – “The Evolution of Solid State Physics”. He gave, but was unable to complete, a series of public lectures at Stanford based upon notes he had prepared that are contained in 4 large boxes. Unfortunately Conyers succumbed to the infirmities of old age before he could finish what would have been an authoritative and unique history. Perhaps someday some science historian will be able to use the notes and complete the task. It's sad that Conyers could not do this himself, but its wonderful that he never gave up trying even after seven marvelous decades.

I am one of the many fortunate others to have had Conyers as a friend and colleague for so many years and will always remember this remarkable person with deep affection.

Ted Geballe. Aug 22. '09.